TRANSACTIONS

of the

THIRTY-SIXTH NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE

Conference Theme:
RESOURCE USE AND QUALITY LIVING

MARCH 7, 8, 9, 10, 1971

Portland Hilton

Portland, Oregon

Edited By
James B. Trefethen

Published by the
WILDLIFE MANAGEMENT INSTITUTE
WIRE BUILDING
WASHINGTON, D. C. 20005
1971

Additional copies may be procured from
WILDLIFE MANAGEMENT INSTITUTE
Wire Building, Washington, D. C. 20005
for $6.50 Postpaid

PRINTED IN
U.S.A.
by
MONUMENTAL PRINTING CO.
Baltimore, Md.

WILDLIFE MANAGEMENT INSTITUTE

OFFICERS

DANIEL A. POOLE, *President*
L. R. JAHN, *Vice-President*
H. L. HAMPTON, JR., *Treasurer*

Program Committee

C. R. GUTERMUTH, *Chairman*

KEITH G. HAY, *Vice Chairman*
Representing THE WILDLIFE SOCIETY

STEWART M. BRANDBORG, *Executive Director*
The Wilderness Society, Washington, D. C.

C. J. D. BROWN, *Past President*
American Fisheries Society, Bozeman, Montana

EDWARD P. CLIFF, *Chief*
U. S. Forest Service, Washington, D. C.

RODOLFO HERNANDEZ CORZO, *Former Dir. Gen. de Fauna Silvestre*
Subsecretaria Forestal y de la Fauna, Mexico, D.F.

FRANK C. DANIEL, *Secretary*
National Rifle Association of America, Washington, D. C.

RAYMOND F. DASMANN, *President*
The Wildlife Society, Washington, D. C.

WILLIAM J. DUDDLESON, *Director of Policy Studies*
The Conservation Foundation, Washington, D. C.

HARDIN R. GLASCOCK, *Executive Secretary*
Society of American Foresters, Washington, D. C.

LESLIE L. GLASGOW, *Former Assistant Secretary*
Department of the Interior, Washington, D. C.

KENNETH E. GRANT, *Administrator*
Soil Conservation Service, Washington, D. C.

HOWARD GRAY, *Past President*
Outdoor Writers Association of America, Seattle, Washington

GEORGE B. HARTZOG, JR., *Director*
National Park Service, Washington, D. C.

ROBERT L. HERBST, *Former Executive Director*
Izaak Walton League of America, Glenview, Illinois

ALLAN MURRAY, *President*
American Ass'n. for Cons. Information, Winnipeg, Manitoba

H. WAYNE PRITCHARD, *Executive Secretary*
Soil Conservation Society of America, Ankeny, Iowa

BOYD L. RASMUSSEN, *Director*
Bureau of Land Management, Washington, D. C.

THOMAS W. RICHARDS, *President*
The Nature Conservancy, Washington, D. C.

JAMES H. SHAEFFER, *President*
National Wildlife Federation, Parker, South Dakota

ANTHONY WAYNE SMITH, *President*
National Parks Association, Washington, D. C.

SPENCER M. SMITH, *Secretary*
Citizens Committee on Natural Resources, Washington, D. C.

ELVIS J. STAHR, *President*
National Audubon Society, New York, New York

RICHARD H. STROUD, *Executive Vice President*
Sport Fishing Institute, Washington, D. C.

JOHN S. TENER, *Director*
Canadian Wildlife Service, Ottawa, Ontario

WILLIAM E. TOWELL, *Executive Vice President*
American Forestry Association, Washington, D. C.

W. LLOYD TUPLING, *Conservation Representative*
Sierra Club, Washington, D. C.

ROBERT WINTHROP, *President*
North American Wildlife Foundation, New York, New York

HARRY R. WOODWARD, *Past President*
Int'l Ass'n. of Game, Fish and Cons. Comm'rs. Denver, Colorado

GORDON K. ZIMMERMAN, *Executive Secretary*
Nat'l Ass'n. of Conservation Districts, Washington, D. C.

DONALD J. ZINN, *President*
National Wildlife Federation, Kingston, Rhode Island

Ladies Committee

MRS. C. R. GUTERMUTH
MRS. L. R. JAHN
MRS. KEITH G. HAY
MRS. DANIEL A. POOLE

● ● ●

The Wildlife Management Institute expresses its appreciation to The Wildlife Society and the many organizations and individuals who contributed to the success of the 36th North American Wildlife and Natural Resources Conference.

CONTENTS

PART I—OPENING GENERAL SESSION SOCIETY'S FAILURE TO SOLVE ENVIRONMENTAL PROBLEMS

PART II—TECHNICAL SESSIONS CONTROLLING LAND USE

CHEMICAL CONTAMINATION

OIL, FISH AND WILDLIFE

OIL DEVELOPMENTS IN ALASKA—A PANEL

FIELD AND FOREST

CONSERVATION COMMUNICATIONS

PART III—CLOSING GENERAL SESSION NATIONAL WELL-BEING DEMANDS SOLUTIONS

PART I

OPENING GENERAL SESSION

GENERAL SESSION

Monday Morning—March 8

Chairman: ERNEST W. HARTUNG
President, University of Idaho, Moscow

Vice Chairman: ELWOOD R. MAUNDER
Executive Director, Forest History Society, Santa Cruz, California

SOCIETY'S FAILURE TO SOLVE ENVIRONMENTAL PROBLEMS

FORMAL OPENING

DANIEL A. POOLE
President, Wildlife Management Institute, Washington. D.C.

It is a pleasure to open the 36th North American Wildlife and Natural Resources Conference.

The many organizations and individuals who helped to develop this year's program are hopeful that all of us will depart from Portland enriched in mind and strengthened in dedication. Also of importance to attendees here are the gatherings of the many organizations that arrange special meetings and discussions. These next few days provide great opportunity for exchange among policy makers, administrators, managers, technicians, educators, and laymen; among articulate and influential conservation and environmental strategists; and among skilled seekers and applicators of biological and ecological knowledge.

An obvious conclusion that can be drawn from the long history of this Conference is the flowering of environmental awareness, both in the individual mind and the national conscience. To those of us professionally engaged in this work the awakening should suggest a

broader and more mature purpose. None of our work, no matter how specialized, is free of the forces that influence the environment. No professional can remain aloof or detached. His personal and professional participation is needed if this urgent mission is to succeed.

We start this year at a new peak of national interest in the environment. The major political parties are vying for public attention, each striving for primacy in protecting the environment. But merely providing more money or expanding existing authority will not be enough.

Some cleanup is possible, but little can be done to overcome environmental offenses without deliberate realignment of state and national priorities, without new policies and programs that change procedures now contributing to environmental degradation. Little will be accomplished if we continue solely in a role of environmental cleanup. Our objective should be to correct at their source those things that degrade the environment. We have the technology to accomplish much. We could have more money, if spending priorities are reordered.

Natural resources programs of the Federal Government rank in 11th place out of the 13 major budget functions for the next fiscal year. This is some small gain over 1970 when, with 1.3 percent of the total budget, natural resources were in dead last place. But dollar inputs do not tell the whole story. Programs in the natural resources category, particularly those relating to water resources and power, minerals, land management and recreational resources—ill-planned and poorly executed as some are—detract from rather than add to the national environmental estate. Federal budget priorities are clearly out of balance for administering and managing the natural resources that sustain our society.

Another way to help achieve a better balance is through reorganization to strengthen the association between agencies with responsibilities for water, forests, land, parks, fish and wildlife, outdoor recreation, and the rest. In his State of the Union Message, President Nixon made known his desire to create a new Department of Natural Resources. The details of his plan have not been divulged, but already there is a superficial scramble to be for or against what the President may propose. There is much logic for a regrouping of federal resource agencies, and the test of the reorganization will be the scope of what is proposed and accepted. A mild reorganization will not suffice. New tweeds should not be draped over a tired body.

This year also marks the time of decision on recommendations of the Public Land Law Review Commission, some sound and others unacceptable from the conservation point of view. The Commission's

recommendations on dominant use, sale of rangelands to private grazing interests, and the interjection of legislative command into the day-to-day management of public lands are sure to draw the fire of conservationists. The Commission also failed to come to grips with the outmoded Mining Act of 1872, which gives prospectors a free hand to use and alienate public lands. The Commission further failed to distinguish between the public and private interests in these valuable lands.

Complex problems confront conservationists in Alaska, where State and Federal Governments seem reluctant to fully exercise their authority to control the opening and development of that great land. The discovery of oil on the Arctic Slope, proposals to get the oil to an open seaport, and the emotion-ridden issue of native claims present profound questions that must be resolved.

A further complication is the Federal Government's tardiness in undertaking a plan for the huge expanse of public land in interior Alaska, which, under present weak laws, will be open to essentially unregulated resource exploration and exploitation once public travel is permitted on the pipeline support road. It is unthinkable that the government, as agent for the public interest in Alaska, may be a party to more of the same kind of unordered development that mars the Lower Forty Eight. By preparing an appropriate land plan, the government can designate proper areas for new townsites, transportation and communications facilities, and industrial and commercial sites. Development should be channeled and fitted into a program to minimize environmental impact on that unspoiled land. Temporary withdrawals and reservations can be used to prevent serious inroads before study can be made of the worthiness of candidate areas for recreation, wilderness, wildlife refuges, parks and other public purposes.

In Alaska, and elsewhere, there is great need for professional resource managers and educators to upgrade the consideration given to conservation programs. First, there must be broader multi-purpose planning and better program execution by responsible agencies. Secondly, more people must realize that preservation, while an entirely appropriate facet of conservation, is not a substitute for conservation. In some cases, the desire to preserve is obstructing rational consideration of land management problems.

One of these conflicts is demonstrated by the appeals for more national parks—certainly a worthy cause—but some are being promoted by political and economic interests and preservationists for diametrically conflicting purposes. In fact, recent newspaper clippings from Hawaii and Idaho, where park proposals are brewing,

report National Park Service personnel speaking warmly to businessmen of the tourism the parks are sure to generate. The name *national park* is an assurance of quality, sure to draw many visitors, one Service spokesman is quoted as saying.

Even the President, in his recent message on the environment, differentiated loosely between national parks and wilderness areas. Wilderness, he said, is a place "where nature thrives and man enters only as a visitor." Yosemite, Yellowstone and other of the great natural, national parks amply demonstrate that unregulated visitation is inimical to maintenance of the esthetic, faunal, floral, and other scientific and natural values that such national parks are supposed to protect. The act creating the new Voyageurs National Park in Minnesota authorizes public use activities previously unacceptable in any of the other great natural areas of the national park system.

If the desire is to provide recreational opportunity and to promote local economy, then more attention should be given to creating national recreation areas, administered by any of the several agencies that control public lands. Operational plans should give equal consideration to all kinds of outdoor recreation. And stronger reliance should be placed on the creation of more wilderness as the most appropriate and workable means of retaining natural ecological communities.

The past year has seen much progress under the National Environmental Policy Act. The Council on Environmental Quality has been grappling with many immense problems, some artificial and self-erected, that prevent federal agencies from giving appropriate attention to the environmental impacts of their activities. The Council has made progress in getting the machinery of government geared toward complying with the high ideals of the law. This effort still is in a period of trial and error, with everyone impatient for regular and visible signs of progress and accomplishment. The President's courageous action in halting the damaging Cross Florida Barge Canal shows what can be done. He also may intervene in the Alaska oil pipeline problem, as many are urging him to do. The surest evidence of the success of the national environmental effort will be the lessening frequency of the scrapes federal agencies get into because of environmental short-sightedness in planning and executing their programs.

If the drive for environmental quality is to make any real contribution toward the betterment of human life and society, then we must strive to achieve water and air quality goals, proper land use, and all the rest where the bulk of the people live and work. To focus most attention on a few remote areas that only a small percentage of the

people may visit, if at all, is to do less than to meet our full responsibility. The objective should be to assure pleasant conditions where people spend most of their time, where they live and work. The "oasis theory" now advocated by some is not an adequate response to our social need and desire for environmental improvement.

In closing, I have a few brief announcements. For the benefit of those who are attending their first Conference, I want to point out that the Conference is not a convention nor an action body. It does not adopt resolutions or take actions of any kind either against or in support of any issue. The Conference is basically intended as a clearing house for exchanging views on resource and environmental problems.

After each presentation those of you who wish may comment on it or question the speaker. We ask only that the discussion be germane to the subject. All floor discussion will be published in the Transactions of the Conference. For the benefit of the reporter, we request that speakers from the floor identify themselves by name and state or affiliation. Apart from this, I hope that you will consider this your meeting and participate in the exchange of ideas and information.

The Ladies Luncheon will be held in the Pavilion Room at noon today. Visiting ladies who wish to attend as guests of the Institute should pick up their tickets at the Conference registration desk before 10:00 o'clock. The Wildlife Society's annual dinner will be held in this hotel tonight. Tickets must be purchased before noon at the Society's desk in the registration area, since the hotel requires a guarantee on the number to be served.

Also, those who wish to attend the Conference banquet tomorrow evening are urged to purchase their tickets as soon as possible to avoid disappointment. The musical and variety show will live up to the high standards that have prevailed in the past.

Now, I wish to introduce the chairman of this session, Dr. Ernest W. Hartung, president of the University of Idaho, long known for his personal interest and leadership in environmental matters. Dr. Hartung.

CAN GOVERNMENT MEET ENVIRONMENTAL NEEDS?

RODERICK NASH

Associate Professor of History; Chairman, Environmental Studies; University of California, Santa Barbara

To plunge directly into the topic assigned, I do not believe that government in the United States or anywhere, for that matter, can meet what I construe to be the most basic environmental need without a basic change in society's ethical perspective. I do not keep intellectual company with the "government beaters" who flagellate public servants for sins that are ultimately their own. To be sure I am not exonerating government. It is plagued by the lack of a coherent national environmental policy, by an unwieldy and unimaginative legislative and executive branch, by a preference for compromise rather than leadership, and by a reluctance to challenge concentrated and well-heeled private and corporate interests. The point is that the condition and the future of the environment is largely in the hands of the public rather than the public's servants. Environmental health is ultimately a matter of values, morals, ethics—what the society regards as right and wrong. Law, education, and economics, to name the other three topics to be treated this morning, reflect, rather than determine the underlying ethical bedrock.

To launch my discussion I want to draw on the wisdom of a nineteenth-century Californian named Henry George. Then I will move into an analysis of the Santa Barbara oil spill of 1969 and its implications for environmental ethics. Finally I wish to present my interpretation of where we've been, where we are and where we could be heading with regard to ethics.

In the winter of 1869 a young Californian named Henry George walked the streets of New York City, observing the sharp contrasts between the conditions of the rich and the poor. In an age before income taxes and labor unions the gulf was wide indeed. Elegant carriages took the Vanderbilts and other charter members of "The Four Hundred" to lavish theater parties while children starved in freezing tenements. Shocked and outraged, George vowed to find the reason why the progress the nation was so obviously making in industry, technology and economic growth was still associated with grinding poverty. Why was there so much scarcity amidst so much abundance? (Barker, 1955)

A few months later, back in California, George rode his horse through the lush oak and grass-covered hills east of San Francisco Bay. Agriculture was flourishing, towns springing up, and land offices doing a proverbial land-office business. Stopping at one, George

asked the price of land that he knew had sold for just a few dollars an acre several years previously. The reply was $1,000. In a flash it dawned on Henry George that here was the reason for the association of poverty with progress. The growth and expansion of American civilization as a whole caused the rise in land values, but a few speculators drained off the profits of progress. These people, George felt, did nothing to earn their money. They parasitized society. The fortunate few who *owned the earth* reaped the benefits that should be the commonwealth's.

In 1879 George wrote a famous book on this subject, *Progress and Poverty*. It proposed the elimination of all taxes save that on land. This "single tax," as it was known, would, in effect take real estate profits from private hands and return them to society. Radical as George's idea was in terms of capitalistic traditions, it found wide acceptance in the late 19th century. And Henry George's question—How can we have both progress and poverty?—still has relevance to environmental problems. We have only to recast "poverty" in aesthetic and spiritual terms to see the point. Thus we could ask, following George, how is it that we continue to progress in terms of quantity, energy, Gross National Product, and the so-called standard of living and yet find that many Americans (even rich ones) experience an increasingly "poorer" life? We are poorer, I submit, in the satisfactions of living. The *quality* of life we lead amidst a trillion-dollar GNP is declining. For instance, we find ourselves with marvelous automobiles and nowhere worth driving to. We have picture-windows in our lavish homes and nothing to see but smog. We have the best diet of any people in history, but in the Los Angeles basin air pollution prevents school children from taking physical education about every other day and football teams have to practice at 5 a.m. before the smog alert. That's what I mean by progress and poverty.

Aldo Leopold (1945) once asked, "of what avail are forty freedoms without a blank spot on the map?" So I would say of what worth is a progress that erodes the quality of our lives? Leopold put the point in parable form in lectures to his University of Wisconsin classes. Consider, he suggested, that there are six vacant lots in a certain community. It is "progress" to build houses on the first and second, and perhaps even on the third, fourth and fifth. But when we build houses on all six of the lots, we forget what houses are for. I would add that we are in danger of forgetting what progress is for. Despite the urgings of General Electric, progress is *not* our most important product. It is, or should be, the means to an end and that end is a satisfying, not just an affluent, life.

I wish to suggest that oil development in the Santa Barbara Channel is an example of progress and poverty. The more development we have, I submit, the poorer we become. Wealth, ironically, is poverty. The proceeds from the Channel oil fields may be impressive, but the quality of the lives of Santa Barbarans goes quietly down the drain. So I am prepared to say "no" to oil and to similar resource exploitation that detracts from the quality of our lives. Not "no, unless technology improves" or "no, until we really need the oil next century" or "no, if it involves more than a dozen platforms" but just plain "NO!" This is an extreme statement of course. It is uncompromising. But I believe the time has come for extremism and for uncompromising stands. In fact I reject the whole notion of compromise that the oil industry and the government holds out to us. It is as if a man came to your front door and announced his intention to rape your wife. You demur. "All right," he cheerily replies, "Let's compromise. I'll only rape her for ten minutes." Oil devlopers in the Channel are making the same kind of deal with their sanctuaries and buffer zones and technological improvements. To continue the metaphor, this is like saying "well, we won't rape all of her" or "we'll use great technique in the rape, she'll love it!" The point is that the husband and wife, or the community of Santa Barbara, always loses in this so-called compromise. The oil industry is not giving us anything. It is a heads they win, tails we lose arrangement. Let's never forget that the *whole* Santa Barbara Channel was a "sanctuary" before the first rig. Those who liked it that way lose with every step toward development.

Going back for inspiration to Henry George again, I want to challenge the conception of private property when it is applied to the environment. I think this notion is at the root of many environmental problems including the local one. Can someone or some company really *own* a piece of the environment; *buy* a mountain; *sell* a forest; *lease* a square mile of the Santa Barbara Channel? George did not think so in the 1870s. Every man, he felt, has a natural right to use the earth. The private ownership of the land violated the idea of a commons, and of sharing. Now I am not here to attack the concept of private property when it is applied to personal possessions. Let me put it this way: If you own a living room rug and you elect to cut it up, grind dirt into it, drill holes through it, and spill oil on it, that's your business. I don't have to come into your home and walk on your polluted rug. But when you do this to the environment—the sky, a river, a forest, the ocean, the Santa Barbara Channel—you are damaging *my* home, the one I share with you and the rest of the biota.

This I resent, and I challenge your right to buy the privilege of polluting my house.

I contend, specifically, that oil development off Santa Barbara reduces the quality of my life just as surely as if someone came into my home and soiled a rug on which I loved to lie. Consider just the visual aspect. The sight of the rigs reduces the aesthetic quality of the life of many Santa Barbarans in precisely the same manner as would a series of inky blots on a prized picture hanging on a living room wall. Indeed for people fortunate enough to have a view of the Channel from their living rooms the analogy is remarkably exact. Moreover, where the Channel is concerned the "picture" can't be replaced. What is the magnitude of the loss? Specification is difficult. But the Psalmist who declared that he would "lift up mine eyes unto the hills, from whence cometh my help" suggested the stakes involved. Similarly the people of Santa Barbara regard the Channel as an aesthetic commons, not for the grazing of cattle or the gathering of wood, but for the nourishment of the human spirit. When a few individuals have come along and leased portions of the Channel for their private gain, the community is poorer.

I believe the heart of many environmental problems lies in this institution of private property. We accept it as a sacrosanct principle in the American culture, but in fact it is neither old nor universal. In the past, in cultures such as that of the American Indian, for instance, it was inconceivable for an individual to own land. The environment was the Great Spirit's and man used it with other forms of life. The earth was a community to which man belonged not a commodity he possessed. This was what Aldo Leopold (1945) called the "ecological consciousness." It isn't new except in name. We had it and we lost it.

Can we regain it? The biases in our culture in favor of rugged individualism, private property, competition, profit, and the material definition of progress are going to be hard to overcome. The first requirement, in my opinion, is to make conservation a matter of ethics rather than economics, or legal coersion, or even fear for our survival. This involves extending the same concepts of right and wrong that now apply, in theory, to human beings to other forms of life and ultimately to the environment itself. Let me explain with the help of a diagram (Fig. 1).

The first point to make about this ethical pyramid is that it applies to an ideal not to behavior. Obviously, at times, all of us are still mired in the lower ethical echelons. But although we fail to live up to it, at least we have the concept of right and wrong behavior toward other people. According to the diagram, this concept grew over time

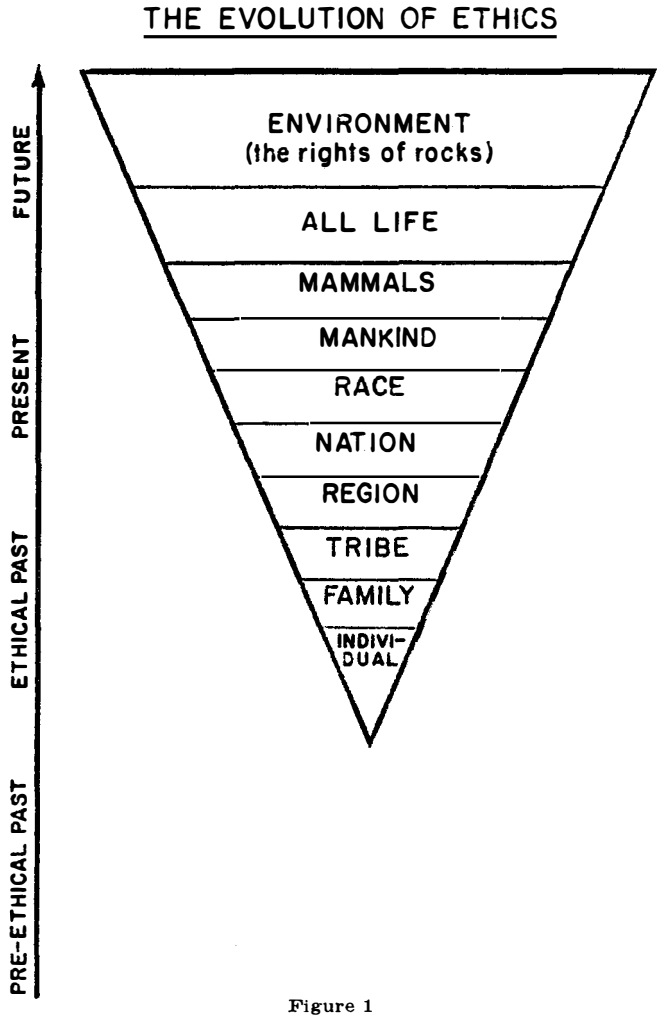


Figure 1

to embrace larger and larger groups. For thousands of years ethics applied only to the individual. Under pressure to survive, a man might cannibalize his offspring and mate. Then an expansion of ethics to include the family occurred. More time passed and the ethical province expanded to the tribe. In this stage the daughter of a fellow tribesman was protected by ethics, but if one encountered a woman from another tribe on a forest path, she was raped instantly. Right and wrong did not apply to her. But again time brought the extension

of ethics to everyone in a region and then a nation. Yet during times of war many of us still regard the other side as the evil enemy. For instance the Americans in Vietnam responsible for the My Lai massacre did not regard their actions as unethical. In their eyes the slain were not men but "gooks"; the killers only did their "duty." The ethical restraints they observed in regard to their families, neighbors and countryman did not apply to people outside the nation.

The ethical leap from nation to race by Americans is particularly relevant to the subject under discussion. Until 1863, the date of the Emanicipation Proclamation, many Americans regarded slaves as outside the ethical sphere. They were property and the owners relationship to them was not governed by concepts of right and wrong anymore than was his relationship to a horse or a house. However, a considerable number of Americans did not agree. A civil war was fought over the issue. At its conclusion the nation, in theory, extended the ethical circle to include blacks. Some ethical philosophers have urged the inclusion of all mankind. Yet other forms of life, and the environment itself, remained enslaved.

This attitude has begun to melt around the edges in regard to the higher mammals. Some men today are willing to concede that dogs, horses, deer and similar animals are partially within the ethical sphere. The movement to prevent "cruelty" to animals reflects this consciousness as does part of the motivation for wildlife conservation. But note that spiders and snails, not to speak of plants and protozoa, are beyond the pale. A few prophets, like Albert Schweitzer with his reverence-for-life idea, did not agree, and they point the way to a giant ethical leap to encompass all life that shares the planet. The last stage, and one I must confess I can conceive only in highly theoretical terms at the moment, extends ethics to the environment itself. It would follow that rocks themselves have rights and that the same ethical restraints that govern our behavior toward our families would govern our use of the ocean, the sky, and the soil. We are obviously a long way from such a concept. But the increasing popularity of Aldo Leopold's "land ethic" as expounded in *A Sand County Almanac* (1949) and the growth of a willingness among younger Americans to question the values of the establishment hold the promise of possibility.

Ethical expansion will require, among other things, a commitment on the part of educators at all levels but especially in the early years of childhood when basic values are instilled by society. For instance, there is a need for parents who instead of squashing the bug on the bathroom floor, or flushing him down the toilet, will transport him unharmed to the yard with an admonishion to a watching child that it

would be wrong to kill the bug. In advocating this I definitely disqualify myself from the bogus sentimentalism that fusses over the "wife and children" of the bug. The point is to teach a child the rudiments of ecology and the necessity of ethical restraints with regard to living things.

Wilderness is one of the best schoolrooms in which to gain this ecological perspective. To experience it is to regain a long-lost sense of man's limitations and of his consequent dependency on the environment. This humility leads to greater depths of appreciation and higher levels of ethics. Wilderness contributes by stripping away the blinding arrogance that is one of civilization's most unfortunate byproducts. In wild country we rediscover natural processes and ourselves as part of them. We learn that the environment does not exist for our benefit alone. We regain a sense of respect for the community with other life forms. We develop reverence for life and its support system. (Nash, 1970).

Have we strayed far from the Santa Barbara Channel? I don't think so. Wilderness, in the last analysis, is a state of mind (Nash, 1967). The term designates a quality (as the "-ness" suggests) that produces a certain mood or feeling in a given individual and, as a consequence, is assigned by that person to a specific place. Many Santa Barbarans assign it to the Channel. After all, the sea is one landscape that bears no visible sign of civilization—ships and oil rigs excepted. Indeed the Channel is less frequented than the John Muir Trail or the Colorado River in Grand Canyon on a typical summer day! As leaders of the wilderness preservation movement have been saying for a century, we must keep some places like this undeveloped for their value as wilderness. Recreational pleasure is obviously not the only dividend. To keep a part of the earth undeveloped is to establish a limit, to say that if we can't prosper without its resources then we will simply limit prosperity to this extent. We thereby acknowledge that the good life may be reached at a point short of the full economic utilization of every resource on the planet. With a bow to Henry George, we put other considerations before growth. We redefine progress to include preservation and appreciation as well as development and to apply to man's spirit as well as his stomach.

For Americans, especially, such self-limitation does not come easily. One hallmark of our national character is a thirst and a talent for conquering nature. This drive came over on the *Mayflower,* went west in covered wagons, north to Prudhoe Bay, and now seeks new worlds among the stars. Its accomplishments are indisputable, but so are its dangers. The point is to make a place alongside the pride we take in

man's works for humility in the face of nature's. If we can understand and cherish the Santa Barbara Channel and places like it as cultural resources and ethical educators, valuable simply because they are there, we will have made a giant leap in this regard. We will also have moved toward making ourselves and our government responsive for environmental needs.

LITERATURE CITED

Barker, Charles A.
1955. Henry George. New York.
Leopold, Aldo
1945. The green lagoons. American Forests, 51: 376-377.
1947. The ecological conscience. Bull. Garden Club of America, 46(00): 46-53.
1949. A Sand County almanac. New York.
Nash, Roderick
1970. Can we afford wilderness? Proc. University of Utah's Grand Canyon Symposium, June 16, 1970. University of Utah Press, Salt Lake City.
1967. Wilderness and the American mind. New Haven. 1-7.

DISCUSSION

VICE CHAIRMAN MAUNDER: That was certainly one spicy meat ball. You know, if we keep getting papers like this, we may have to go to a rating system in order to advertise our future conferences.

Some of you, I am sure, have been stimulated to come forward with some questions for Dr. Nash. Also, while you are getting yourselves to the microphones, I have one or two remarks for Dr. Nash.

Many of the participants of this symposium are of the belief that oil should not be produced in the Santa Barbara channel. However, other speakers have made equally strong arguments that man will continue to require energy and natural resources, not just for the next 15 to 20 years but for many, if not all generations. Now, the supply of natural resources that will be required to maintain some minimal level of existence for men are varied. Of course, it is true that some of these resources can be conserved through recycling but oil and gas, once burned, are gone forever.

Therefore, I ask you pragmatically, how long can Santa Barbara post a "no trespassing" sign on the channel and tell the rest of the nation and the world to go dirty someone's shore? Is it ethical for Santa Barbara to close its channel and expect other communities to open their backyards to the very problem that Santa Barbara does not desire? You have questioned the concept of property ownership, and yet at what point do the interests and needs of all mankind transcend the desire of community or a small interest group to guard and protect its particular resource from being used?

DR. NASH: I think the best answer to those kind of questions is to suggest that if the new definition of progress which I spoke about is widely adopted, consideration such as supply of energy and natural resources would be made less important and would be almost unimportant as time went on. The expanded ethical consciousness would reinforce this posture by making excessive demands on the environment not only uneconomical or illegal but wrong. That is the most important thing I have been trying to say to you this morning.

We have to transcend law and economics to spheres of ethics. The combined result would be a new orientation or a life style that would really turn back what I had planned to say and perhaps turn ahead to a pre-technological way of life. For example, the SST would be absurd and so would the internal combustion engine.

Yes, I am prepared to give up driving a car provided, of course, that everybody else does and they build a school near enough to my home for my children to walk to. I think many of us feel this way. We feel locked in and imprisoned by a society that necessitates technology.

This will happen, I think, as a result of the type of change to which I have been speaking. It will not be a matter of Santa Barbara selfishly protecting its particular resource but, on the other hand, will be mankind as a whole recognizing the liability and eliminating the problem posed by Pittsburgh, Gary and Prudhoe Bay.

We have to remember, for example, that the "good life" once existed without these places and their technologies. Of course, what I am talking about is a dream. This is maybe similar to the kind that Martin Luther King had a few years ago. To paraphrase a well-known song—if you don't have a dream, how are you going to make a dream come true?

MISS LOIS WEISS: I would like to know what role you see for the primary and secondary school in relation to environmental ethical education?

DR. NASH: Well, with the risk of perhaps treading a little bit on the paper of Mr. Pearson, who is not here and which is going to be read to you, let me put it this way—that, in connection with a little child, we have to start molding this ethical attitude very early. If you saw a spider crawling across the floor of your bathroom, what would be your reaction? In other words, what would you do? Here you are in the morning, for example, you are groggy and a spider comes across the floor. Well, I know what most people would do. They would grab it with a piece of toilet paper and they would put it right down the toilet, would they not? They would flush it down without a thought.

Well, I did this once when my child was two or three years old, and my child asked me, "What did you do that for?" He was shocked. After all, it was a pretty frightening thing to him to see a bug floating on the water and then you merely pull the lever and down he goes.

There is a need for parents who instead of squashing the bug on the bathroom floor, or flushing him down the toilet, will transport him unharmed to the yard with an admonishing to a watching child that it would be wrong to kill the bug unnecessarily. In advocating this I definitely disqualify myself from the bogus sentimentalism that fusses over the "wife and children" of the bug. The point is to teach a child the rudiments of ecology, the necessity of ethical restraints, and a reverence for life. Further, if we do not build true concept in the very young, then I don't think we are going to get it from them later on because by the time they are as old as you and I they will already have developed the attitudes we deplore.

MISS WEISS: I have another question. I should like to refer to your remarks about Prudhoe Bay. Do you believe that the use of sea water and its potential for danger, somehow should be reflected in the balance sheet—that when people are making economic considerations with regard to a good oil spill that there should be some evaluation of these factors in their preliminary thinking?

I am from British Colombia. I think some of these considerations should likewise be reflected in relation to the economic structure and yet, on the other hand, I think that ultimately we have to make this a personal and ethical thing rather than an economic one. In other words, we have to see that something is wrong and not just that it is going to be uneconomical. That has been the kind of drift to your talk. I guess I am a dreamer and way off in the clouds, but I think we have to come to the realization that if we are going to get to the top of the problem we are going to have to consider other than economic factors. What do you think about this?

DR. NASH: Right on! If people could be taught that some of these things are *wrong*, and, therefore, at least would not do them from an ethical basis and not from an economic one. We have a long way to go in this respect but I think that there is hope for the future or I would not be talking here today.

MR. JEFFRY GOTTFRIED: I would like to relate a little story that happened to me this morning in relation to a few of the things you are speaking about.

I sold my car two days ago and I live within bicycling distance of work. I was going to try, at least for a while, to see how it would work without a car.

Therefore, I rode my bicycle here this morning. I went downstairs to the hotel and asked if I could chain it up somewhere. They said "Of course not, we just cannot take bicycles, we only have room for cars." I said, "Well, it certainly does not take up as much room, I will just chain it to a gate over there on the side where there is plenty of room." However, the individual again very curtly replied, "You cannot do it because we just cannot park bicycles." Well, I then went upstairs with the thought that I would chain it to a parking meter in front of the hotel and one of the hotel employees said to me, "I am sorry, you cannot put it there", and so he asked me to remove it. Well, finally I gave up, brought it into the courtyard and chained it to a bannister and I hope it is there when I leave. (Laughter)

What I am trying to say is that we have a long way to go. There is some education needed, not just for young people, but for old people as well.

DR. NASH: That is at once one of the most sad and most encouraging stories I have heard in a long time.

LEGAL INSTRUMENTS TO PROTECT THE ENVIRONMENT

DAVID SIVE

Attorney; Winer, Neuburger, and Sive; New York City, New York

All powers of government are, of course, exercised through what can be deemed "legal instruments." The subject of Professor Nash's talk, preceeding mine, as well as my own limitations, however, dictate to me that my special contribution to this conference should be concerned with only one group of such legal instruments, those instruments which involve adversary proceedings, calling for the particular arts of the lawyer, as distinguished from those of the political scientist and public administrator.

My basic point can be succinctly stated. Adversary proceedings, both governmental and private, constitute an indispensable and important aspect of environmental management. By "adversary proceedings" I mean proceedings of record, before administrative agencies or courts, at which parties in adverse positions and of adverse interests examine and cross examine witnesses under oath, under formal rules which determine what may and may not be received as evidence and be made part of the record. Let us use the term "litigation" for such proceedings.

The need for government-instituted litigation is self evident. Environmental laws, just as those governing everything from homicide to securities transactions, require the stick as well as the carrot for their enforcement. Criminal, quasi-criminal, and civil enforcement proceedings must be used by the enforcement agencies.

Not as self evident, but in my opinion more important and effective in the early stages of the development of the current environmental movement has been the private litigation, proceedings instituted or intervened in by private conservation groups, both the major perma-

nent national organizations and *ad hoc* groups. That private litigation, in which I have spent a major portion of my total time and effort in the past seven years, is the principal legal instrument to protect the environment which I will discuss before this distinguished gathering of much of the environmental leadership of the nation.

THE FUNCTION OF PRIVATE ENVIRONMENTAL LITIGATION

The importance of private environmental litigation as an enforcement technique was recently demonstrated in the reaction to, and disposition of, proposals by the Internal Revenue Service to deny the deductibility of contributions to public interest law firms. The reaction was swift and dramatic, from every corner of the country and every shade of political opinion, in a showing of opposition to a rule which threatened to cripple the use of the courts for not only environmental purposes, but much other important social reform. It was as though those of us who have faith in the effectiveness of our traditional legal procedures and firmly believe that they can reshape our society where it must be reshaped, were being told that we were deceiving ourselves, that the only real effective instruments were the ones fashioned by believers in simplistic theories about either fascist pigs or effete snobs.

The reaction to the threat to the effective use of private environmental litigation was led by the President's own Council on Environmental Quality, which in turn, followed the advice of its Legal Advisory Committee. Internal Revenue Service withdrew its proposal, which I am convinced was primarily if not wholly the product of provincial bureaucracy at its worst, rather than administration policy. It officially sustained the place of public interest law firms (which include the legal arms of the principal national organizations) as long as they follow certain guidelines, which I believe are wholly proper and reasonable; they are fashioned primarily to prevent the representation of the "public interest" from becoming a device for private profit.

What is there about private litigation—a Storm King Mountain, Alaska Pipeline, Columbia River Airport or Hudson River Expressway litigation—that makes it the major environmental enforcement technique which the CEQ said it was? I think the answer involves first a philosophical proposition and secondly a basic look at techniques for arriving at truth and wisdom in cases where both unreasonable and reasonable minds may differ.

The philosophical proposition is, I think, at the heart of the democracy versus plutocracy argument. How often have all of us heard the suggestion that we could solve our difficult environmental

problems—power versus natural beauty, downhill skiing versus wilderness, and others—if only we would get the right people around a quiet table, to talk it over in cocktail-softened tones, and compromise it all out? The answer I have always given is that (1) the problems are too complex, (2) they need the clarification of clash, and (3) most important, nobody can really tell whom and how it is to be determined who are the "right people"?

I think there is no set of "right people" to make important environmental decisions. Those basic and general enough to call for legislative or other political resolution require the melting pot of our traditional political processes. I do not want an environmental aristocracy of Weyerhaeusers, Udalls, or Charles Reich's anymore than I want foreign policy dictated solely by a few generals or Yale or Harvard professors. Call me a traditionalist liberal! Those environmental problems not basic or general enough to be susceptible of express legislative determination must be aired and enlightened by a litigating process. That process, with its features of examination and cross examination and reasoned exclusion of what is irrelevant from the bases of determination, is the technique. The press releases, the passionate claims about either the hundreds of babies who will die in the blackout induced by mountain lovers or the destruction of the atmosphere itself from one more industrial plant, and the advertising brochures, can never give us the whole truth. A process under which a dogged questioner can compel answers comes much closer.

I hasten now to reassure you that by litigation I do not call for ill-tempered discourtesy or intolerance or any other practice designed to reduce the effectiveness of if not destroy, the process. Although our causes are equally important and perhaps in some basic respects the same as those of the civil rights bar, we environmental lawyers have as yet not tried the technique of creating courtroom chaos and anarchy. Thus far our clients trust our techniques in the court rooms more than some more direct action techniques. We think the law can be reshaped to equate natural beauty, in proper cases, with dollars, and I think a few power and oil companies, army engineers, and superintendents of highways would agree.

Nor do I exclude in all cases compromise and settlement, in or out of court. I reject the notion that we on the environmentalist side must be the judicious in-betweens and thus entrap ourselves, in the ultimate compromises or litigated decisions, to a between-in-between and exploitation-of-resource result.

In environmental litigations, however, as in others, we should not litigate every case to the client's last dollar or hour, or to our own children's last evening with father at home.

THE RESULTS OF PRIVATE ENVIRONMENTAL LITIGATION TO DATE

The results of private environmental litigation to date are what I want to turn to next. There are two fields of appraisal, the strictly legal and the larger political. I will try to compress the strictly legal—the new doctrines of law—into as summary and non-technical a package as I can, for two reasons; one is the great frequency with which I have talked to professional groups about such technical points in recent months. The groups have been different with little overlapping and I think I have generally avoided boring them. I have begun to bore myself; that is infinitely worse.

The second reason why I want to examine more of the way in which this litigation fits into the much broader political world is primarily because of this unique opportunity to discuss it—presented to me by the very cosmopolitanism and distinction of you, my audience.

Let us go quickly down the strictly legal checklist. First, we have achieved the *sine qua non* of litigating, the very right to be in court to represent the non-pecuniary public environmental interest, against the economic interest of the resource exploiter. We have our standing. The rule first promulgated in the Storm King Mountain case, that "those who by their activities and conduct have exhibited a special interest" in the areas of the "aesthetic, conservatorial, and recreational aspects of power development" may assert those interests, has been extended to other kinds of developments.

One of the latest extensions has been in the Hudson River Expressway cases, in which the Court of Appeals for the Second Circuit has held that the "legally protected interest" which the suitor must have is no more than the public interest itself and that the only further requirement is that the entity which sues to protect that public interest be a "responsible representative" of it. This may not be the law, for a few more weeks, in the Ninth Circuit, this State, California and Washington. The grant by the Supreme Court, just two weeks ago, to the Sierra Club, of Certiorari in the Mineral King case, to me, however, means that you on the Columbia will shortly catch up with us on the Hudson in the fight for the right to fight to preserve its remaining beauty.

A second development I think, is the end of effectiveness of claims by federal agencies which they still make, discourageingly and by rote, to sovereign immunity. If a federal official acts illegally he may be enjoined therefrom. He is no more immune from the law, as a sovereign, than private persons who, collectively, are, of course, the ultimate sovereigns. This immunity from immunity applies no matter how large, expensive or brazen the acts may be. The Interior

Department and associated companies may not go ahead with the Alaska Pipeline, and Overton Park in Memphis may not be invaded for an expressway, contrary to law, any more than you or I may unlawfully pick a single alpine flower in the Cascades. This is comforting.

A third important development, of immense significance, is the beginning of the taking by courts of wider and deeper looks at what administrative agencies do with resources. The traditional role that the administrative decision must be upheld, whether seemingly wrong or right to the reviewing court, if it has any rational basis and is not wholly arbitrary or frivolous, has been softened in the Scenic Hudson, High Mountain Sheep, *Parker v. United States,* and *EDF v. Hardin* (D.D.T.) cases. Mere weight of papers will not, it is hoped, satisfy requirements that important administrative decisions disposing of resources be made only after ascertainment of all of the relevant facts, and the application of new environmental values to legal terminology.

The fourth and final legal development I will cite is the developing capacity of environmental groups to litigate the application, in major resource, use cases, of the G.N.P. axiom. The High Mountain Sheep case, the Environment Policy Act of 1969, a recent California Court decision turning down a power plant in Los Angeles, and some quasi-legal sources of definition of the public interest such as reports of the President's Office of Science and Technology, furnish the basis, in my opinion, for litigating the "whether" as well as the "where" question. By that I mean that in determining an application for a particular dam, road or power plant project the appropriate administrative agency or court may be required to ask and answer the question whether the public interest is always increasing the G.N.P., and accommodating the environment to such increase.

The question David Brower has wanted to ask for several years in a series of books he would like to produce, and what I once startled Gene Marine by asking about New York's proposed fourth Jet Airport, while he was writing his *America the Raped*—What if we didn't build it at all?—is now, I believe, a proper legal issue in many cases.

What does all of this mean in the larger political arena of the environmental movement? How do this litigation and the doctrines developed fit into history?

I would first suggest that much of the explosive force of the environmental movement results from the at first small and now growing number of important litigations. I am not a publicist, but I do submit that a litigation has inherent drama. Claims and counter-

claims somehow achieve legitimacy and importance when made within the bounds of a legal proceeding. Perhaps the drama is akin to that which may turn some of us this very evening away from forest wildlife to televised aspects of the wildness within us. I leave this analysis to the psychologists and psychiatrists.

Whatever the explanation, an environmental lawsuit can be and has frequently been an effective political instrument. The conservationist may lose the case and win the war. The examples are legion. I cite only the one that was my first court involvement for the Sierra Club or a similar group. Three years of legal effort resulted in the defeat in court of individuals and corporations seeking to enjoin the construction of a cafe in the southeastern corner of Central Park, New York, which was to be financed by a gift of Huntington Hartford, Jr., by which, I have always assumed, he sought to set out the intimations of his own immortality. By the time of the final turndown of the opponents of the cafe by the Circuit Court of Appeals of New York State, however, Lindsay became mayor and the son of one of the plaintiffs, Thomas Hoving, Jr., park commissioner. Mr. Hartford's fame rests primarily on a museum a few blocks west and out of the Park.

The possibilities of litigation as a political instrument in our environmental cause pose some dangers. Courts should not be used as political ploys, for reasons which go much beyond the breach of lawyers' professional ethics which may be involved. Their functions are far too important and their difficulties far too great to subject them to being turned into such instrumentalities. On the other hand the fact that there may be a political means of resolving a legal issue, particularly one involving important public environmental claims, should not forbid resort to the litigating process. The use of litigation as a part and parcel of corporate proxy fights has always seemed to me to raise similar questions. Perhaps environmentalists should have the same rights as corporate empire builders.

I do not know the answer. I use this opportunity to pose the question to a responsible and distinguished deliberative body. I pose, for your analysis, broader and more penetrating, because of the multitude of your disciplines, than that which I can furnish to them, two other aspects and problems of the evolution and use of the legal techniques I have described. One compares the relationship of administrative agencies to courts. By and large the environmental struggles in courts have involved challenges of administrative action. The recently published work of Professor Joseph Sax of the Michigan Law School, *Defending the Environment,* is a fascinating and eloquent case by case account of a few of the major controversies.

What was five years ago or even one year ago the effort of a few private groups has gradually become, however, what it should be—an effort by our environmental policing agencies, at the national, state and municipal levels. Polluter policing is the way to political fortune in the 70's, as racket busting was in the 30's. Every prosecutor and environmental administrator is an ecological Tom Dewey.

This is wonderful. There is no jealousy between the private organization suitors and the public prosecutor. Suppose, however, that the government enforcers begin to rely, for the purpose of sustaining their determinations and policing acts, on the same administrative law principle that the conservation groups have been attacking. It is not too improbable that the Army Corps of Engineers, for instance, will be denying many applications for permits in the recently announced permit program, and that the applicants for authority to dump wastes into navigable waters will be putting to good use the methods and theories environmental lawyers have developed for fighting that same Corps of Engineers and the Federal Power Commission and other administrative agencies.

Perhaps there is no strictly partisan answer to this probable development. My advocacy of the environmentalist cause does not lead me as far as seeking different rules of law for what I like to call the good guys from those that apply to the bad guys. There is the underlying question, however, of where we believe the environmentalist cause can be advanced further before the generalist, the court, or before the specialist, the administrator. I prefer to argue to the generalist, to the non-technical expert. I distrust specialists as decision makers in any situations where conflicting values must be weighed. For that reason I react adversely to proposals for special environmental tribunals. In the current search for answers to the power-siting problem I do not see as the solution simply requiring the utilities commission to weigh environmental factors, or making the environmental department head a member of the sitting decision-making body.

This overall distribution of power problem is another aspect of the relationship of the adversary process in which I am the technician to the broader political and social aspects of the conservation movement at its present stage.

I come to the end of my allotted time to discuss with you the subject of legal controls to protect the environment. The summary nature of my description of some of the leading points developed and problems remaining has eliminated one aspect of the subject matter with which I will close—the excitement, the romance of being involved in the creation of the legal tools. If ours is a government of laws and

not whims, then the function of environmental law is, in my view the substitution of a pantheism for an anthropomorphic deism as the philosophic grounding of the laws which direct what we do with our one earth. As an optimist, I close with some proof that we have begun that process of substitution. Let me quote one of Thoreau's principles. "Most of the luxuries and many of the so-called comforts of life are not only not indispensable, but positive hindrances to the elevation of mankind."

Now I will quote from part of the Court's opinion in the 1965 reversal of the Federal Power Commission's first grant of a license to build a power plant at Storm King Mountain. As its direction to the Commission in retrying the issues, the Court said that the renewed hearings must—"include as a basic concern the preservation of natural beauty. . . keeping in mind that, in our affluent society, the cost of a project is only one of several factors to be considered."

I interpret the Court's language to mean some of what Thoreau meant. Is not the message of both Thoreau and the rule of law I have cited that we should transfer dollars and intelligence from SST to righting the wrongs which still deprive many of their fair share of our affluence, and with the large measure still left over devote ourselves to the elevation rather than the further fattening of mankind?

DISCUSSION

VICE CHAIRMAN MAUNDER: Thank you, Mr. Sive, for a very revealing paper on the development of patterns of legal instruments to protect the environment.

MR. EARL DELTON: (Seattle) In your remarks you refer to the SST and, being from Seattle, I am curious as to what kind of legal instruments, for example, would a resident of a small island in the Caribbean or the South Pacific use as an aggrieved party to prevent the invasion of his privacy by aircraft flying at supersonic velocity? In other words, what legal instruments are available to him? Can he use the World Court in any kind of adversary proceedings?

MR. SIVE: I think not. Now, I am not a student of international law but jurisdiction. Court of the Hague depends upon voluntary submission of disputes by nations. However, there is no international court yet to which one can take a dispute as a resident of any locality in relation for example, to the SST development.

I think the SST problem is one of those types of problems that essentially has to be determined by the Congress, by the legislature and not by the Court.

MR. DELTON: What I am referring to, is how would the aggrieved party even know the national flag carried by a supersonic aircraft? In other words, what type of adversary proceedings would be used to establish the nationality of that particular aircraft?

MR. SIVE: If the implication of your question is that there should be a World Court to which a South Sea resident can talk, then I might agree. However, there is none that I know of.

MR. DELTON: Perhaps the SST powers should agree to submit any potential litigation concerning the SST to the World Court. Failing that, perhaps the SST should not be built.

MR. SIVE: I would certainly think that is a suggestion which could be considered, yes.

MR. DELTON: I have one other point to make.

There are opportunities for adversary proceedings other than the Courts. I know that while there are not a large number of them, there are some.

For example, the public broadcasting service has been engaging in such an effort for the last year or so called "The Advocates." It does offer a political arena for questions that are appropriate to the politician rather than to a legal challenge. Maybe we should explore other non-legal adversary proceedings as such. Thank you.

MR. SIVE: I would agree with you.

MR. JAMES ANDERSON: (Oregon) Could you comment on the law or standing regarding withholdings of statutes or reports submitted to government administration on matters concerning environmental quality and projects involving public funds or lands? In other words, do I, as a citizen, have the legal right to obtain a copy of these studies and/or reports?

MR. SIVE: The answer to that is not clear. There has been a great deal of controversy over the endorsement of the provision of the Environmental Policy Act. In fact, that has been interpreted to refer only to a final form of those statements and not to what are called "the drafts." This controversy has developed a great deal in the last three months.

I personally feel that all of the documents should be public. We own them. The people writing them are our agents. As far as I know, there have been no court determinations of that question.

MR. ANDERSON: Do you foresee a closing of this matter or some goal reached in the near future? Do you foresee a judicial determination of this?

MR. SIVE: I would guess that it will come before some court soon. However, insofar as I know, it hasn't as yet.

MR. ANDERSON: As a citizen, is there something I can do to bring this on?

MR. SIVE: To bring this on, of course, you may yourself institute the suit and you may have standing to do so. Unfortunately, it is very difficult to predict the precise questions that will be determined when a suit is over. In other words, it doesn't always turn out the way you think it might.

MR. ANDERSON: I am sorry to dwell on this but I have to get a little more clarification. In other words, in order to get a report, let us say, of the SST advisability, airport studies, pipelines, et cetera, I would have to file a suit with the Government to get the reports?

MR. SIVE: Let me suggest there is a right under the so-called "Freedom of Information Act." Now, rather than consume further time here, perhaps I can discuss that with you informally after the session here has been concluded.

MR. ANDERSON: Thank you very much, I shall appreciate doing that with you.

NEEDED IMPROVEMENTS IN ENVIRONMENTAL EDUCATION[1]

NORMAN PEARSON

Chairman, The Centre for Resources Development, The University of Guelph, Guelph, Ontario, Canada

THE CLASSIC DILEMMA

Society's failure to solve environmental problems can only be corrected by action based on improved environmental education. Unless public attitudes change, and unless a better understanding and appreciation of environmental processes spreads rapidly to all parts of the world society, our changing surroundings will continue to deteriorate. In this situation we face the classic educational dilemma. The present problems are largely the result of ignorance and indifference. Because of that widespread ignorance and unconcern, relatively limited public funds are available for needed improvements in environmental education. Since environmental education is restricted, the ignorance and indifference persist. As a result, the problems worsen and the lag in our culture between the real needs and public attitudes increases. Since problems worsen and become major crises and disasters, the options for future environments become restricted and the need for reform increases as technology speeds up the actual physical changes in our surroundings. The pace of change has rendered much of our formal political machinery and most of our institutional educational apparatus obsolete, and this constitutes one of the major blocks in the pathway ahead. Yet we must break out of this cycle, for it is our very survival which is at stake.

WHAT ROUTE CAN WE FOLLOW?

What route can we follow to escape this inimical system? What we are really dealing with is a problem of man's view of himself in relation to the environment, and it is like the problem which confronted geologists and biologists in the last century, when popular beliefs and entrenched institutional attitudes in religion and politics and universities stood in the path of human development and understanding. When Darwin synthesised the contradictory facts into a comprehensive theory of evolution a new path opened; indeed, much of our present education establishment, the specialist departments and disciplines in our universities and schools, arose on the wreckage of orthodox religion and moral philosophy, on the collapse of classical education. In the early years of this century the revolution in physics

[1]In the absence of the author, this paper was read by Dr. Ernest W. Hartung.

and in cosmology, derived from the insights of Einstein, did much the same for ideas of time and space. It used to be believed that Marx and Freud had achieved an equivalent breakthrough in relation to society and the psyche. Out of all this came a conventional image of the power of science, a naive belief in political revolution as the cure for all evil, and a simplistic view of the environment as the alternative determinism to heredity, shaping mankind; in this mechanical view, all man had to do was to unlock the mysteries of genetics, and understand the mechanisms of the environment, to be able to master all things. When that view became widespread throughout the world, it appeared that scientific discoveries, converted into technical answers, applied universally through massive industrial development, could convert tractable and unlimited nature to unlimited human ends.

On this basis our present world paradox has arisen: Just at the moment when the earthly paradise appears in view, the apocalypse hangs over us, and the mechanical and specialist views create monstrous problems. Locked away in specialist journals is most of the knowledge (and many of the insights) we need to achieve a world of humanity's highest ideals; but it is not applied effectively. Indeed, much of it gets lost to be rediscovered painfully much later. That image of unlimited human power over unlimited nature crashes to ruins under the hard facts of the limits of time, space and energy; the fundamentals of ecology; finite resources; and the nature of human institutions.

The only route we can follow out of this morass is to work towards a change in our view of ourselves in relation to the world and to nature and to all our fellow men. Fortunately we have at our disposal an increasing public awareness, dramatized by such scientific precision as man's voyages to the moon, that we live in a world which for all practical purposes is the only home mankind can ever know. We have a general public understanding that atomic warfare can wipe out humanity. We have masses of young people who are dimly aware that we live in a world society. We have the technical means of communication to transmit a few basic precepts about man as part of nature and about the problems of human adaptation. We have ephemeral symptoms such as the crises of pollution, mental and physical health, famine and urbanism, which cry out for the identification of the fundamentals creating these situations. Perhaps as never before, the truthful representation of what is known on a universal basis using mass media, in as simple a form as can be achieved, creates a distinct possibility of a major revision in man's thinking, towards the ethic of conservation. This can be achieved by honesty and by objectivity. In

the face of mass media, over a decade or two, in which basic fundamentals about life and this world are stated, the obsolete ideologies and institutions and rationalisations can be quite dramatically shifted. This endeavor can do what seems impossible by coercion, by brain-washing, by propaganda, by revolution, by repression, or by any other means.

The need for a basic change in human attitudes on a basis of universality is so pressing that it should receive the urgent attention of all environmental educators. So far, conservation-minded people have made a considerable impact, but the acceleration of environmental problems and the diminutive forces in the conservation movement, mean that we face a long and extremely difficult task, fighting on all fronts at once, until these changes in human attitudes occur.

Once they do occur, we can expect a new kind of politics, a new kind of institutional pattern, and a set of forces which will work towards a better harmony with nature. But while that work goes on in the extension education field, what other improvements are needed in environmental education?

A DARWIN OF THE ENVIRONMENT—SOCIETY PROBLEM

We should look for the equivalent of a *Darwin,* in the field of environment and society, and strive towards a synthesis of our knowledge about how human society works within the natural order, and how the natural order works under the demands of human society. The "environment-society" problem creates a situation in which we need, from the fields of biology and zoology and the environmental sciences, people who can translate our ecological understanding into programs which can be put into effect through the web of social institutions, and to do this with the effectiveness hitherto apparent in the worlds of medicine or engineering. Similarly, in the worlds of sociology and administration and politics, and in the social sciences generally, we need people who have a basic appreciation of the natural order and the environment of man. We should train people who can think of both sides of the man-environment reaction and interaction simultaneously. Much of the result we look for will surely derive from people who are capable of visualizing what the world can be, in a situation where man and nature are in harmony, and capable of translating that visualisation into actuality. We need a workable theory which serves as our equivalent of the insight of a Darwin or an Einstein. Because our world is one of increasing and deepening specialisation, it is often argued that such a synthesis is impossible, and further, that such generalisation is meaningless, or else

that it means the end of specialisation. But what is apparent is that all science has developed on the sub-structures of periodic synthesis as masses of new knowledge were built up; that we need both the specialist and the generalist; that the synthesis is extremely difficult; and that while we push on with the manifold specialist studies, we also need to advance rapidly to pull together what we know and to offset that imbalance.

SOME URGENT NEEDS

Our urgent needs are:

(1) To develop an elementary and secondary educational system which gives young people a clearer appreciation of the environmental-social problem, and how a democratic system works.

(2) To establish at the undergraduate level in the universities a similar appreciation and to bridge the artificially created barriers we have erected around so-called arts and sciences.

(3) To use such a common basis of understanding as a foundation for:

(a) New generalist professions such as regional and resource planning, environmental management and administration.

(b) New specialties capable of working with others effectively across the dividing lines, such as predictive biologists, environmentally and socially conscious foresters, environmental sociologists, ecological political scientists, and theoretical and applied ecologists.

(4) To establish academic and institutional incentives for inter-disciplinary and multi-disciplinary research and practice.

(5) To translate the findings of all relevant research into terminology capable of being used by all disciplines concerned with man and his environment.

POSSIBLE METHODS

Many of our methods must change radically. The traditional idea of laboratory and library and lecture has never been fully effective in the environmental and social areas and in practice much of the talk about holistic and integrative studies fails because no attempt is made to make the world we live in the real classroom. Theory and practice must be one, and field studies involving both the physical and the social-institutional environment are needed at all levels. If this is not done by universities, it will be done despite them.

It is fashionable to give lip-service to the idea of inter-disciplinary study and research and practice: We need to convert our academic institutions into places where this idea can be a reality, and where promotion and esteem and rewards come as well to these workers as to

the specialists working in isolation. The situation here is apparently universal and particularly frustrating, because we have as yet little experience of workable arrangements. Yet certain fields have done wonders in such conditions, and they would obviously repay study. All the environmental professions have inter-disciplinary practice; so have many medical organisations, industrial and commercial corporations, and military agencies. We could learn much from the combination of specialist and inter-disciplinary study and operation evident in the space program, in the "combined forces" operations of the 1939-45 war, in the integrated river-basin development of TVA, or in the disease and pest control operations of FAO and WHO. Until, however, we put enough funds into such work, it will remain small and limited. We need a budgetary allotment for environmental education equivalent to the moon-shot program, for it will be noted that all these successful examples are on a massive scale.

The citizen will soon learn to look at a region or some comprehensible segment of the environment and demand an improvement in his surroundings. He will eventually seek, and find, the professionals, the managers, the administrators and the politicians with the necessary awareness and skills to deal with the man-environment problem more intelligently and more sensitively than we are now doing. At that time, the universities will face a challenge like that which made the classical and mediaeval places of higher learning obsolete. The industrial revolution created our present universities. The environmental and social challenge will shortly put them in the situation where, if they become just another bureaucracy or corporation defending their truth against reality, reality will win every time. In particular, when an awakened citizenry seeks integrated and holistic answers to urgent, massive and indivisible problems, if the universities fail to deliver, then grants will be drastically cut and some new institution will be devised to meet the new needs and serve the new cosmology. In plain language, if the universities can not adapt they will be replaced.

The success of the analytical-specialist method has blinded us to the need for freedom for researchers; many research workers who want to work in inter-disciplinary settings find so little academic or professional incentive and so much peril to their specialist standing that they prefer the freedom of being their own master in some small unique area of study. While we are quite willing to let brilliant individuals work on minute advanced problems in physics or in chemistry, we give virtually no impetus to our best minds to work in the urgent areas of human survival and geo-hygiene in inter-disciplinary fashion. Yet what is clearly needed is block grants to

enable groups of diverse experts to learn how to work together: we could envisage a contemporary equivalent of the mediaeval college, with groups of researchers and scholars freely associated within a unit under their own control, working on problems of integration in both theory and practice.

Fortunately, in all fields, serendipity works, but as human situations become increasingly more complex it becomes more and more difficult for the responses to come from any one division of knowledge or any one specialty or any one man. We also know that "group" research, where a corporate or institutionalised semi-coercive atmosphere exists, does not create original findings. We need to find methods whereby free individuals can co-operate in cross-disciplinary research and applied research and actual practical operation, without being penalised for leaving their neat compartment of knowledge. The walls must be pierced; in due course they might even be made movable. One of the worst barriers to human progress in environmental education is the academic department and its attendant bureaucracy. Nature presents us with whole problems and we respond with partial answers.

We have lived through a period where one specialty after another has laid claim to the whole field of environmental and social knowledge. Such arrogance was the academic smokescreen for empire-building. In due succession we were told that all the secrets of the universe would be revealed once everything had been expressed numerically; that with enough psychoanalysis, all man's drives would be harnessed; we were told that the really integrative discipline of geology, or geomorphology, or history, or geography would solve our environmental problems; we lived through the era when social (or even anti-social) engineering, behavioral science, or soil mechanics, would resolve complex issues; we were told that planning, or systems thinking, or input-output economics, or descriptive sociology, or more precise chemical analysis, would really put us on the right road. Indeed, apart from witchcraft and animal psychiatry, we have tried all the specialist answers. They do not work. They all create worse problems than before. Nobody believes that the tough and critical social and environmental problems are as easily answered as the controlled experiments on special aspects would have us believe.

In essence the needed improvements in environmental education are to change some deeply rooted attitudes so that we respect the limits of nature and learn to work together. The social and biological sciences must come to the forefront. The arcadian myth, the idea of going backwards, which appeals to the current fad for ecology, simply does not work in a world of urban man. For our part of the world, the

problem is to guide and control our post-industrial society so that we retain and extend the real advances we have made in the quality of life and restore our ravaged environment. For the great bulk of the world, however, the problem is immensely more complicated: how to industrialise and achieve a basic decency in life without repeating our experience. For us all the difficulty is to steadily bring the present uncontrollable environmental-social problems under human guidance without wrecking the globe in the process. We are so shockingly ignorant of our surroundings that while we can land a spacecraft on the moon with relative precision, we are incapable of managing any of our regions in which we live towards some concept of harmonious evolution. What that paradox tells us is that these social-environmental issues are the most appallingly complex problems ever to be encountered. As ever, the challenge to environmental education is to create points of light in the darkness of this ignorance until we see clearly and can act wisely. We can not let the present ecological fad cut off the hope of material progress which most of the world needs; nor can we use the need for industrialisation to wreck the balance of the world.

In this situation environmental educators are only beginning their efforts, but no better calling exists in the world, in what H. G. Wells called "the race between education and disaster." Unless we learn to work together, we may pass the point of no return.

DISCUSSION

VICE CHAIRMAN MAUNDER: I am sure all of you will agree that this was a most excellent paper and that Mr. Pearson seems to have a rather dim view of the precision in our universities. I think it perhaps is germane, if there are no questions if I might ask some of our earlier commentators and perhaps Dr. Hartung, as the president of the University of Idaho, if they have insights or any signs of hope that the interdisciplinary approach is really gathering any steam or getting any further forward in our universities as they see them today? Perhaps I should ask Dr. Nash to comment on this first.

DR. NASH: I would just like to say that at the University of California, Santa Barbara, we occasionally turn to problems like that. I have put together a program called "Environmental Studies," which I have had the honor of chairing down there and much of what Mr. Pearson's paper referred to we have experienced. This is especially true with regard to the difficulty of bringing together men from different disciplines.

One thing which we have done, which I hope might be interesting to most of you, is that we have taken the concept of general education and keyed it to the environment so that instead of teaching a course like chemistry, physics, history, economics or even English, we teach a course called "Environmental Studies" and plug these various disciplines into them. Therefore, a student is taking a set of six courses in relation to Environmental Studies, in which, in turn, he is exposed to the whole facet of environmental disciplines.

We have one of the largest undergraduate majors in the university-people who have declared themselves interested in majoring in environmental studies. I do

think we are on the right track and I think that the American university can respond.

I would also like to get President Hartung's impression on this.

CHAIRMAN HARTUNG: Referring to Mr. Pearson's paper, I do think that barriers still exist in large measure in many universities and that this is a frustrating fact, which may perhaps be the reason my voice trembled somewhat when I got on that subject.

I think one of the things we must do in large measure that has not been done, except in very special instances, is push forth for an inter-institutional cooperation rather than mere cooperation at the institutional level itself.

In a brief way, what we have done generally in cooperating among institutions is cooperate within marked-off areas. In other words, two universities would be perfectly happy to cooperate in a project, let us say, in educating graduate students in certain areas so that one or the other did not have to have all of the specialties involved in the total education of that particular area. However, I think this kind of cooperation must go on in other departments in the institutions—that is to say, the physics department in one institution, perhaps cooperating as suggested by Professor Pearson with the sociology department in another. For example, if the sociology department in "Institution A" happens to be geared or properly attuned to the areas of investigation of research necessary, then that would be the way they would go.

I think perhaps the best approach to this is one where we are endeavoring to try now, between the University of Idaho and Washington State University, to perform some of this cooperation. Now, the fact that these two particular institutions are only eight miles apart does give us hope that an interuniversity environmental kind of research-oriented agency can develop, using many, many departments interchangeably within the two institutions. This is still in the planning stage. Something has been done on paper, some authorization has been granted and one or two individuals have been hired. However, these are things that need to some from within the institutions.

I am going to take this paper of Professor Pearson's home and give it to all the individuals involved on both campuses because I think it is worth considering.

MR. BILL NOCE (Weyerhaeuser Corp., Washington): I am interested in the interdisciplinary approach that you were talking about. You mentioned, for example, that you chaired a department of environmental studies.

As I gathered from your comments the students would receive more or less a smorgasbord, a smattering of little bits of everything that would be related to the environment. Perhaps I am wrong, but I see this more or less as preparing students as problem identifiers and not as problem solvers. Frankly, there are a lot of problem identifiers in this country but far too few problem solvers. While a graduate in environmental studies may well find a job with the regulatory agencies or teaching in school and may be very well equipped to identify more problems in the environment, I am not sure that these are the people that are going to come up with the solutions we need. It would seem to me that the solution to critical, technological environmental problems is still going to come from the specialists, the chemists, the physicists, the environmentalists, if you like. I would like your comment about that.

DR. NASH: That is a well taken point, sir, and I am prepared to agree that there will still be a continuing need for specialists. Our motivation for undertaking environmental studies was rather to create an educated citizenry in the Jeffersonian sense. For example, looking at the department of history at my institution and what happened to people that majored in it, I note that about 10 of these people actually became historians—that the majority of them merely use history as a basis of becoming educated, such as becoming educated housewives and members of the PTA or whatever it may be. However, we think that environment is equally as good a general basis on which to develop a liberal arts education from the point that they do get their B.A. We also think that from this basis we might be able to interest enough of them to want to go into a particular specialty. It may be one of

the engineering specialties as you suggest. However, I think an equally important one would be economics, sociology, psychology, or some of the humanities, which I think we have neglected in relation to some of our positions.

DR. CLARENCE COTTAM (Texas): It seems to me that there is another possible solution. I think it is in the political arena, where there is need for some action.

For example, if the Army Engineers want to put some dams on the Potomac River, then there ought to be some provision in higher politics which indicates that other points of view must be taken in relation to this matter, such as cleaning up air pollution, and so on.

This is the approach we are getting from some governmental agencies and I think there needs to be reorientation of the governmental approach in relation to some of this.

SHOULD ECONOMICS DICTATE RESOURCE ALLOCATION DECISIONS?

MICHAEL F. BREWER

Vice President, Resources for the Future, Inc., Washington, D.C.

During the last century economics was stigmatized as the dismal science. Society's more recent concern with environmental problems has burdened the science with another uncomplimentary adjective. The popular generalizations which cast economic growth as the prime villain responsible for environmental pollution implicitly relegates economics to the status of a dirty, old, dismal science. With my topic scheduled at the end of a panel stressing society's environmental failures, I'm not sure whether economics has any chance to shed this label of disapprobrium. Despite the odds, I submit that economics can make a substantial—and I might add, indispensable—contribution to the resolution of the imposing array of environmental problems that confront our society and species.

To test this proposition in the few minutes I have this morning, I shall sketch out the kind of resource decisions I believe will confront us during the 1970's, the cast of characters who will have responsibility for deciding how to resolve them, and the type of information and disciplined talent which they will need to dispatch that responsibility. Against this backdrop I will examine the particular contributions the science of economics can make to the decision process, and will end up with some speculations about how the field of economics may evolve to better encompass contemporary resource and environmental problems.

WHO'S INVOLVED WITH ENVIRONMENTAL PROBLEMS AND WHY?

One change which has occurred within the field of conservation in the past decade or two has been the shift in focus from natural

resource problems to environmental problems. While the former have not disappeared, a transformation has occurred within our field of concern which lays stress on quite different types of problems than those which occupied most of our attention a decade ago.

Our earlier concern about the adequacy or supply of resource commodities has given way to a concern for the environment which must assimilate the left-over materials (or residuals) from our production and consumption activities. The life cycle of natural resources usually entails three phases: raw material, product, and garbage. Today's headlines stress the question of whether the environment can receiveth, rather than giveth.

There is a broad spectrum of national and worldwide concern with environmental pollution—which may entail simple annoyances, major economics loss, or a threat to the life-support capacity of the planet. In our effort to achieve some acceptable level of environmental quality, we have implemented pollution abatement measures, endeavored to "clean up" our technology, and considered modifying human settlement patterns. But before these or any other strategy can be argued as appropriate, the ambiguities must be removed from the notion of environmental quality. It must be defined. Only then can we consider systematically management programs, public policies, and other changes in the human behavior pattern designed to improve environmental conditions. A quality goal is needed from which criteria can be deduced that will help us in choosing from among the available options within any particular decision area.

This need to determine an objective for enviromental quality has fundamentally changed the nature of the conservation policy game. A decade ago when national concern focused on possible resource commodity shortages, quantitative objectives were relevant—whether they involved maximizing yield, or profitability, or minimizing social costs. These were targets for which plans could be developed by management experts. Recall how many of the federal programs addressing natural resource problems were conceived of and formulated by experts within executive branch agencies—often some distance from the field in which the programs were implemented. This is not surprising, for the design of resource management plans to achieve explicit, quantitative targets is a job for experts. Armed with information about the resource problem, and with scientific expertise in the relevant disciplines (engineering, economics, etc.), such experts had as good a chance as anyone to redress natural resource problems—and the public entrusted these problems to such groups. Not so with problems pertaining to environmental quality. Determination of that set of environmental attributes which constitutes the desired quality

must be made within each community where such problems are perceived and redress is planned.

Who best can do this task? Can some removed group of experts set objectives on behalf of individuals and communities who will be affected by their definition of environmental quality? When one deals with quantitative targets this is altogether possible, but when a broad array of values is invoked as is the case when we define quality to ourselves, individuals are loath to let the decision out of their own hands. In short, the individuals affected usually wish to have some say in the kind of program which will be followed within their community to secure a high-quality environment. This felt need for self-determination has been reflected in phrases such as "participatory democracy," and such efforts as neighborhood planning and action groups. Communities are trying hard to discover forums on which the parties affected can voice their particular interpretation of environmental quality, and debate with other members of the community who have different notions as to what constitutes appropriate environmental targets. If this is the case, any effort to address broad environmental problems must have a way of discovering who the "affected parties" really are. If those parties are all contained within a municipality, a country, or state, established political forums may suffice. But when watersheds or airsheds violate political geography, or when there are remote third parties who are affected by environmental resource allocation, new arrangements must be discovered, and often new methods for measuring third-party effects must be devised.

It is here that economics can make a contribution, for the discipline provides concepts and measures useful in identifying parties at interest. Certainly individuals who suffer damages from environmental quality deterioration are parties at interest. It behooves a community to have some knowledge about who bears these costs—are they primarily visited upon poor, inner-city minorities, or downstream areas, or some other groups? It also is important to know who secures any benefits obtained through arrangements to enhance environmental quality. Sometimes these two distributions are not congruent: Gainers may include quite different groups than losers. This is not to suggest that serious effort to enhance the quality of the community environment is not worth pursuing under those circumstances, but the community ought to recognize who is doing what to whom, who pays and who benefits. This entails obtaining and interpreting economic information.

OPTIONS AND THE PROCESS OF CHOICE

Once having defined the basics of an environmental quality problem, and thereby having identified the key parties at interest, one

needs to develop substantive information about the environmental systems involved. This information should indicate those sets of activities or programs which will modify the existing situation favorably. For each alternative program information is needed about its cost and the extent to which it changes things for the better. Usually this is a complex set of information.

For example, let us assume we have a polluted stream in a particular community which is amenable to light, medium, or heavy pollution abatement programs. The first may increase the stream's level of dissolved oxygen, the second alternative may achieve the same level of dissolved oxygen but in addition reduce the sediment load, while the third, or "heavy," treatment gives the largest level of dissolved oxygen with sediment reduction and a substantial improvement of the vegetative cover on the stream's banks.

Each of these strategies will involve a somewhat different management program. Technical expertise is needed to discover what collection of measures can achieve the several targets. Economic expertise is needed to identify those management arrangements which can do the job most efficiently, and this is of concern to the community which must pay the bill. The analysis involved is sometimes quite complicated. One can readily identify the direct costs of materials used to implement an environmental management program. But there may also be indirect costs to the community. For example, one possible strategy for cleaning up our streams may involve closing down an existing pulp and paper mill, with the consequences that payrolls shrink, local unemployment increases, etc. Of course the company may reopen in some other area, thereby adding to another local economy elsewhere in the country. While from a national point of view the local loss is cancelled out by a gain experienced elsewhere, the community trying to improve its environment will consider the available options in terms of the costs they impose locally. Sometimes the most attractive option from a local standpoint differs from the nationally or regionally preferied option. When this occurs, a compromise may be achieved if some sharing in transfer of costs or benefits can be arranged.

Thus far I have argued that economics is needed to identify parties at interest to proposals for improving environmental quality. I further have argued that economic information and analysis are needed to identify and compare alternative management programs for various environmental quality targets. I now will argue that economic logic often is critical for reaching a community decision when many individuals participate in the act. When groups of people with different values and priorities contemplate joint action, impasses

often occur which effectively prevent decisions from being made. These circumstances often characterize community efforts to enhance the quality of its environment. However if economic logic is followed, if often is possible to discern ways in which a quasi-marketplace can be established on which individuals affected (or their representatives) can trade their "votes" with respect to the options available. This has the distinct advantage of at least letting the decision process function even though there are constituencies in the community whose values may compete directly with values held by other constituencies. The values held by people will determine the environmental decisions made. Economics is useful in expressing what those values are.

SOME SHORTCOMINGS OF ECONOMICS

While economics plays an essential role in the steps communities must take if they are to do something about their environment, it doesn't contain all the answers. Economics is similar to any other intellectual field; it is a growing, evolving and transforming enterprise. Economic theory is being extended through contemporary scholarship, and methods of analysis are evolving which take advantage of modern computational techniques and the availability of new kinds of social science data. There is no reason to doubt that expansion of the field will continue in the future, rendering it increasingly effective in addressing environmental problems. The trick will be to insure that the science recruit first-rate young people, provide them strong training, sharpen their perceptions of environmental situations, and free them from static orthodoxy in their research activities. Accomplishing these objectives will require change in the way the profession now is organized—down to such subtle rules of the game as the reward-and-punishment systems which currently obtain in academic departments of economics. While the frictions of change are many and evolution is slow, it can be facilitated and accelerated by wise and determined leadership.

IN SUMMARY

I believe that as the intricate and complex nature of our environmental problems becomes more apparent, and the mechanisms for reaching decisions on programs for enhancement of environmental quality become established, economics will be increasingly realized for what it is—the stalwart companion of the conservationist. It is impossible to think of responsible environmentalism today without a healthy dose of economics. Clearly there will be problems which cannot be answered, or can only be partially answered, with the

present state of economic knowledge. But the science is continually advancing. Those who perceive its shortcomings can help it develop. Simply scolding economists doesn't help much. If you don't like the tune, don't shoot the piano player!

DISCUSSION

MR. WALTER HOWARD (University of California): I wonder if you can help me with the problem I am having with my economist colleague and dialogue I am having with some of the graduate students. For example, one issue that I have to contend with is that when I pin the economists down, their span of projection involves a relatively few years, whereas, on the other hand, an ecologist may be thinking for much longer periods. Also, when I pin down the students and faculty, they indicate that our population problems will be solved by increased personal income and through the affluences of controlling the birth rate. When I really back them against the wall, they all indicate that all of this is contingent economically upon a continually growing population. Would you please respond?

MR. BREWER: I will endeavor to do so.

First of all, I think there are fundamental and different perspectives and points of view between economics and other environmental sciences. The time framework is a very good example. Yet this difference can be bridged by mutual education. On the other hand, a great many of these considerations require a different kind of equation for the professional practitioner.

Your concern for the population is one which I personally share. Obviously, a finite system simply cannot contain a continuing population expansion. It just cannot do it. On the other hand, I will not suggest that simply stabilizing population growth, or reaching some particular level, will make all of our resource allocation and environmental problems disappear.

It is not only the numbers of people which affect environmental quality but also what the people do. This should be encouraging. I am not hopeful that a rapid drop in global birth rate will be achieved in short order. I am hopeful that we will in time achieve it. But, in the meantime, there are things that we can do about behavior patterns of our population which can greatly improve the natural environment.

MR. HARRY KLINE: I never did hear you exactly address the question of a zero economic growth. I do agree with you that zero population growth is not going to simply answer the question because I think the bigger threat is what the people who remain behind are doing with their activities and their consumption. However, I would like to hear you address the question of zero economic growth.

MR. BREWER: Let me try to do this briefly.

This is a complicated question and the words we use may mean different things to different people.

I would make this point—that as we move to produce and consume the things we want to produce and consume, in a way which minimizes the burden that the environment must carry, production and consumption will require relatively more capital than has been invested in these activities in the past. In other words, there must be an availability of capital for this type of strategy to succeed in the long run.

The requirements of additional capital suggests very clearly the need for viable and prosperous economies within communities striving to undertake this kind of environmental enhancement strategy.

Therefore, I do not think that zero economic growth is compatible with enhancing the quality of the environment if a modicum of free choice is going to be made available to communities to decide what it is that they want to produce and consume.

I would also say that the symbols to which we refer to when speaking of eco-

nomic growth—and this is most often the concept of Gross National Product—is a partial and often imprecise measure of human welfare. There are many situations which, because of the accounting procedures used in calculating Gross National Product, environmental degradation is tallied as a contribution to Gross National Product. These perversities and aberrations in the measurement and the accounting that lie behind these measures are familiar to all economists.

On the other hand, coming to the central question, I do not believe that zero economic growth is neither necessary for nor compatible with the kind of strategies I believe will be effective for future environmental enhancement. I think that the cost of producing things should reflect the environmental burden associated with that production and, hence, the cost of paper will have to go up in order to cover the anti-pollution measures that the pulp and paper plants may have to introduce in order to maintain their effluents at a tolerably low level. This means then that you and I as consumers would find familiar articles with unfamiliar price tags on the store shelf. If we are discriminating consumers, we will select less expensive paper, which may not be dyed and that the housewife may be willing to purchase a particular food commodity with less packaging than another because the latter would bear a higher price to reflect the environmental burden of the additional packaging.

Therefore, there are these changes in the rules of the game which can help enhance environmental quality under a growing economy.

MR. WILLIAM NOCE (Weyerhaeuser Corp.): Would it be proper to go back to a comment that Dr. Nash previously made or would it be inappropriate at this time?

VICE CHAIRMAN MAUNDER: It would not be, if the question now here in front of the audience has something to do with the current speaker.

MISS BETTY COLEMAN (Oregon): I am associated with the Planning Council in and around the metropolitan area. It seems to me that most of our decisions made with regard to land use are based on economics—that is, enhancements of the tax base, I wonder if you have any comment?

For example, it is my considered opinion that the tax base can be enhanced through proper use of land, but we don't seem to be able to convince our leaders that this can be done.

MR. BREWER: Yes, I think that there have been a great many environmental wounds inflicted as a result of efforts to expand the tax base of the local communities. This is very true where you have many communities in a region in close proximity to each other, competing for the plant, for example, that is going to locate there.

There are some useful arrangements which the local community might consider which would reduce the level of competition among these communities and reduce the incentive to give away bits of the environment as attractive bids for that plant or industry which is going to locate there.

I think of the very interesting experiment which has taken place in the Twin Cities in Minnesota, in which a new level of government has come in. This new level sits on top of the municipalities. There are 200 municipalities in this case, and the financial impact of this is that new plants or any expansion of the tax base within the region, a part of the property evaluation, some 50 percent of it, goes to municipalities where that expansion takes place and the other 50 percent goes to a regional pool and then is redistributed to the region as a whole.

Now, what this sort of arrangement effectively has done is to keep city "A" from competing directly with City "B". Formerly this devasting kind of internal competition among local government units has caused some severe environmental problems, particularly in the water pollution and air pollution fields.

VICE CHAIRMAN MAUNDER: Thank you, Mr. Brewer.

For better or for worse, the social objectives of government are carried out through economic policies and measures, and Mr. Brewer has a strong case for enlisting economics as a stalwart companion to the conservationist. Perhaps we all need to consider declaring a closed season, at least for a while, on shooting

economists and perhaps ask ourselves if we have taken an economist to lunch lately. If you have, perhaps you might turn to the historians. There are also a lot of hungry historians who would like to go to lunch also.

I believe there was one question in the audience that was to be directed to Dr.Nash?

MR. NOCE: Earlier I asked you about your program entitled "Environmental Studies" and perhaps your comments have made me think of something else.

One of the problems we have at our company is we receive many requests, and these are increasing as time goes by, from undergraduate students who are interested in working in industry and specifically with our company—in other words, working in the environmental area—and many of them have been proud to say that they majored in Environmental Studies at such and such a university. However, I wonder, from what you said, whether or not their type of measure is really an education in a Jeffersonian sense, perhaps the same thing you can say in relation to a history major. In other words, I am wondering if these students are aware, when they choose the major of "Environmental Studies" and get the smorgasboard instead of a solid major in one subject, that they cannot hope to find job opportunities in industry?

DR. NASH: Yes, they are, although, as I gather it, your bias seems to be against a smorgasbord, which I have found delightful.

Now, going back to the concept of human learning, I think, with all due respect, that for a company, such as yours, that owns such a great expansive timberland, that you could indeed use some of these people who, in turn, might bring a little more breadth to some of your decision-making. (Applause.)

MR. NOCE: I am afraid you misunderstood me. Of course, we certainly do need this type of thinking, at least in general, but what I am saying, for instance, is, in relation to behavioral psychologists, should we have more of them?

Of course, we do need people with a broad liberal arts background but what I am simply saying is that these people feel they can move into scientific areas as problem solvers and yet they simply cannot and because some of them have majored in what we call "environmental sciences," where they take Biology I, Geology I, Botany I, that they are well qualified as problem solvers. Actually, while they know a little bit about everything, they do not know everything about one thing in relation to which they can really come to grips with problems such as air pollution, water pollution and the like. That was simply the point I was trying to make.

DR. NASH: I see that point very clearly. I sympathize with you.

FROM THE FLOOR: My question is somewhat related to that of the gentleman just before me. Tommorrow a decision will be made in Oregon with regard to the Oregon students' public interest research group. I don't want to prejudice the discussion that is going to be made in this connection but I would like to ask Mr. Sive what his judgment is about students working in things like this, including the legal aspects—not just simply the research but including the hiring of lawyers and other factors? For example, pollution has been going on for 20 or 30 years and I don't think you have to have a doctor's degree to see that. Therefore, I just wondered what your feeling was as it relates to the education factor—how are you, in fact, going to educate students so they can work within the system and so that they can really do something as private citizens?

MR. SIVE: Your question, insofar as it is directed to me, is how students can be used to help lawyers in legal efforts?

Well, there is a great use for them now, especially in connection with law students. There are certain practical problems involved, one of which is that as a legal proceeding goes on, work on it sometimes has to be done instantly. There is very little notice beforehand of it having to be done, but a good deal of the work cannot be organized in connection with any long-range organization. Therefore, it funnels down to the student whose main activity, of course, is involved with the learning process.

Further, there is sometimes the problem of giving due credit. For example, I sometimes find it difficult to give due credit to students. For example, names cannot go on a brief. Of course, they can be "of counsel." This goes for law students also but, on the other hand, if the case is large enough and then if there's enough time to organize it, students can be and are a great help in a lot of legal situations.

FROM THE FLOOR: Do you have in New York such a group? Are you familiar with this idea?

MR. SIVE: Yes. Virtually every law school now has an environmental law society, and all of us work in these public interest fields and need that type of help and use them. The organization of environmental groups in universities generally outside of law school is something which is of cimmon knowledge to everybody here. For example, Denver started an environmental law group and it spread across the nation. Of course, I realize that in Oregon they do have some 30,000 students and they are asking that money be taken from their fees and paid into a fund only by the students. On the other hand, there is nothing like that in New York. In connection with the University of Massachusetts, a certain part of those fees are turned over to specific environmental work.

CHAIRMAN HARTUNG: Ladies and gentlemen, I believe our time is up. You know, we have to remember that the advantage of a "smorgasbord" is that one can go back as much as one desires. If there are no announcements, this session will stand adjourned.

PART II

TECHNICAL SESSIONS

TECHNICAL SESSION

Monday Afternoon—March 8

Chairman: S. J. SCHULMAN
Coordinating Consultant, Urban Development Corporation, White Plains, New York

Discussion Leader: DOUGLAS A. YANGGEN
Associate Professor, University of Wisconsin, Madison

CONTROLLING LAND USE

REMARKS OF THE CHAIRMAN

S. J. SCHULMAN

In a sense, I am a part of the enemy because I represent a governmental agency that has the power of condemnation and, knowing this, potentially, both you and I are enemies. Unfortunately, on the other hand, we have not yet done enough to get into each other's hair.

My selection as chairman of this program was made when I had a different title, when I was a participant in park programs.

My colleague is Douglas A. Yanggen, professor of Agricultural Economics at the University of Wisconsin. He will moderate the question portion of the session.

In contrast to this morning's plenary session, my comments will be extremely brief.

We are now down to the realities of the situation. This is not to demean any of the remarks made this morning but we, at this session this afternoon, are going to get into more of the technical aspects of our respective involvements in this general field.

It is interesting to look around at any conference. This one is just like so many others that we have all been to—it is an assemblage of widely and wildly different approaches to a series of problems and issues that are so difficult, so complicated, that no reasonable man can

really expect solutions. Therefore, I suspect that we will only be able to keep our sights at a realistic level and not go away too unhappy. I would suggest that we not be arrogant in proclaiming our expertise or unreasonable in our expectations. And yet this afternoon's session, I suggest, will address itself to the issues of the land as it is, as against, with all due respect to our colleagues, the other issue that I think is relatively subsidiary on the rest of the program, such as contamination, oil, fish, wildlife, fields, forests and related matters. Today's session is also notable because it is the one overall technical session that inevitably will be focusing on urban issues, for which there have been assembled a panel of true experts from several professions, from several levels of government, and from several points of view.

Now, I don't think that you will get unanimity from all of us. Today's session also is different in a lot of ways in that it assumes a large degree of knowledge which focuses on new techniques, which looks to the "how" rather than the "why." We are all going to assume we are members of thee same religion. We are going to try to figure out how to get to the so-called Promised Land. In other words, the emphasis will be on simplification, how to get things done, rather than exortation and emotional harranguing; on practice rather than theory; on learning rather than complaining.

The six men in front of you really add up to a package of solid presentations, each of which will unquestionably generate a fair amount of heat and, I suppose, as much light.

ENVIRONMENTAL PLANNING IN NORTHERN EUROPE AND RUSSIA

JOSEPH J. SHOMON

Director, Nature Center Planning Division, National Audubon Society, New York City, New York

Environmental planning can be defined as the coordinated input of *all* of the physical, biological and social factors that make for a pleasing and salutary man-made entity or institution, be it a school, park, highway, new town, or the redevelopment of a megalopolis. While there is much talk of the need for this kind of planning, there are only a few places in America where one can see such planning applied. A critical look, therefore, at what is going on in northern Europe and Russia might be helpful.

FRANCE

Historically, France has been identified with a measure of good planning. While the World War I and II years seriously disrupted the country's political and socio-economic life, the fact remains that early France and post-war France have shown considerable concern for both physical and social planning.

Paris, an old but well-planned city, has long been the center of France's political and intellectual life. In addition, this capital city has been the seat of the country's industry, business, and tourist attraction. The greater Paris region occupies an area of 4,570 square miles and has a population of 8,500,000—equal to that of France's 33 other largest cities. The City of Paris, according to a recent census, shows a population of 2,800,000 and occupies an area of 33.5 square miles. The city's population has risen from 700,000 to nearly 3,000,000 in a century; the population of its suburbs has climbed even more abruptly, from 400,000 to 5,000,000. If the Paris region grows as it has between 1946 and 1962, an estimated 16,000,000 people will occupy the urban area by the year 2000.

How is the Paris region planning its future? The answer, French officials modestly admit, is, "Not nearly well enough!"—but some important planning and development strides are clearly evident. The government took steps to plan Paris' growth in 1928, and again in 1932, 1935 and 1944, mostly by drafting a general plan and setting up rules for development. In 1960 the City adopted the first major plan for Greater Paris, called PADOG, a 5-10 year plan to control the region's 463-square-mile urban complex. A year later a law was passed which set up the District of the Region of Paris, establishing an agency to coordinate planning and help with financial development. Its mission was to propose plans with a view to a global town and country planning policy. An interesting feature of the District is that its field of competence covers an area ten times greater than the present Paris urban complex, including over 1300 communes, of which more than 100 are rural.

The Paris master plan envisages an urban complex of 14,000,000 people by the year 2000, with a whole series of self-contained suburban cities ranging in population from 300,000 to 1,000,000. The plan rejects urban sprawl and haphazard development, favoring instead regional and nationwide coordinated planning of suburban cities to control growth and expansion. The sub-cities are to be connected to Paris by high-speed rail lines and expressways, are to have complete systems planning for traffic, service needs, parks and open space, and proper waste disposal.

One suburban city hub of great and promising design near Paris' western gate is the *Quartre de la Defense.* The project is planned as a total satellite city with an underground railroad station, subway stop, parking lots, green malls, shopping centers, high-rise and medium-rise apartments. The business center alone will occupy a picturesque 25-acre site overlooking the Seine River. The residential area will occupy 1500 acres. Also being planned is a new 15,000-student university. The project, estimated to cost one billion dollars, was begun in 1964 and is expected to be completed in 1975.

ENGLAND

Environmental planning is not new in England. Government planning has been at work for some 300 years, and planners working in the public interest have long been accepted by the people. In America planning is quite new, and planning agencies are often controlled by developers, real estate brokers, and others with vested interests. Little wonder why the average American has grown somewhat distrustful of planners. This is not the case in Britain. Let us, therefore, examine the environmental planning process in England.

First of all, planning is much more centrally controlled in Britain than in the United States. The control largely remains in the central government, enabling city, regional, and nationwide planning to mesh together. The government also exercises a strong influence through fiscal incentives over development—especially over such things as renewal of old cities, new cities and towns, the location of business and industry. The private sector is brought into the picture by a sort of "marriage" of government and private enterprise with the latter given the responsibility for developing what has been planned. A notable result of these concepts and this framework of policy instruments is that land is no longer merely a commodity but an investment in which the public has a vital interest. Speculation, therefore, is very much removed from the land exchange business. When exchange (change of temporary ownership) takes place, it is the public interest that gains rather than the individual.

Today there are 26 new towns in Britain and two more in Northern Ireland. There are eight new towns around London, including Letchworth and Welwyn Garden City. The center of war-ravaged London has been preserved as a one-square mile historic "Old London" area (with some new buildings) where few people live. The rest of war-torn London has been rebuilt as "Modern London," but with a density now reduced to 6.5 million. Beyond the city is the 5-10 mile wide London "Greenbelt."

The instruments which have made all this possible were four

legislative acts: (1) The 1946 Distribution of Industry Act; (2) The 1946 New Towns Act (modified in 1962); (3) The 1947 Town and Country Planning Act; and (4) The 1952 Town Development Act. These instruments plus such measures as the Greater London Plan have achieved phenomenal results—they have reduced densities for London, eliminated urban sprawl, promoted orderly growth and development for the population and industry, maximized livability in suburban new towns and cities, and preserved sufficient living greenspace in and around urban areas.

The famous Greenbelt around London provides the city with several important benefits: As a green area 5-10 miles wide, it limits the land growth of London (since building restrictions are very tight in the Greenbelt), provides a biochemical cleansing and refreshing effect for London, and provides welcome breathing space and recreaction for millions of urbanties. Within the Greenbelt is the Epping Forest, a large well-kept woodland region with wildlife, walks, trails and drives, all in an an area of preserved natural beauty.

To better understand the role of environmental planning in Britain, it would be well to examine three projects rather closely—two so-called new cities, Welwyn Garden City and Harlow, and a London suburban new center now under development called Thames-Mead.

Welwyn Garden City (WGC) was developed through a private corporation and begun in 1920. A Golden Jubilee celebration was planned in 1970 as a success story; it is one of the best new towns in England. WCG now has 43,000 people; its capacity is 50,000. The Commission for New Towns is the authority set up to manage new cities after they are developed. The Commission is the grounds landlord, including landlord of the land on which factories and shops are built. An elected council does the governing.

The new city of Harlow (population 75,000) is another good example of what England has done. It was set up by a public corporation sponsored by the central government. The city is only 25 miles from London, is self-contained, has variety in housing, industry, and business. The turnover is only 5 percent a year—in contrast to the national average of 10 percent. Most people who leave go to other small cities, other new towns, or other countries. They do not move back to London.

The city has good age balance and has attracted light industry without noise, smoke, or other kinds of pollution. Farming is still going on in the open space; forestry is practiced in the woods. The city center, once planned for cars, became intolerable, and finally autos were banned there. Half of the building architecture was done by a government corporation; the other half by private architects.

The density of the city is 50 to 60 people per acre. Most backyards of homes are screened by brick walls and shrubbery. The buildings and homes are also largely brick. Trees, shrubs, and landscape plantings flourish; flowers are everywhere.

Thames-Mead is a development of low-rental housing in South London along the Thames River. The land area is 1,600 acres, of which 1,300 are available for buildings. The density plan is 100 persons per acre. The area has 3½ miles of low, part-marshy river front.

Development of three lakes of 30 acres each its planned. These lakes provide open space and receive surface drainage water, as the area is tidal and low. The housing development is being done by 35 percent private enterprise and 55 percent government.

When completed, Thames-Mead will house 60,000 people, "about the same number as America's single largest stateside project, New York's environmentally starved Co-op City." Thames-Mead is entirely government-sponsored, but 20 percent private participation is planned. Most noteworthy is the fact that this super community in London's suburbs is being put together by systems building—large concrete prefabricated slabs built on the site by a government client. It is the largest single systems building project in Western Europe. Only Russia has a larger one.

SWEDEN

No one who visits Sweden, especially Stockholm and its suburbs, can help but be impressed by the quality of planning and development going on in this modern nation. Sweden has a total land area of 173,665 square miles and has achieved an almost stabilized population of 8,000,000. There are no slums in Sweden; urban sprawl is unknown; poverty is absent. The country has no illiteracy and enjoys the highest health standards in the world and the highest living standards in Europe. Stockholm is a stunning, magical city of 1,300,000 and one of the finest capital cities in the world. Architects, planners and city officials from all over the globe come to see Sweden's environmental planning, its systems approach to development, and its architecture.

In Sweden the prime planning sources are the municipalities. They have powerful expropriation rights, including rights to acquire or take land before master planning is finished. Both the national government and the municipalities are committed to a national policy of quality livability, adequate housing for all, and controlled development that is in harmony with nature.

As an example of the farsightedness of the Swedes, the City of

Stockholm began buying land for possible new towns soon after the turn of the present century. Today such new towns as Vallingby Centre, Farsta, and Skarholmen are models of good planning. The first two are beautifully designed suburban centers outside of Stockholm, while Skarholmen is a commercial, social and cultural center in the southwestern part of Greater Stockholm. Vallingby was planned for 70,000 people on 10,000 square meters of land; Skarholmen will have at least 20,000 square meters and planned housing (of all types) for 300,000.

The most significant things that catch the eye in Sweden are the total environmental planning of towns and town centers, the hiding of ugly parking lots and utilities (underground), the emphasis on pedestrian rights-of-way, and the mediculous, almost fierce, worship of natural features. Heavy equipment around trees, shrubs and natural rocks is taboo. Native rocks, some very close to buildings, are guarded zealously. There is no scarring, no marring of trees, vegetation or water areas. Rocks that are blasted away are carefully cushioned and matted before explosive charges are detonated, and all blast marks are smoothed over by masons using hammer and chisel. The Swedes, clearly, design and build with nature appreciation in mind.

FINLAND

If Sweden's Stockholm and its satellite towns and suburban centers are a planner's delight, then Finland's Helsinki and its new towns are an architect's and planner's dream. And nowhere in Europe does a private venture in new town planning come closer to what is possible in America than Tapiola.

Tapiola is without doubt the best planned new town in Finland, if not in all of Europe. It is a small new town of 16,500 people, situated on 660 acres of lovely Finnish natural landscape. The density is only 25 persons per acre. Transportation to Helsinki is principally via expressway by modern bus. Here one sees a gracious blending of the countryside with development, the best seen anywhere in Europe.

The individual houses are state subsidized, as are the apartments. The quarters are very modern and spacious. There are individual houses, row houses, and apartment buildings, all built in appealing, innovative architectural style and oriented toward nature. The whole town is heated from a central heating plant by hot water. Dirt and litter are not evident. The children, who are required to spend four hours a day outside in organized recreation and day-care centers, look and are very healthy. Ducks and other wildlife take refuge in the ponds and pools of Tapiola center during the hunting season, and many forms stay around all year long. They are fed.

The most commonly seen trees are white birch, pine and spruce. Just a few big old trees remain. Most trees left are young or middle age. The average tree size is between six and nine inches d.b.h. No fences are allowed, and the feeling of openness and spaciousness is strong. One leaves Tapiola feeling that this is the kind of place in which he would like to live.

RUSSIA

There is a tendency on the part of American visitors to Russia to downgrade and even belittle what the Soviets have done and are doing. They see, for example, endless massive units of housing, great bleak stretches of open space, enormous boulevards, but few amenities. Yet, as we shall see, the Soviet Union is capable of doing some big things well. It would be a grave mistake to underrate the Russians' capacity for accomplishment or their systems approach to large-scale development and planning.

Environmental planning in Russia must be viewed against the background of its most notable effort—its massive attack on the housing problem. The Soviet approach to this dilemma, as Carl Koch points out, is easy to understand:

> It is based, we feel, on four essential ingredients: (1) the establishment of building and planning standards, applied nationally while being subject to regional and local modifications; (2) an extensive and open-ended program of research and development, aimed at studying standards and, most significantly, living or livability standards; (3) the mass production of standardized building system components under controlled conditions in prefabricating plants; and (4) the *guaranteed* and *continuing* high volume construction of standardized housing."

Let us see, then what this kind of approach to one problem has meant for Russia.

According to a United Nations report, the Soviet Union created more than 900 new towns between the years 1917 and 1965. Of these, 500 were created through the development and radical reconstruction of small settlements, and 400 were on completely new sites. Between 1939 and 1959 a total of 88 towns and urban-type villages were created annually; during the period 1958-1963, 98 towns and villages. An average of more than 20 new cities are erected annually.

As a result of this massive frontal attack on housing, planners in Moscow expect to see the nation's housing problem solved in four years—by 1974. One needs only to know what is happening in Greater Moscow to appreciate the size of the task that is being undertaken.

For example, in this city alone, 80,000 family units are being erected by mass production each year. Contrast this figure with a New York City super venture on Manhattan's lower tip in the Hudson River-to-Battery Park area which boasts of 15,000 family units in *twelve* years.

"Environmental planning is continually going on in Russia," said one spokesman, Sarge Korlikov of the Office of the Moscow Regional Plan, "and nowhere is it being more clearly demonstrated than right here in Moscow."

Moscow is a city of eight million; a total of thirteen million people live in Greater Moscow. A thoroughly modern city, it is a blend of old and new. It is shaped like a potato, with the Moscow River flowing through the center. The river is still polluted and silted, but pollution abatement measures are underway. For example, in the future Moscow's central core will have no heavy industry to pollute air and water. The industrial plants are being relocated in various regional suburban complexes. Moscow is bisected by an "X" system of wide thoroughfares and a marvelous system of subways, many lines of which are new, fast, quiet and incredibly clean.

Planning in Russia, according to chief planner Mikhail Posokhin, is three-pronged—city planning, greater metropolitan planning (which produced Moscow's regional plan), and nationwide planning. Moscow's population is deliberately being limited to seven or eight million. The excess population will be moved, largely by the factor of availability of jobs, to self-contained new cities in the suburbs and the hinterlands—cities with population densities of around 250,000.

Open space is planned into the character of Moscow, Posokhin says, with a star-shaped pattern of open space radiating outward just beyond the city's central core. There is full recognition of the importance of open space in providing cooling and air purification for central Moscow. Sewage, water systems, central heating plants (using hot water), transportation, businesses, parks, all are planned together when new towns or new suburban centers are built.

One leaves Russia with mixed feelings. While we may not like their political system, there is much that we can learn from the way they do things. Perhaps we can weave some of their better techniques into our free enterprise system and profit in the long run.

APPLICATION TO THE UNITED STATES

Several developments in environmental planning in Northern Europe and Russia appear relevant to the United States:

(1) Surely it is time to recognize that planning must be given a

stronger role at all government levels in the United States or our problems of environmental deterioration, particularly land misuse, will continue.

(2) Because our land resource is finite, the public must have a greater stake in our land base and in *all* land use changes. We need a new strong, national land policy to reflect America's new view of land.

(3) The European experience shows us that planned, orderly growth and development are possible without urban sprawl and land misuse, that new towns and cities can be totally planned *environmentally,* and be beautiful, and that government planning and the private sector can be brought together harmoniously for the enhancement of life.

There is evidence of the emergence of some good planning in America—in Toronto and Ottawa, Canada, in Reston, Virginia, and Columbia, Maryland. Also noteworthy is the planning of an "ecological park" for New York City's Welfare Island.

All these are good, but we need lots more.

DISCUSSION

VICE CHAIRMAN YANGGEN: Thank you very much, Dr. Shomon. We will take time for several questions or comments with regard to this fine discussion that has just been presented to you.

MR. DAVID BROWER (Friends of the Earth): This is a comment, if you will permit it.

We have been busy trying to get sister organizations set up in some of these other countries and in this effort I think I have observed that there is a waste going on that we may be losing.

We have the opportunity to import from Europe some very good examples of fine planning, where people have lived for a long, long time without disrupting their environment. However, we also have what is going on in the other direction. We are exporting a good many of the out-moded parts of the American dream that are now causing us so much trouble.

For example, in Stockholm, Sweden, where I was a month ago, they are ready to take apart some of the finest buildings along the main canal. They are cutting out the boats because they state that their population does not want to take old, slow boats. Further, the automobile traffic is so bad that you also do not want to walk the streets.

Now, in Paris, for instance, they have new towns there, but it seems to me that these are sort of sanitariums for overpopulation. They are not anything like what Paris is.

My point here is that I am afraid that we are exporting so much of an overmechanized society that Europe itself is losing very rapidly the very things that we would like to bring back here for ideas, including even the National Parks idea.

For example, Sweden is ready to put a dam in one of its greatest national parks. Further, in England, they are ready to mine in an open park—in other words, to put in a big open pit mine. There is really no park policy to preserve that.

My observation here would be that we need to mind our exports and we cannot, with outmoded American dreams, spoil the chance to keep living examples alive very long in the environment that Europe is becoming.

IN ACCORDANCE WITH A COMPREHENSIVE PLAN: THE ROLE OF UNITED STATES PLANNERS IN MANAGING LAND USE

PETER Q. ESCHWEILER, A.I.P.
Commissioner of Planning, Westchester County Department of Planning, White Plains, New York

A colleague passed me a note the other day at a particularly tedious meeting on which he had doodled the following question: "Isn't action without planning better than planning without action?" I was tempted to paraphrase that doodle into the title of my talk this afternoon: "Is conservation without planning better than planning without conservation?" I think that if I had been drawing up your conference program, I would not have titled this section as did your program chairman, "Controlling Land Use," because it has been my experience that control is only a very small part of the solution of our natural resources problem and is only the means to a more important end. I hope to explain more fully what I mean by explaining to you the techniques and experiences of the planning profession in controlling land use to reach an objective.

HAS LAND USE CONTROL BEEN OVERSOLD?

I am an urban land use planner, and I head the technical staff of a county planning agency in a suburban New York county. My graduate training was in the field of urban planning, and I have had eleven years experience working with local planning boards and county planning agencies in an effort to direct the course of future land use in those communties. I disagree with the program chairman not out of the perversity of the prophet three thousand miles from this own country, but because I find that "control" is a trap that the conservation-oriented fall into all too easily. "If only we could control the use of land, then we could prevent . . ." whatever is the current land-related ill. The means becomes the end. As I shall explain shortly, planners have found that control alone will not do the job, and that any control or other device to guide land use is of little value if it is not subordinate to an overall plan acting as a reference framework leading to the particular objective. Had your program chairman titled this afternoon's session "Promoting the Most Appropriate Use of Land," I would then have placed myself squarely on the side of the affirmative.

THE ROLES OF THE URBAN PLANNER

Planners today come in all shapes, sizes, flavors and prejudices. To some, a planner is merely a boy scout with a power complex, or a landscape architect with a whole community as his client. To others, he must be an economist, devoted to the promotion of land uses that will be fiscally beneficial to the community's tax base and property tax burden. An everbroadening area today is that of the social planner, who often foreswears the physical planning aspects and concentrates on determining the needs and oppressions of various subgroups of our society and acting as their advocate before those who hold the political power. In my own community, if I mention casually at a cocktail party that I am an urban planner, I immediately get pinned to the wall with a half-hour lecture on my audience's personal opinion of the planning process based on some astute zoning board's denial of his illegitimate variance request, or an ill-founded rumor of some superhighway deemed to be headed for our village. In its essence, however, planning, simply expressed, is the organization of policy, and includes all of the necessary preparatory work in order to advise the politically responsible authorities to take rational and consistent action on all major aspects of development.

One of the early leaders of the planning profession was Frederick Law Olmsted, Jr., son of the famous landscape architect, who became distinguished in his own right as a city planner. At the National Conference on City Planning in 1911, he gave perhaps my favorite description of what a city plan is:

> We must cultivate in our minds and in the mind of the people the conception of a city plan as a device or piece of . . . machinery for preparing, and keeping constantly up to date, the unified forecast and definition of all important changes, additions, and extensions of the physical equipment and arrangement of the city which a sound judgment holds likely to become desirable and practicable in the course of time, so as to avoid so far as possible both ignorantly wasteful action and ignorantly wasteful inaction in the control of the city's physical growth. It is a means by which those who become at any time responsible for decisions affecting the city's plan may be prevented from acting in ignorance of what their predecessors and their colleagues in other departments of city life have believed to be reasonable contingencies.[1]

[1] *Proceedings of the Third National Conference on City Planning*, Philadelphia, Pennsylvania, May 15-17, 1911 (Boston: 1911), pp. 12-13.

THE COMPREHENSIVE PLAN

The main point of that definition, and that which I wish to emphasize to you this afternoon, is the prime importance, in any program involving the appropriate use of land, of the comprehensive plan. In the sense that I will be using it today, this term should be taken to mean both geographical comprehensiveness and logical comprehensiveness—all-embracing. This may bespeak compromise, for you must make room in your plan for the other fellow's viewpoint, as well as your own.

How does an urban planner approach the preparation of a comprehensive land use plan? The general sequence is: the statement of objectives and the measurement of the status quo; the comparison of the two to determine gaps, shortages or needs; the application of a variety of standards to express the needs in measurable terms; the projection of needs and objectives throughout the time span of the planning period; determining the most appropriate means of accomplishing the objectives; and scheduling their accomplishment throughout the planning period on a basis of priority. Note that I have spoken generically of the process, and not listed the typical studies—population, economic base, circulation, water supply, physical characteristics, and the like—that are usually included in the municipal plan. I omit them because today my emphasis is on method and how our professions can utilize similar techniques to solve problems of our common concern. Under this approach the role of the planner is similar to that of the travel agent: Your client wishes to take a vacation and your job is to find out where he *thinks* he wants to go, where he *ought* to go, where he can *afford* to go—and then show him how to get there—in time.

GOALS AND THEIR USES

Every profession has its own jargon—highly descriptive (for the insider), constantly changing, and usually completely impenetrable. For example, the planner invariably speaks of goals *and* objectives, although my Funk and Wagnalls considers them as interchangeable. One of the most lucid and potentially helpful sets of definitions differentiates the following common terms: values, goals, objectives, policies, priorities, programs, and projects.

> A *value* is a very broad statement of a societal purpose or aim, quite often expressed by a single word or phrase. For example, basic values of American society, as promulgated in the preamble to the Constitution, include "justice," "domestic tranquility,"

"general welfare," and the like. Any number of others might be thought of in a more modern context, such as "freedom of choice," "mobility," "comfort and convenience," and so forth. The common characteristic of values is that they are end states toward which people strive, believing that progress toward these end states (even though they are perhaps never fully attainable) will have favorable impacts on society.

A *goal* is a somewhat more specific statement; it includes both a value and an action to be taken with respect to that value (e.g., "increase safety" or "decrease environmental pollution"). A goal indicates societal actions necessary to cause the desired evolution toward the "ideal" end states embodied in the society's values. Goals may be defined at several levels: societal (for example, "improve public health by reducing air pollution"); functional area ("improve public health by reducing air pollution caused by transportation"); or specific agency ("improve public health by reducing air pollution caused by motor vehicles"). A goal, like a value, is not necessarily completely attainable; total achievement may be a physical impossibility (e.g., "totally eliminate accidental death"), or, one goal may conflict with another (for example, the goal "minimize transportation pollution" could conflict with the goal "minimize transportation cost"). The inevitability of some goal-conflict requires that the society state its goals realistically and establish priorities to permit decision-makers to "trade off" achievement of conflicting goals in a rational manner.

An *objective* contains the value and action statements of a goal and adds a third element: a specific quantitative statement of the desired level of achievement of the goal and the time span within which it is to be achieved. For example, a transportation objective might be "reduce transportation air pollution by 50 percent within the next decade." The purpose of an objective from a governmental standpoint is to provide a target for program design. It is, therefore, important that objectives be realistic, that is, they should be attainable (at least in theory). Implicit in the statement of objectives are *a priori* decisions by the people, expressed through their elected leaders, as to acceptable levels of trade-off and compromise involved in attaining conflicting goals. Thus, priority statements are important in the formulation of both objectives and goals.

Essentially, a *policy* is simply a statement of the framework of freedoms and constraints within which the society (or its representative, the government agency) must operate in attempting

to achieve its goals. For example, a policy relating to the goal and objective statements above might be "increased operating costs of up to x percent can be incurred in achieving our desired 50 percent reduction in air pollution." Policy statements are essential for directing the design of program proposals, and conformance with policy is used as one of the tests for evaluating such proposals.

A *policy statement* quite often specifies directions to be taken (implicitly or explicitly setting priorities), but can be general enough to allow alternative objectives to be proposed and evaluated.

A *priority* is a rating or preference that indicates the *order* and/or the *degree* of attention given to problems of a society. Priorities are not fixed; they often change with circumstances over a period of time.

A *program* is a group of related actions ("projects") that operationally are directed toward the same goal and administratively are grouped together for purposes of organization and management.

A *project* is a specific action intended to make a contribution to the achievement of a stated objective. For example, "installation of smog-control equipment on all government owned vehicles" could be a project intended to contribute to the previously stated hypothetical objective of air pollution reduction.[2]

GUIDING URBAN DEVELOPMENT

You can now begin to see why I feel so strongly that the control of land use is only a part of the planning picture. One of the serious pitfalls for conservation groups is to seek to *over-control* the use of land. I'd like to call your attention to the words of a very wise planning professor of mine at Cornell, John Reps. Professor Reps once framed the acronym "ACID" (before that word had other social connotations) to explain the various phases that municipal guidance of land use has taken over the years. The word is made up of the initial letters of the four different types of activities that an inventive profession has used to shape urban development: *Advice, Controls, Inducements,* and *Development.* Their sequence is generally indicative of the order in which they have been employed to obtain greater public leverage in constructing urban patterns.[3]

[2]From: *Goals For Transportation in New York State,* Planning Division, N.Y.S. Department of Transportation, Albany, N. Y. Nov. 970, publication FRO70411, pp. 8-10.

[3]See: John W. Reps, Pomeroy Memorial Lecture: "Requiem for Zoning," in Planning 1964, Selected Papers from the ASPO National Planning Conference, Boston, Massachusetts, April 5-9, 1964 (Chicago: 1964) pp. 56-57.

The *advisory* role of municipal planning was typical of the civic arts and beauty commissions of the early 20th century. Their role was strictly advisory, they had no real powers, and in many cases, were not even an officially recognized branch of local government. By the development of exemplary plans of the beaux arts school generally patterned after the examples of the 1893 Chicago World's Fair, these groups sought to influence future development, principally of civic plazas and public buildings, with emphasis on very formal types of urban design. Advice, and the closely related techniques of persuasion and inspiration, still play important roles in guiding development. Indeed, at the metropolitan level, this is the chief technique on which we rely.

When municipal officals realized that advice alone was not sufficient to produce the type of urban environment desired by their citizens, the inventive planners of the United States developed several new concepts of *control*—our letter "C"—of private developments as a means of achieving civic goals. Out of this concept grew the widely recognized and practiced methods of land use control through zoning, the official map, the development plan, subdivision regulations and the like. In many areas of the country, particularly the rapidly growing suburban rings around urban city cores, control of private development for public purposes hit its highpoint in the decade 1955-65. When, in my area at least, virtually all of our suburban communities either adopted or strengthened their assortment of control powers.

But controls are basically negative instruments, written in commandment form: "Thou shalt not . . .". They can be used to prevent, but not to compel. Even though this form of guidance has probably been used in the production of more dollars-worth of investment than any of the other devices, they have still not achieved the type of development that many felt was needed. For example, our slums were still with us, the urban poor were becoming more and more concentrated, the replacement of obsolete housing and buildings was virtually nil in many areas, and the pace of private development was governed more by the areas of greatest return than by the areas of greatest need or public good.

The planning profession again came to the rescue, and we entered the period which saw the development of a wide variety of federal, state and local programs for the *inducement*—the letter "I" of appropriate development. Inducements took many forms, but were generally financial subsidies. These were either direct or indirect, as for example through the abatement or elimination of taxes, one of the major burdens of the rent roll. FHA, VA, Urban Renewal, FNMA—

at least 57 varieties of alphabet soup agencies became commonplace, as the public again tried to induce private development to accommodate the public good.

The final stage of planning power development, or at least the current one, sees the role of government change from advisor, controller, and inducer to that of the developer, the letter "D." Where the other techniques have not worked fully, government takes unto itself the powers of the *developer,* actually acting as the entrepreneur: obtaining and packaging the land (as in urban renewal), preparing the plans and, if necessary, acting as prime contractor. New York State has recently (1968) created a new state agency, the Urban Development Corporation, which combines in one agency powers never before so assembled: the powers of eminent domain, independent financing, exemption from local taxation and from local codes and ordinances, including zoning; reportable only to the governor of the state; and given a mandate for action anywhere in the state for the elimination of "blight."

You can see why I am hesitant to urge you as natural resource conservationists to accept the *control* of land use as even the prime means for the obtaining of your purposes. Planners, the inventors of land use controls, have found them lacking in many areas to achieve the desired objectives. Land use guidance systems are continually evolving, and I would hate to see you get hung up on one that may not be the best choice within our existing system.

PLANNING IN THE PRIVATE ENTERPRISE SYSTEM

As Dr. Shomon has pointed out,[4] American land use planning leaves much to be desired when compared with the work of our European counterparts. One of our problems is that we are dealing with an extensive system of private ownership of land, and a tradition of government—federal, state, county and municipal—that with rare exceptions have been founded on the tradition that a man's home is indeed his castle, and that the municipality has precious little right to interfere with his use and enjoyment therein. Coupled with this is the concept that virtually all of our urban development facilities, other than those uses that are patently public, such as courts, firehouses, schools and governmental office buildings, must be provided through the private enterprise process.

The private developer is counted on, therefore, to provide us with most of our housing, utilities, transportation systems, communica-

[4]Joseph J. Shomon: "Environmental Land Use Planning in Europe and Russia," 36th North American Wildlife and Natural Resources Conference, Portland, Oregon, 1971.

tions, recreation, and other facilities, all at some degree of profit to himself for his entrepreneurial efforts. Since he is motivated by profit, he often seeks to maximize that profit, and in the eyes of many, the developer left to his own devices will maximize his gain at the expense of the community. The basic land use control procedures, therefore, are based upon a negative approach, which as Professor Reps has pointed out, can limit but not compel. The basis for municipal control over land use and the land development process rests in the basic police power of municipal government, the right of a government to control the public and private acts of its citizens in the interest of the public health, safety, morals, and general welfare.

PLANNING AND THE POLICE POWER

The municipal use of the police power is further constrained by the United States Constitution and those of our fifty states, particularly the due process and equal protection clauses of the 14th Amendment. If, as my cocktail party opponent claims, one intends to challenge the constitutionality of zoning action "all the way to the Supreme Court," the legal test will be of one or more of these three elements: First, was the ordinance so restrictive as to deprive the individual of his property without due compensation—the eminent domain clause; or second, was the application of the ordinance such as to deny the individual due process, that is, a legal procedure that is fair, reasonable, and in conformity to recognized standards of justice, or third, was the individual denied his right of equal protection of the laws because the zoning ordinance discriminated against him through an unequal application of the law?

One of my more conservative associates defined police power rather broadly as "the right under law to use my equity for your purposes." And with the background that I have drawn here, I think you can see that this is not far from the target. The municipal government is using these powers to control the actions of private developers in the urban market place to shape their entrepreneurial efforts in such a way as to permit them to develop only in accordance with land use patterns and designs which the community holds to be acceptable. These land use controls then are used to implement the community's policy, which you will recognize as being a synonym for the community's land use plan.

PLAN IMPEMENTATION DEVICES

Let us assume that after determining your objectives, measuring your needs and laying out your plan, you do determine that the police power approach is the correct one. What tools are at your disposal?

There are a variety of classic implementing devices based on the police power. The first and most obvious is the zoning ordinance, but others with which you should be familiar are subdivision regulations, the official map, site plan review and the urban renewal process. Most of these are negative devices—"thou shalt not"—and with the exception of urban renewal, all that can be said is that they do not make things happen, but simply allow things to happen. A good test of this is the statement that was taught me at an early stage by my first planning boss: "If zoning could make things happen, we could all zone for oil wells and retire"!

THE ZONING ORDINANCE

The zoning ordinance is the legal instrument used by a community to divide the land of the municipality into geographically defined districts and to control the use, bulk, and intensity of land use in those districts. It is not the plan, which has to do with the overall design of the community, but is rather a plan-implementing device controlling the physical arrangement and size of individual buildings and other structures placed upon the land. Typically, the community is divided into two or more districts, which vary one from the other on the basis of the type of use permitted, the arrangement of the buildings on the property, in terms of lot size, frontage, yards, setbacks, distances between buildings and the like, and the height and other dimensions of the building in relation to the size of the lot on which it is located. Two of the tests of a legal zoning ordinance is that it must serve legitimate purposes and must permit some reasonable and economic use of land by the property owner; to be denied all economic use would deprive him of the use and enjoyment of his property without due compensation, as I have mentioned above. You may frequently hear the cliche "highest and best use," but this is a concept based primarily on economic rate of return, and has little place in the implementation of a comprehensive development program in any municipality.

Early zoning provisions had little regard for conservation of land and natural resources. The standards were people-oriented, drawn to assure the adequate circulation of light and air into buildings, to lessen congestion in the streets, to secure safety from fire and flood, and to provide for an appropriate density of population, but little thought was given to the use of zoning as a device for preserving exceptional areas of natural beauty or ecological importance, or as a shaping device for urban form, the visual and subjective contrast between uses and between geographic areas. More modern zoning

standards, generally those written in the last ten years, are being used to permit such popular open-space-preserving developments as cluster subdivisions or planned unit developments, but I can think of only a rare instance in which a zoning ordinance has been used to limit land for use as a "park." A park is basically a public use, and we are dealing with the regulation of private land. To place a land in a park zone would be clearly to deprive the owner of his land for a public purpose without due compensation.

THE DRAWBACKS TO ZONING

One of the unfortunate aspects of zoning is that it uses a series of *minimum* standards, and therefore allows a *minimum* community to be created. Because of the equal protection requirement of most state enabling statutes, and the United States Constitution, zoning standards must be equally applicable to all properties in the same zoning district. This means that the minimum standards become lowest common denominators.

Few are the communities that have not found the need to make exceptions to the general rules of broad-brush zoning. Because exceptions must be made, zoning ordinances provide for a variance procedure, a zoning board of appeals is created to act in a quasi-judicial role, and is authorized to grant relief to those who would suffer from the strict application of the ordinance's requirements. The test which the zoning board is usually asked to apply is "Would the application of the strict letter of the ordinance cause the property owner unusual hardship or practical difficulty?" If the appellant can show that he does suffer from one or both of these characteristics, or is otherwise legally deprived of the enjoyment of his land, the board can exempt his property from the letter of the law and permit him a use or a dimensional exemption which he would not otherwise be allowed.

Unfortunately, many boards of appeal see themselves in the role of the International Red Cross, making it their prime purpose to grant relief to anyone coming before them, whether his hardship be legitimate or illusory. This has the effect of weakening the validity of the plan which the ordinance was intended to implement. A zoning board must remember that it is a board of *relief*, and not a board of *privilege*. It has a responsibility to see that the landowner is restored to the same level of enjoyment of the use of his property as that accorded his neighbors who do not suffer the hardship. The landowner seeking a variance should not be allowed to use his land or to build in a manner denied to them if that grants to him a privilege denied to them. Above all, the hardship must be one that runs with the land, and not be simply a personal inconvenience to the land owner.

SUBDIVISION APPROVAL

Zoning controls the use of land and the intensity of use upon the land. Municipal planning boards in most states have another device which they can use to control and implement the design aspects of their land use plan. This is the procedure of subdivision review: The property owner who proposes to divide his land into separate lots for individual buildings is required to apply for and obtain the approval of the local planning board before he is allowed to sell or develop any of the land. This approval is based on the layout of his subdivision as shown on a subdivision plat, and on the design of physical improvements shown in detail on the accompanying construction plans. He is usually required as a condition of approval to install these improvements shown on the construction plans, such as roads, sewers, water supply, and so on before any of his purchasers will be allowed to move in. The planning board's procedure is usually stated in a series of subdivision regulations, adopted by the board and describing as well the design criteria for the improvements to be installed.

Whereas the zoning ordinance describes the minimum size of lot for each use, and probably gives basic minimum dimensions, such as 100′ width or 200′ depth, subdivision regulations will describe the design details of the neighborhood. This may include how those lot lines must be perpendicular to street lines, how intercepting streets must meet at right angles, the maximum and minimum grades of new streets for safe vehicular use and for adequate drainage, the location of utility lines within the subdivision, and the placement of such amenities as street trees, street lights, road signs, sidewalks, and the like. In many jurisdictions the planning board is entitled to require the developer to set aside a certain proportion of the land in his subdivision for park or recreation purposes. Enabling statutes vary as to whether the developer can be required to turn over that land to the municipality, but this is frequently the case, since the developer usually does not want to retain any continuing interest in his land.

In some states, New York for example, a dictum has been established which permits the planning board to waive the actual reservation of land for recreation purposes and to require instead that the developer make a contribution of money to the municipality in lieu of such reservation. These funds are to be used by the municipality for the acquisition of recreation land outside the subdivision but available to its residents. Land reservation standards usually vary by density of the zoing district in which the subdivision is located, and are usually related to some standard of acres-per-family of recreation land desired by the community, such as three acres per 100 families.

The fee required in lieu of such recreation land usually bears some relationship to the market value of the equivalent acreage in that particular subdivision. In Westchester, at least one of our communities is now requiring a recreation fee of $500 per lot in new subdivisions for use for this purpose. This park land reservation clause can give conservationists an opportunity to preserve at least some of the ecologically important land in new subdivisions, and the money in lieu of land procedure can be used to acquire conservation land elsewhere in the community, as long as it is available to the residents of the subdivision that provided the funds.

SITE PLAN REVIEW

Subdivision regulations apply, by definition, only in those cases where the land is being divided into separate lots. Exempted from subdivision regulations therefore would be major apartment or condominium projects, where the land is either to be rented or preserved in an undistributed manner. In these cases, planning boards can utilize another police power technique, site plan review. This is a procedure directly comparable to subdivision approval, and is usually made a mandatory step before a building permit can be issued for the permitted use. The developer is required to show much the same sort of information as is required in a subdivision procedure, and compliance with the approved site plan is made a condition of building permit issuance.

THE OFFICIAL MAP

The official map is a device that is not well understood in most jurisdictions and is usually used sparingly. It is a means by which a municipality may take formal action to reserve the rights-of-way for municipal improvements even though no construction or acquisition is anticipated for some time. The power is gradually increasing in scope, for in some jurisdictions, not only may new streets be shown, but also the rights-of-way for other municipal facilities, drainage lines, or in some cases, future recreational areas. With regard to the opening of new streets, the enabling statutes usually provide that no building permit may be issued for a building which would be located in the bed of a mapped street. This will prevent blocking of an ultimate street extension by the inadvertant placement of a building on unsubdivided land.

As part of the checks and balances, the statutes usually provide that an aggrieved property owner may seek relief from the board of appeals if the application of the official map principle would deprive him of the reasonable use and enjoyment of his land. The statutes

often contain horatory language that the relief granted by the board should be the minimum necessary to reserve and permit the future extension of the street. In New York State, the state enabling statute permits the official map to be used to show future recreation areas, but curiously, the building permit exclusion clause is not extended to protect these uses as well. As a result, this recreation feature is relatively infrequently used, and most planning boards regard as adequate the indication of future parks and open space areas on the minicipal development plan alone.

URBAN RENEWAL

Urban renewal is the popular name for the device by which government can intervene in the market place for urban land in the interest of implementing the plan, especially where the plan calls for the promotion of new development to replace unattractive, uneconomic, blighted areas. It is used usually in those cases where there is so small a difference between the cost of land even with its blighted development and the land once cleared of blight that private enterprise cannot afford to acquire and redevelop it at private expense. It may also be that the land cannot be privately acquired for redevelopment because there is no willing buyer-willing seller relationship—the hold-out property owner. Any government with the power of eminent domain must use that power only for a public purpose, and generally speaking, public use is a public purpose. It would be an illegal use of the eminent domain power for a municipal government to acquire the private land of that hold-out owner and then to resell it to the frustrated buyer, since that would have involved the use of governmental power as muscle to deprive the seller of his property.

In the urban renewal process, a state enabling statute is necessary to make that type of acquisition (either by purchase or condemnation) and resale of legitimate use of municipal authority. Once given this power, the municipality can acquire the blighted land, clear it, install necessary public improvements and then re-sell it for private development. That new development is usually limited to uses of a type and even a design found acceptable to the municipal government. The municipality may wish to keep the land and use it for some municipal purpose, but this was within its basic eminent domain authority to begin with. Similarly, public development of the land would probably mean that the land did not go back onto the tax rolls.

The financial inducement to private, tax-paying development is that land becomes available that may not otherwise have been obtainable. The municipality may wish, as an inducement, to sell the

cleared, improved land at a price lower than its municipal investment. This becomes legal under the urban renewal procedure. As an incentive, the Federal Government has a program of underwriting a major share of the cost differential or write-down cost. In return for this financial involvement, the Federal Government requires that its procedures and particular brand of red tape be used. Despite popular misconception, however, the urban renewal process is basically a state and local power, not a federal power.

These basic land-use control powers constitute the arsenal of weapons available to the urban planner. I hope I have made clear their inherent limitations and the fact that in the case of negative powers, they can limit and prevent, but not compel. When these powers are invoked and used, they must be used as a means, and not as an end. The end should be the implementation and achievement of the comprehensive plan.

This is the basis of my concern for the overall condition of land-use controls as a means of obtaining conservation objectives. In our area, at least, the popularization of ecology has resulted in a rash of project-oriented ordinances to prevent such activities as wetlands draining, soil erosion, topsoil stripping, tree cutting, and the like. Of course I am not advocating that such practices not be limited. What does disturb me is that the groups that promote these controls do so without the benefit of a positive program as a framework. They make no differentiation between the beneficial activity and the nuisance or abuse. They make the adoption of their "anti" ordinances a vote of confidence in ecology, so few politicians can refuse. On the other hand, the legal and administrative procedures they set up for the control and enforcement of the program—and for the exemption of the innocuous—can put the cumbersome subdivision review and urban renewal processes to shame. The local supporters of these projects become obsessed with the power at their disposal, so that when they should be working toward the foundation of conservation objectives and positive programs, they are out in the afternoon sun chasing the sound of chain saws with warrants in hand.

THE ROLE OF THE CONSERVATION ADVISORY COUNCIL

How can conservation interests at the local level be most effectively channelled into positive programs for the most appropriate use of land? One approach that is gaining tremendous support in our area is the municipal conservation advisory council.

The New York State legislature has authorized the establishment of municipal conservation advisory councils throughout the state. These

councils are patterned after those established elsewhere in the northeastern United States and provide for the appointment by the local legislature of not less than five nor more than nine members, each for three year terms, to a council which shall have the following powers:

—To advise in the promotion and development (note those positive words) of the municipality's natural resources.
—To conduct researches into the land area of the municipality.
—To seek to coordinate activities of unofficial bodies organized for similar purposes.
—To have the authority to advertise, prepare, print and distribute such maps, books, charts, plans, and pamphlets which it deems necessary for its work.
—To keep an index of all open areas in the municipality for the purpose of obtaining information pertinent to the proper utilization of such open areas.
—To keep an index of all open marsh lands, swamps, and all other wetlands in a similar manner.
—The council may recommend to the municipal legislative body a program for the promotion, development, and utilization of all such areas, and with the approval of that board, the council may recommend this program to the State Conservation Department.

When this legislation was passed there was immediate concern that this agency would be just another municipal headache. It would indeed be a needless extravagence of time, energy and money to create another municipal agency unless there was a job for the agency that needed doing, and if that job was not already being performed by another agency, or could not be performed as well or better by some other existing board. At first examination, it would appear that many of a conservation council's responsibilities are so similar to those of a local planning board as to represent needless duplication of activity by an agency with overlapping responsibility. Based on my experience in local planning and my involvement in conservation activities, I sought to make a comparison of the advisory council to the local planning board.

Although the methods of the two agencies may be similar, there can be a substantial difference between the two in their motivation, interest, and expertise. Generally speaking, the advisory council will be interested primarily in a much narrower spectrum of municipal development than is the planning board. But this range of interest can be of substantial benefit to the planning board if properly directed and properly received. To a large extent, this will be dependent on the staffing of the two agencies, the extent of communi-

cation between them, the willingness of each to accept the contributions of the other and the careful definition, by the legislative body, of the charge, or area of responsibility, to each agency.

Another basic difference between the local planning board and the advisory council is that the planning board has a specified administrative jurisdiction over certain matters, e.g. subdivision plat approval, official map changes, master plan preparation, etc. The role of the advisory council is not nearly so strong, in terms of its authority to act; its purpose is primarily one of education and coordination, it makes few administrative decisions, and it is almost totally powerless to enforce those determinations that it does make. The greatest danger to the work of the advisory council is that it will be ignored, and its greatest need, therefore, is for effective channels of communication.

One way of emphasizing the need for effective communication—although not necessarily insuring it—is in the selection of the membership of the advisory council. The membership should be so structured by the legislative body as to have representation from, and liaison with, those local agencies concerned with planning, with parks, and with recreation, for example. A member of the legislative body should be designated as an ex-officio member, to assure a continual relationship with the legislative body. The citizen members of the advisory council should represent broad range of people concerned with a variety of aspects of conservation. Nor should the membership be limited to "slam-the-door" conservation types; it is very important to note that the enabling statutes provide that the council is to concern itself with the *promotion* and *development* of the community's natural resources, rather than merely hiding them in an open-space land bank. It would be short-sighted indeed for a community rich in gravel deposits, for example, to deny totally the right to mine those deposits (as some of our anti-excavation ordinances do) if, on balance, the municipal economy and long-range interests would better benefit from their commercial use. The role of the advisory council, under those circumstances, should be to promote adequate control over the commercial development of the natural resources to assure that the end product is of benefit to the municipality: a rehabilitated gravel pit, a reclaimed quarry, a newly established recreation and wildlife pond, etc.

Another important difference between the conservation advisory council and the local planning board is in the motivation of its membership. The advisory council, relatively unrestricted by statutory caveats and limitations, can be expected to have a more sympathetic ear for the expression of public sentiment. It will (and should) become the municipal agency to which residents will turn with their

frustrations in matters of local conservation. The agency's job is to listen, to evaluate, and to recommend an appropriate course of action. Since it is almost totally without power to enforce, it will be difficult for the well-run council to become too far separated from apple pie, motherhood, and the American flag. Accordingly, the membership of the council must recognize from the beginning that they were not appointed to take over any other agency's function, but to supplement the action of other municipal bodies. The advisory council suggests and recommends; the execution of its suggestions is left, under the enabling statutes, to others.

On the basis of this investigation, we can conclude that the conservation advisory council can play a needed and significant role in the operations of the community. While the council's operations should be of great interest and assistance to the local planning board, the existence of the council should not be viewed as a threat to the competence, authority, and responsibility of the local planning board. The planning board is all too often already overburdened with other administrative responsibilities to be able to devote too much attention to matters of conservation. If properly coordinated by a strong and willing legislative board, each agency can complement the talents and interests of the other, to the overall benefit of the community.

Is conservation without planning better than planning with conservation? It's probably a standoff. I urge the conservation groups to pool their resources with those of their counterpart planning groups along lines similar to those I have outlined. Leave the traditional land use controls where they can be most effectively administered, and adopt an approach that "Working together, we can do it better."

DISCUSSION

VICE CHAIRMAN YANGGEN: I have a question, Mr. Eschweiler. How do you establish plans to protect the natural resources base and does it meet the acid test?

MR. ESCHWEILER: That is an excellent question.

Let me say first and foremost that I work for a rather conservative administration, which feels that the best way to govern is to apply the least possible amount of governmental authority to the particular problem. However, in terms of the several major ways of open-space preservation in Westchester County, the county park system is an example. In a county of over 450 square miles we have over 14,000 acres in county-owned public park land. We are budgeting about a million dollars a year for additional park-land acquisition for county purposes. We are coordinating our county park acquisition program with the programs of the local conservation agencies and the countywide public federated conservationist groups, also with the soil and water conservation districts.

Also, because of the availability of the county planning department and because of one of the other hats I wear as county planning director or secretary to the County Soil and Water Conservation District, I am sure there is some degree of coordination in that area.

MR. JOHN OLLER (Pittsburgh, Pennsylvania): Mr. Eschweiler, we are very much interested in this concept of local conservation commissions and councils and I

wonder if you would comment on the role of state enabling legislation to help implement and, secondly, whether they are useful as far down as the lowest political subdivision or should be looked upon as a sort of a county conservation council.

MR. ESCHWEILER: The role of the state enabling legislation, I think, is important to the extent that it will allow the community to appropriate money and also plans the operation of these groups. I don't know about the Pennsylvania law but I would guess that in circumstances similar to ours, the local community can create these councils whether they have specific enabling statutes or not. They play basically an advisory and investigational role.

There are a few clauses in our own enabling statutes which I did not read to you, which indicate, for example, that the communities may appropriate money for the expenses of the commission, although they are not salaried—in other words, the representatives of the commission are not salaried.

With respect to the second part of your question—at what level of government can commissions be most effective—I would relate it to the level at which the type of land-use control that you wish to influence is being administered. If your zoning control or the other controls at the county level are in force, then the local advisory board may just make noise and advise but cannot really get their plans and programs implemented. On the other hand, in Westchester, where we do not have zoning at the county level or indirect control of land use at the county level, this agency is more attractive. There has also been parallel legislation passed in New York which permits creation of county-level resource management councils on which each of the local planning conservation councils can have a representative The role at the county level in this case is so similar to that already being performed by a number of other county agencies that we in Westchester have not yet established such a council and I don't know that we will. However, we have used this as the opportunity to open doors through our private conservation group, the Federated Conservationists of Westchester, to see if we can establish better means of communication at this level.

It is not our purpose and I would not recommend that the counties establish another county-level agency, simple because the law permits us to do so. In our case it would overlap too many existing functions.

CHAIRMAN SCHULMAN: I want to interrupt this program in part now, first of all, to tell you a bit as to what we are trying to do. And to set our sights at a level of impact of things that can be done and things that have been done, rightly or wrongly.

Now, Mr. Eschweiler has been very useful, educationally, at least to some of you, with repect to what American planners are doing. And from this point of view, over the years, what do you do with ecologists and how do you work with them and, further, can they do anything except write good magazine articles?

Now, our next speaker is Lawrence Hamilton, professor of conservation at Cornell University. And, in a sense, he is going to answer Mr. Eschweiler in relation to how we can work with each other and give some "for instances" on the practicalities of ecology and conservation.

ECOLOGICAL RELATIONSHIPS AND THE LAND USE PLANNING PROCESS IN A WATERSHED

LAWRENCE S. HAMILTON
Cornell University, Fernow Hall, Ithaca, New York

For many years, natural scientists and conservationists have been calling for more ecological sensitivity and input into the planning process (Hamilton, 1963). Too often, and for far too long, land-use decisions have been made by engineers, real estate or other business interests, politicians, lawyers and others with no understanding of ecological relationships and the "living landscape." Even the professional planners have been woefully slow in recognizing that there are such things as natural determinants of land use. We have consequently reaped a harvest of headaches, pocketbook pain, visual violence and sometimes even catastrophe. One need only think of housing developments on unstable slopes, high value real estate on flood plains, the filling of wetlands for roads and unnecessary use of prime agricultural lands when other sites for urban development or highways were available to recognize that we have made and are making serious blunders in our land-use changes.

Fortunately, progress is being made in one facet of ecological land use planning. Thanks to persons like Bartelli (1962), the Soil Conservation Service now has a strong program of promoting the use of the Soil Survey in making interpretations for various kinds of land uses. Angus Hills (1961) too has developed a formal method of land analysis which then classifies a given location as to its potential for various kinds of uses. McHarg (1969) with his system of landscape analysis and map overlays has also made an outstanding contribution to ecological land-use planning. These three pioneers and others too, have worked from the valid premise that each portion of the landscape coming under planning scrutiny has certain physical, biological, (and in McHarg's case) socioeconomic characteristics or properties which indicate how the land might best be used. They are therefore most applicable in the physical location process in planning. I have recently been involved in a study by one of my graduate students in which by synthesizing the approaches of the three pioneers just named, he (Lacate) has developed a method of highway route location based on resource analysis and landscape ecology (Lacate, 1970). This study has already shown results in connection with the location of a limited access highway in the area of Ithaca, New York.

Progress is being made in this aspect of getting ecological input

into planning and land use. Particularly is this true in the area of making interpretations of the capability of given soil units to accommodate certain uses ranging from campgrounds to pheasant populations, to unsewered housing developments. Thus it is delightful to find that on occasion ecologists are being called to the planning table to give advice on the question: "Where, in the area under planning scrutiny, shall we locate a peanut butter factory?" Or, conversely what is often more relevant "What locations in the area under planning scrutiny should be avoided in locating a peanut butter factory?" We need more of these invitations to the planning table and should press to have the natural determinants of land use given a hearing.

Yes, progress is being made, but another major, probably more important question is the following: "Given that the area under planning scrutiny is a complex web of relationships—an ecosystem—what will be the *effects* of locating a peanut butter factor there?" We are attempting to shed light on this kind of question in a multidisciplinary seminal at Cornell University. We have developed a new approach which we hope may find wide application.

The ecosystem under our scrutiny is the Owasco Lake Basin, a 205-square-mile watershed of one of the smaller Finger Lakes of Central New York. The city of Auburn is located at the north end of the lake and marks the terminus of the basin. The rest of the basin is rural in character: 34 percent forested, 48 percent in active agriculture and 15 percent in brushland or retired farmland. There are two principal villages, one at the south end of the lake and one in the headwaters. The lake is roughly 11 miles long and averages about 1 mile wide. It is the source of water for the City of Auburn, and more water is needed for water supply and low-flow augmentation. Competition for water use and for lake shore access is intensifying. Rural land uses are swiftly changing. It is hoped that the study will be a prototype for other lake basins of similar general character.

Planners from the New York State Office of Planning Coordination and the Cayuga County Planning Commission met with the graduate students in seminar sessions. They were essentially saying: "For years you ecologists have been screaming about ecological interrelationships, now put up or shut up,—give us something on the ecosystem impacts of various land-use alternatives as a basis for planning or controlling land use." Only a multi-disciplinary group can do this kind of a job, and in our seminar we had mature graduate students with expertise in the following areas: forestry, wildlife, law, economics, city and regional planning, agronomy, soil science, geology, civil engineering, aquatic biology, public administration, agricultural engi-

neering, outdoor recreation, biology teaching, entomology and conservation education.

The planners' challenge was accepted. We looked at the Owasco Basin as an ecosystem and attempted to find out what important processes (energy flows if you like) were going on. From on-the-ground visits, air flights over the area, meetings with knowledgeable persons in the watershed such as the County Extension Agent, use of air photos, maps, planning studies and reports from various resource management agencies, we identified 57 key "processes" which we felt characterized the system. These came from physical, biological, resource use (market) and political-socio-economic sectors, as shown in Table 1.

TABLE 1. IMPORTANT PROCESSES IDENTIFIED IN OWASCO LAKE BASIN SYSTEM

A. *"Physical" Processes or Variables*
1. Erosion
2. Deposition
3. Eutrophication
4. Water flow through basin

B. *Biological Processes or Variables*
5. Natural forest growth
6. Planted forest growth
7. Wildland
8. Grassland pasture
9. Cultivated cropland
10. Aquatic plant growth
11. Fisheries
12. Waterfowl and aquatic mammal populations
13. Wildlife of forest and field

C. *Resource Use Processes or Activities*
14. Cash crop agriculture
15. Livestock production
16. Forest production
17. Mining activity
18. Construction and maintenance of transportation and service facilities
19. Water supply-surface water utilization
20. Water control activities
21. Groundwater utilization
22. Waste disposal to water
23. Waste disposal to land
24. Waste disposal to air
25. Insecticide application
26. Herbicide application
27. Fertilizer application
28. Land reclamation for development
29. Establishment of public and related institutions
30. Preservation of natural, historic areas
31. Fishing
32. Boating
33. Swimming
34. Shorefront institutional camps
35. Snowmobiling
36. Skiing
37. Hunting
38. Game activities in developed areas
39. Camping, picnicing, biking
40. Viewing for pleasure
41. Cottage shorefront development
42. High rise lakeshore development
43. Single upland homes
44. High density housing
45. Commercial developments—visitor service
46. Industrial development
47. Power generation
48. Outdoor advertising
49. Sewer and water extensions along lake

D. *Political-Social-Economic Variables*
50. Regulations of health and safety
51. Regulation of land use
52. Public access to water and land
53. Employment in the watershed
54. Regional income
55. Ugly environment
56. Interest group activity
57. Land value and tax base

The next task of the seminar was to define each of these processes or variables—no easy task—so that every member of the group knew precisely what was meant by the process name. Individual students were assigned two or more processes or activities depending on their expertise or interest. Narrative papers were prepared giving the present status of each particular activity in the basin. For a process such as mining, an accurate inventory of number of active operations, type and area can be obtained from air photos and trends over time noted from previous and present photo coverage. Interviews with

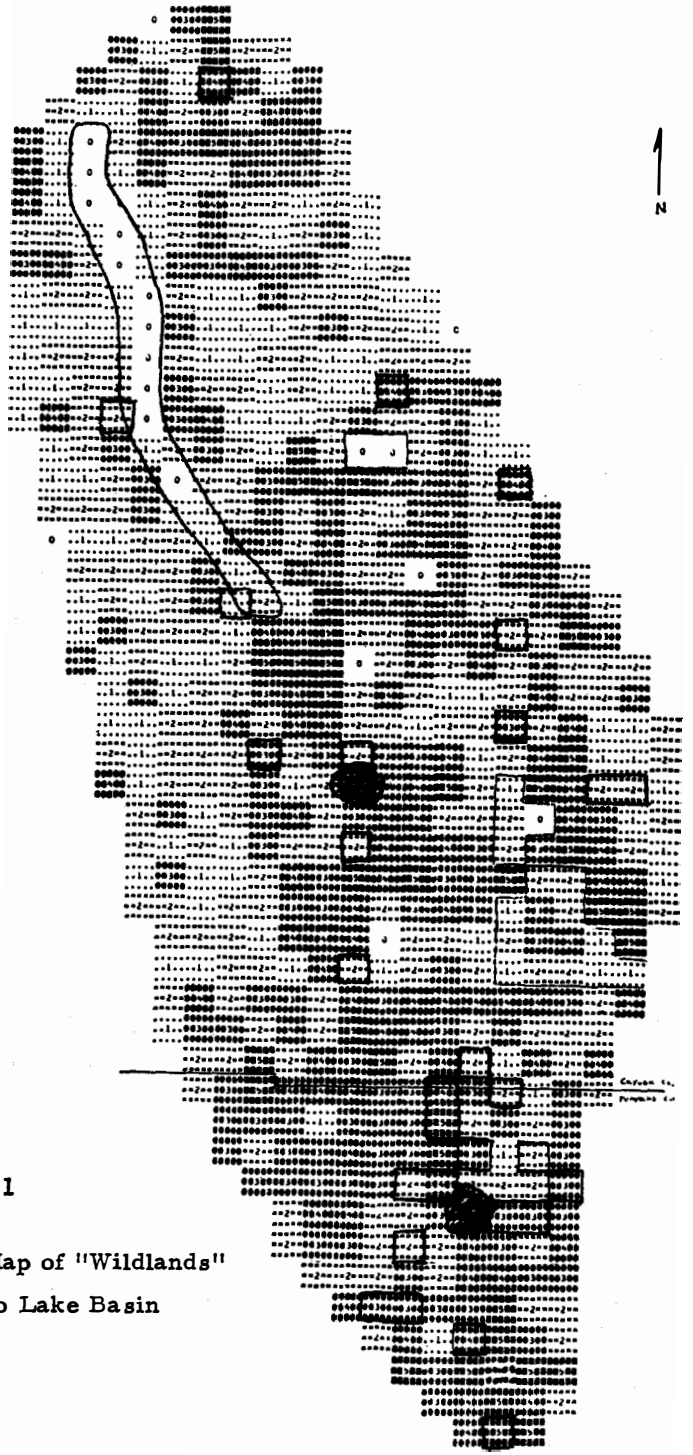


Figure 1

Computer Map of "Wildlands"
in Owasco Lake Basin

Figure 1

managers of active operations, plus statistics in industrial planning studies can yield quantitative data. For a process such as snowmobiling, only approximate estimates of the extent of this activity are available from windshield surveys and recent winter air photos. For some processes accurate data were available from the Cornell Land Use and Natural Resources Inventory (LUNR) and the information available as computer print out maps (PLANMAP). (Swanson, 1969) (Figure 1).

The audacious question was then asked for each process: "What would be the effect on the other 56 processes if this one were to increase through natural circumstances or through a planned change?" The seminar member, using his narrative, literature reviews, advice from experts in various areas at Cornell and his best judgement, indicated the direction of change in each of the other processes by a statement, then symbolized it by an algebraic sign: plus, minus, zero, or plus and minus for a countervailing effect.

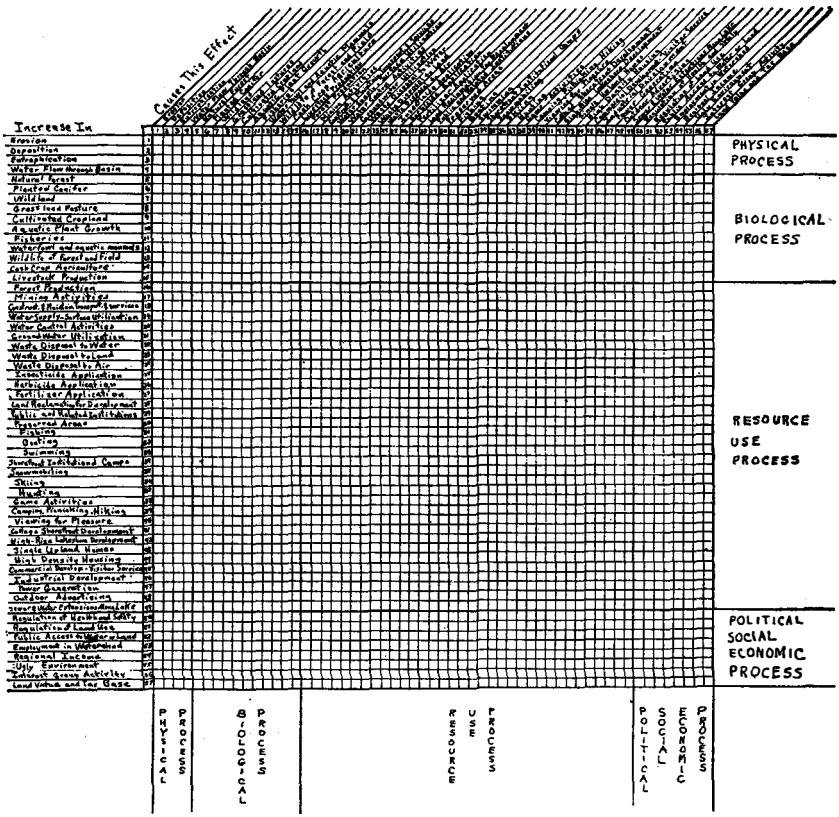
To make these impacts visible, as a system, they were presented in a two way matrix table (Figure 2).[1] When the matrix is filled in, reading across the horizontal row shows the effect on the other 56 processes. For instance it is suggested that an increase in pesticide use would increase agricultural production (+), decrease the fishery (—) and not affect skiing (0). The judgment of what effect might occur was brought in this manner before the jury of the whole seminar group of experts, defended, and revised where necessary. A randomly selected portion of the matrix as filled out is enlarged and shown as Figure 3. If the person reviewing the matrix finds it puzzling that an increase in natural forest (5) has no effect on erosion (1), he must consult the narrative.

No value judgment was made as to whether an increase was "good" or bad—only the direction or change was suggested. The people of the Basin and their planning bodies are given the task of deciding whether or not the changes are desirable and then the option of changing the direction of the causative factor. We have attempted in this manner to keep any bias out of the picture, and to simply indicate the amoral effect on the ecosystem from an increase in any one variable.

Moreover, if planners or the citizens of the area decide that an increase in some process or variable for instance, "the ugly environment" is considered undesirable, by looking down the vertical column

[1]The concept of a visual presentation of process interrelations in a matrix form is attributed to Dr. Arthur Sullivan whose ecosystem approach to planning was developed in a Cornell Ph.D. thesis "Toward a General System Theory of Estuarine Area Resource Mangament" Sept. 1969.

Figure 2 MATRIX OF RELATIONS BETWEEN IMPORTANT PROCESSES IN OWASCO LAKE BASIN ECOSYSTEM



55, the plus signs will indicate all of the processes contributing to an uglier environment.

We are continuing to refine this approach, which really is a very simple thing. As we push more deeply into refinement we get increasing complexity. Our greatest lack is quantitative, hard data which would enable us to say: "If we increased process X by Y amount, what would be the direction change in the other variables and *how much?*" Can we go to + + or even + + + if magnitude classes can be recognized even if specific numbers are not? Then we may move to a three dimensional matrix or to the computer. There is also a

problem of threshold effect. Certainly an increase in fishing will increase the amount of erosion even if only from increased traffic of fishermen on stream banks, but is it significant enough to include when our object is to give important information for planning land use? We are now proposing to include special designation for those changes which are irreversible and those which can be reversed at the

FIGURE 3

OWASCO LAKE BASIN SYSTEM

Increase in	Causes This Effect	Erosion	Deposition	Eutrophication	Aquatic Plant Growth	Wildlife of Forest & Field	Water Control Activities	Waste Disposal to Water	Waste Disposal to Land	Fertilizer Application	Fishing	Hunting	Viewing for Pleasure	Ugly Environment	Land Value & Tax Base	
		1	2	3	10	13	20	22	23	27	31	37	40	55	57	
Erosion	1		+	+	±	0	+	0	0	0	-	0	0	+	-	PHYSICAL
Eutrophication	3	0	0		+	0	0	0	0	0	-	0	-	+	-	PROCESSES
Natural Forest	5	0	0	0	0	±	0	0	0	0	0	±	0	±	+	
Cultivated Cropland	9	+	+	+	+	±	0	0	0	+	0	±	0	0	+	BIOLOGICAL
Fisheries	11	0	0	-	0	0	+	+	0	0	+	+	+	0	0	PROCESSES
Waterfowl & Aquatic Mammals	12	0	0	+	-	0	0	0	0	0	0	+	+	-	0	
Forest Production	16	+	+	+	+	+	+	0	0	+	-	+	-	+	+	
Mining	17	+	+	0	0	-	+	+	+	0	0	±	-	+	±	
Waste Disposal to Water	22	0	+	+	±	-	0	0	0	0	-	0	0	+	-	
Insecticide Application	25	0	0	0	0	-	0	+	+	0	±	0	0	±	0	RESOURCE
Land Reclamation for Development	28	0	+	0	-	-	0	0	0	0	-	0	-	+	+	USE
Boating	32	+	+	0	0	0	0	+	0	0	0	0	0	+	±	PROCESSES
Cottage Shorefront Development	41	-	+	+	±	±	+	+	+	+	+	±	-	+	+	
High Density Housing	44	+	+	+	+	0	+	+	+	0	+	+	+	+	+	
Regulation of Health and Safety	50	0	0	-	±	0	0	-	-	-	+	0	0	-	+	POLITICAL SOCIAL ECONOMIC PROCESSES
Employment in Watershed	53	0	+	+	+	±	+	+	+	+	+	+	+	±	+	
		Physical Processes		Biological Processes			Resource Use Processes							Political Social Economic Proc.		

present state of the art. There is a problem also, in deciding when to include second and third order linkages as well as direct effects. Feedback, as we attempt to improve our system, indicates that we should include as an important process the item of "welfare and family assistance."

Yes, there are plenty of problems and imperfections in this ecosystem approach. Perhaps by next year we will have more precise data so that we can for instance replace the word "eutrophication" with "phosphate input" for Owasco Lake (if phosphate input is the limiting factor). Then we can begin to compare the relative effects on the lake of an increase in livestock production versus an increase in cottage shorefront development, because we know something about phosphate output from these two variables. But, until we have similar kinds of quantification for the processes involved, even the forecast of directional change effects from changes in certain causative agents will give valuable guidelines for planning land use. The planners with whom we are working welcome this approach to decisions about land use, and the Cooperative Extension Service is finding it a useful model in working with citizens groups discussing community resource development.

Land use changes in the urban-rural fringe occur with bewildering rapidity. We are as reckless with our natural resources on this New Frontier as we were on the Old Frontier. Consideration of as many as possible of the impacts from a change in land use can help us to plan better for a habitat which is safe, efficient and pleasant for man.

LITERATURE CITED

Bartelli, L. J.
1962. Use of soils information in urban fringe areas. Jour. Soil and Water Conservation. 17(3): 99-103.

Hamilton, Lawrence S.
1963. An ecological perspective on urban sprawl. American Forests 69(6): 38-42.

Hills, G. A.
1961. Ecological basis for land use planning. Ontario Dept. Lands and Forests Research Report 46. Toronto, Canada. 204 pp.

Lacate, Douglas.
1970. The role of resource inventories and landscape ecology in the highway route selection process. PhD Thesis, Cornell University, Ithaca, New York. 198 pp.

McHarg, Ian L.
1969. Design with nature. Natural History Press. Garden City, New York. 198 pp.

Swanson, Roger A.
1969. The land use and natural resource inventory of New York State. N.Y.S. Office of Planning Coordination Staff Papers. 20 pp.

DISCUSSION

MR. YANGGEN: Now, insofar as ecology is concerned, let's assume that by next year you are not going to know the limiting factors insofar as nitrogen, vitamin B-13 or other chemicals are concerned—in other words, you will not be able to identify in any quantifiable term their sources. Of course, you must be able to again zero in and ask, for example, that in connection with the various sources,

what does the ecologist do in this situation of uncertainty; how does he respond to a situation like this? Would you care to comment on that aspect of it?

PROFESSOR HAMILTON: Let me point out that we do have studies underway on the Finger Lakes, and that we hope to find something about the limiting factors in the eutrophication process. Now, if we do not know, if we have uncertainity, we must continue to leave the word "eutrophication" in as one of our processes. Moreover, we then would consider that any process responsible for inputs of the likely limiting factors (nitrogen, phosphorus, cadmium, vitamin B12) would increase the rate of eutrophication (plus). We have tried to consult the best information available on similar lakes and have tried to think thoughtfully about most likely occurrences in this watershed.

MR. THOMAS DAVIS: I was interested in your discussion about reversibility and irreversibility. It seems to me that this would have some time constraint, because in some length of time almost anything would be reversible. I realize, of course, that this can go to the ultimate degree but time is a very important factor here—a season, five years or ten years. Therefore, I was wondering if you had considered anything in this way?

PROFESSOR HAMILTON: I should have added the phrase, "at the present state of the art and under existing economic conditions."

You have to make some constraint or otherwise, anything can possibly be reversed. Remember, however, this is short-term planning and incremental planning, and this is what I am in favor of.

MR. DALE JONES (New Mexico): You listed only one forest type in all of your requirements. Is your area broken up into various vegetative types?

PROFESSOR HAMILTON: We are in a natural forest region, conifers and wild land—including land being invaded.

MR. JONES: I was wondering, because of the wildlife species tied to various vegetative types, that if you do this one way, you might get a different response than from another way. I was just curious about why you did not go into more detail in relation to the vegetative type.

PROFESSOR HAMILTON: Yes, we did lump things in order to give something manageable to the planners and people of the basin. We do not have wildlife species each identified as a biological factor. In fact we even lumped forest wildlife and farm wildlife. Similarly we lumped vegetation, calling all natural forest types one thing, all conifer forests one thing. No ecologist would agree to this when you get down to focusing on interrelationships on a small unit of land. We lumped cold and warm water fish. We did these things because we are dealing with a large lake basin area and we did it with the concurrence of specialists in fisheries, wildlife, forestry and so forth. It is a pragmatic liberty which we have taken.

MR. WILLIAM TOMLINSON: You commented to the effect that you are leaving the moral decision of your data analysis up to the community.

You indicated it was the communities' responsibility to assess the information you had furnished to them and, hopefully, that they would make a wise decision with this information.

Now, I guess this also would be addressed to Mr. Eschweiler. How is this information being incorporated into the statewide planning system? Is it being used in a zoning way? We are going to exclude "x" number of regions for varying reasons, perhaps the flood plain will be excluded from any development; shore line areas will be excluded from "x" number of uses. Now, how is your data being incorporated into this if indeed it is? Of course, I know that in connection with a lot of areas we have provided ecological data and it has not been incorporated into the planning scheme. Economic development is a good example, where they say "after we develop, then we will do the ecological analysis" and, of course, after the fact development is highly acceptable at this time. I am just really concerned that even if we do provide this information it is not, in its present state, being used.

I would also like to have your comment on the state-wide analysis that New York has just completed some of the other studies that have come out of Harvard, where they have used computer mapping. In other words, how do you see this type of planning taking place at state level?

PROFESSOR HAMILTON: There are a number of questions here.

This is not a physical plan. During previous years, my seminar has done the planning thing, analyzing the natural, cultural and human resources of an area, delineating flood plains, identifying valuable wetland habitats, unstable soils, prime agricultural soils, etc. Then we recommended certain uses to suit the ecological capability of various mapped units. One we made for the Forest Service, one for the State Department of Environmental Conservation, another for a local watershed. The present Owasco Lake project is a different kind of thing. We are not talking about physical locations for uses. What we are talking about is giving ecosystem information for decision making. This is not any kind of a local or regional master plan which would fit into a state framework.

In fact, this is a modest, fumbling attempt to give information about effects and causes to planners and to people in the watershed. We are using the statewide analysis of land use, as I have indicated, only to give some picture of the present status of each land use activity in our study area, to help us in remaining realistic in our judgments. We are engaged in a communication process rather than a physical planning process.

MR. TOMLINSON: How do you see the incorporation of this data at least in the future into not only local planning but in relation to modified regional planning in a statewide plan?

PROFESSOR HAMILTON: I think this approach might be used on the local or regional level to help people ask the right kind of questions with regard to proposed new uses of land or new activities. It is part of the planning process, but it is not data, in fact, we are woefully short of hard data in making our statements about what will happen.

MR. JOHN WOOD (Nevada): I was most interested in the seminar because I was participating in one involving the regional planning agency between Nevada and California. And these very problems you have been dealing with are also what we have been dealing with and trying to put them into a complex matrix, in connection with which we are building a model that the computer is fighting with right now. We have the same problems that you have enumerated. We can concur that this is a very real problem you are dealing with and we are dealing with it out here. As to how it is going to affect the future, we still don't know.

VICE CHAIRMAN YANGGEN: I would like to step out of my role as Vice Chairman here and respond to a question that was previously asked.

This may involve a midwest provincialism at its worst but I would like to take just a moment or two to explain the way that two states, Wisconsin and Minnesota, are attempting to deal with these problems.

We also don't know the answers and we don't understand the complex ecological relationship that exists. That was why I asked that question about the nitrogen and Vitamin B-12 and other potential limiting factors. However, we do know something about some things that are going on and which we can at least begin to take simple steps in dealing with.

What these two states have done is essentially carved out a special order of jurisdiction along the public waters in the States of Wisconsin and Minnesota. These are areas within a thousand feet of the navigable lakes and 300 feet of the navigable rivers and streams, including the flood plains. Essentially what these two states have said is that a state agency is authorized and required to develop certain minimal standards for development that takes place within these areas. These involve local units of government. In this case, for example, the county has the first option to act. If they fail to act, then the state is required to act.

They are required to adopt and enforce these minimum standards they have prepared, admittedly on the basis sometimes of imperfect anology of the complex

ecological relationship that exists. However, there are regulations tying into the disposal of onsite wastes, the soil types, restrictions against cutting vegetative cover, minimum lot sizes, set-backs of structures from the normal high water mark and things of this sort. Now, perhaps my bias will show here but I sometimes believe in control and sometimes I even believe in control without the ultimate of planning.

Now, in connection with both of these states, these regulations can be upgraded over a period of time.

Now, the deadline for the state of Minnesota is June of 1970 and the deadline for the state of Wisconsin is January 1, 1968. There are still one or two counties that have not adopted the regulation meeting the minimum state standards but of the 71 counties in the state of Wisconsin, approximately 39 of them have adopted this basic natural resource development.

PROFESSOR HAMILTON: I wonder if I might make a concluding statement.

You know, people ask the question "Do you want more flood control" and, of course, everyone says "yes"; they also ask "Do you want better roads", and here again the answer is "yes".

Also, when they are asked whether or not they want a higher quality of water, the answer there is likewise "yes." Now, when you ask these questions individually, then everybody in the community says "yes" and some of them conflict. However, that doesn't matter because we become past masters at trying to have something for everybody.

Now, if we keep asking these piece-meal questions, we are liable to wake up some day with an environment altered in a way that we do not like. Therefore, we are trying to help people ask the right questions about what kind of an environment they really want to live in. Therefore, if somebody says "Do you want this?" Then we want to be able to say, "Well, it will affect all these other things, do you want that?" Well, sometimes you do not think of other effects when you think of whether or not you want more flood control, more water and more of this and that.

CHAIRMAN SCHULMAN: Thank you, Professor Hamilton.

Now, we have heard from Dr. Shomon, Mr. Eschweiler and Professor Hamilton and our next participant is Mr. Rielly, which is a deceptive way of putting him in his place. Actually, he has more information because he represents, you might say, the individual who has finally been caught up in this whole issue.

Mr. William Rielly is from the Council on Environmental Quality, Washington, D.C. He is a lawyer, planner and presumeably he can bring together a few heads there. He went to Harvard, Yale and Columbia and, as is his wont, he has switched signals on us.

His title in the program is not going to be followed. His title today is, "Report on the National Land Use Policy as Exemplified in the President's Message". I am happy to present to you Mr. William K. Rielly.

NATIONAL LAND USE POLICY: THE PRESIDENT'S PROPOSAL

WILLIAM K. REILLY

Council on Environmental Quality, Washington, D.C.

In his message accompanying the First Annual Environmental Quality Report the President called for the development of a "National Land Use Policy to be carried out by an effective partnership of Federal, State and local governments together, and, where appropriate, with new regional institutional arrangements."[1] On February 11 of this year the President transmitted to the Congress a proposed "National Land Use Policy Act of 1971," which is now before the Senate as S992, and the House as HR4332. I am tempted to say that this is the first time a President has proposed that the Federal Government intervene in the delicate relationship between local governments and the land. But that would be claiming too much. We owe the insight to Daniel Moynihan that we have long been accustomed to operate under federal policies without acknowledging them.[2] Federal highway programs have very significantly affected the organization and use of land.

But the primary governmental responsibility for classifying and regulating the use of land has been that of the lowest level of government in a given jurisdiction—the town or municipality, or in rural areas the county. Where certain areas are concerned, and where certain problems are involved, the President has moved to change this situation. It was just three years ago next month that the *New York Times* editorially opposed a proposal to allow a State agency to override local zoning, seeing a threat to municipal integrity and home rule.[3]

Today I would like to discuss some of the thinking behind the Administration proposal. Fundamentally, the bill is a call for institutional reform. A number of studies considering the land-use problem from various points of view have concluded that the failure of small units of government to act in concert or to pursue regional objectives was a serious obstacle in the way of an orderly, equitable allocation of land resources. This conclusion explicitly appeared in the findings of the Douglas Commission, whose focus was primarily on the impediments to meeting the demand for housing, and it underlay the

[1]President's Message to the Congress of the United States, Environmental Quality, First Annual Report of the Council on Environmental Quality, August 1970, p. xiii.
[2]Daniel P. Moynihan, The Concept of Public Policy in the 1970's," speech at Hendrix College, Conway, Arkansas, April 6, 1970.
[3]*New York Times* editorial, April 11, 1968, p. 44.

conclusions of the National Estaurine Pollution Study, which was concerned with the conservation of coastal wetlands.[4]

Succinctly stated, the problem is one of perspective and incentive. Small units of government inherently possess a vision delimited by their jurisdiction. A piece of valuable river frontage or a portion of tidal marshland is rarely seen by a locality in terms of its place in a regional ecological system. The rare jurisdiction which acts to steer growth away from ecologically fragile areas must generally overcome a powerful incentive to maximize tax-returning new development. Even when the heart is willing the flesh is still weak.

This is not to argue that the entire system of planning and regulating the use of land should be overhauled. Where purely local interests are affected (and the large majority of zoning cases are indisputably local) the existing system, arbitrary and corrupt as it is often alleged to be, would probably not be improved by involving a more distant, disinterested arbiter.

But the current system is doing very poorly at dealing with three kinds of problems: protecting lands which serve vital natural or aesthetic purposes for a regional population; accepting and siting development which the larger area may need very badly but which may represent net tax costs or pose social problems; and controlling growth which is induced on such a scale by certain magnetic developments that it altogether changes the ground rules of the conventional planning and zoning game.

Remedying these shortcomings must be the objectives of a national policy for land use. Thus, the Administration bill requires that States, the constitutional repositories of police powers, inventory and control their "areas of critical environmental concern." These are defined as "areas where uncontrolled development could result in irreversible damage to: important historic, cultural, or aesthetic values, or natural systems or processes, which are of more than local significance; or life and safety as a result of natural hazards of more than local significance."

The coastal zones and estuaries, rare or valuable ecosystems, shorelands and flood plains of major rivers and lakes, and scenic and historic areas are specifically set out as areas of critical environmental concern. The common need in each of these areas is for protection, for regulation which takes into account the vulnerability of the lands, or in the case of historic districts of the buildings themselves, to

[4]United States, National Commission on Urban Problems, *Building the American City.* (Washington, D.C., U.S. Government Printing Office, 1968). United States, Secretary of the Interior, *The National Estuarine Pollution Study,* 91st Congress, 2d Sess., Sen. Doc. No. 91-58. (Washington. D.C., U.S. Government Printing Office, 1970).

destruction through insensitive siting, irregular scale, and excessive development. The exercise of identifying and defining boundaries for such areas should be an immensely instructive experience for State and local governments. The ultimate aim is to subject these areas to a comprehensive system of regulation which transcends local jurisdictions where the areas themselves do.

A national policy must have a protectionist element, and conservationists understandably see protection of diminishing natural and scenic areas as the priority concern of national policy. But there must also be another dimension; it is not enough to say where development must be limited without providing some direction on where growth will be accommodated and planned for. Thus, the Administration bill requires that States have a "method for assuring that local regulations do not restrict or exclude development and land use of regional benefit," defined as development for which there is a "demonstrable need affecting the interests of constituents of more than one local government which outweighs the benefits of any applicable restrictive or exclusionary local regulations."

This provision calls for a balancing between regional needs and local capacities. It is left for the States to provide in some detail exactly how the proponent of development is to overcome exclusionary regulations. The draft *Model Land Development Code* of the American Law Institute, from which the provision is borrowed, prescribes a number of considerations for resolving the difficulty of locating a facility everyone needs—e.g. an educational institution, sanitary landfill, publicly assisted housing—but which many people do not want quite next door.[5] The strain that would be placed upon local finances or transportation systems and the extent to which the locality has already accommodated regional objectives by siting related development are factors which would presumably enter into the decision of the agency faced with a proposal to override a locality's own preferences.

If States were to protect areas of critical environmental concern, and accommodate development of regional benefit, we should be well on our way to solving our two most urgent land-use problems. Nevertheless, much of the urbanizing countryside might look no different. Subdivisions might continue to sprawl indiscriminately across hill and vale, commercial strip developments might hug any eligible frontage access road leading to a national park or an airport or a major highway interchange. New suburban development might

[5]American Law Institute, *Model Land Development Code*, Preliminary Draft 10, unpublished.

still be laid out with such meagre concern for public open space that 80 percent of our suburban jurisdictions fall short of the recommended 10 acres of sub-regional parkland per thousand population.[6]

To deal with these issues the bill requires of States that they designate and control "areas impacted by key facilities" and all proposed large-scale development "of more than local significance in its impact upon the environment." Key facilities are defined as major airports, major highway interchanges of limited access with frontage access roads, and major recreational lands and facilities. The concept of the bill is to place the responsibility of ordering development around the main growth-inducing public facilities upon the State which can effectively superintend their spillover effects and their often overwhelming impact upon an immediate local area. As for large-scale development, there are several ways a State could define it. Amount of land coverage, number of dwelling units, amount of water use or waste water effluent, number of employees, visitors or residents, are possible measures of large-scale development. Obviously, the definition of large-scale in a larger urbanized area will differ considerably from that in a rural area or smaller city.

Finally, States are to have a policy for influencing the location of new communities, and for controlling the use of land around new communities. This requirement is intended to involve the States in siting cities. Current fashion is to promote platted 40 acre farms as new towns, and surplus military reservations in cities as new-towns-in-town. Be that as it may, the genuine new town usually is intended to be a relatively discrete settlement of distinctive characteristics. Development of land around new towns may often need to be carefully limited if new town densities and the other objectives of planned growth are to be encouraged.

These then are the main elements of the Administration's proposed national land use policy. The actions which States are to be required to engage in are purposely flexible. No one in Washington purports to know precisely how the States should go about the task. The bill sets out three broad techniques, any one or a combination of which a States may select as its "method of control." The first is direct State land use planning and regulation; the second is concurrent State and local regulation with an administrative veto in a State agency, together with last-resort planning powers; and the third is State establishment of criteria and standards for local implementation and compliance, with judicial review and enforcement.

We have seen variations of two of these approaches in Hawaii,

[6]Statistics supplied by the U.S. Department of Housing and Urban Development, based upon more than 1000 observations.

Maine, Vermont, Wisconsin, Massachusetts and New York. In the future I hope we shall see more.

There is to be a full, detailed annual federal review of the laws and "methods" adopted by the States in response to the proposed national policy. However, substantive review of the kind of development which actually is allowed in a given area is to be limited to instances where a State acts "in substantial disregard for the purposes, policies and requirements of its land use program" in an "area of critical environmental concern *to the Nation.*" Hopefully, it will not be necessary to define and identify these areas.

Federal projects and activities are to be consistent with State land use programs which satisfy the requirements of the act. Where a State is without such a program, any major federal action significantly affecting land use is to be considered at a public hearing at least six months in advance of the proposed action, followed by findings subject to comment by the Secretary of the Interior or of Housing and Urban Development.

What, you may ask, is the relationship between the proposed land use policy bill and the national growth policy debate? The short answer is that this is not of itself the growth policy called for by the President in the 1970 State of the Union Message. A growth policy presumably implies some hard, substantive choices about where new development and population should go, and where it should be limited. Senate Bill 992 lays no claim to those answers. The land resources are common to all States; areas of critical environmental concern are distributed throughout the country. Undoubtedly the more populous and growing States have more significant land planning and conservation problems, and for that reason those States would be accorded some preference in grant assistance under the bill. A national policy for land, especially one which stimulates the organization of powerful new State agencies to plan and regulate land use, would appear to be a valuable and necessary component of a growth policy, for it is directed at the qualitative aspects of growth—of assuring that important values are not destroyed, that land use regulation does not inhibit regional needs and opportunities, and that development is controlled and ordered.

As you may know, Senator Jackson sponsored a national land use policy bill in 1970, and I want to take a few minutes to compare the two measures.[7] We profited a great deal by the debate which the Jackson Bill stimulated, and the testimony on the bill was very useful to us. The two bills, in fact, are not so very dissimilar. Both measures

[7]S3354, 91st Congress, 2d Sess., Report No. 91-1435, Dec. 14, 1970. (The bill is S632 in the 92d Congress.)

posit a central role for the States. Each would allow roughly five years for full implementation. They are different, however, in four respects. First, the Administration Bill is selective. It attempts to identify a limited number of problems deemed of truly Statewide significance and worthy of State attention. A State would be free, of course, to go beyond what the Administration's proposed law requires but its primary energies are directed to critical areas, key facilities, development of regional benefit, large scale development and new communities.

Senator Jackson's proposal would require that the States plan and presumably control all their lands except those of cities in excess of 250,000 population. Land would have to be classified according to agricultural, mineral, industrial and commercial development.

We considered this inclusive approach and rejected it, primarily because it was not clear to us that such an ambitious land classification exercise would be the best use of generally fledgling State efforts at land-use regulation. Nor is it completely clear that all agricultural or commercial development is of State interest. (We do not, however, propose to exempt the large cities.)

A second difference between the two approaches concerns "development and land use of regional benefit." No such provision appears in Mr. Jackson's proposal.

Third is the matter of federal-level jurisdiction. The Administration proposes that the Department of the Interior exercise primary administering authority, with the Department of Housing and Urban Development sharing review powers. The Council on Environmental Quality is to issue guidelines to assist the federal agencies in carrying out their responsibilities under the Act.

Senator Jackson proposes to expand the Water Resources Council into a "Land and Water Resources Council" to administer the grants and review State programs.

Finally, Senator Jackson's bill contemplates a funding level of $100 million annually in grant assistance to States and river basin commissions. The discipline of incumbency has obliged us to propose a funding level of $20 million annually, which brings me to my last question: Can you legislate an essay?

The phrase comes from an unidentified staff member of a Congressional committee quoted on February 14 in a *New York Times* analysis of the Administration bill. It presumably refers to the level of assistance to the States that is proposed. As you are probably aware, past federal support for land-use planning has been provided through the Comprehensive Planning Assistance program adminis-

tered by the Department of Housing and Urban Development. The Administration proposes to double the funding in that program from 50 to 100 million dollars for Fiscal Year 1972. Thus, the resources available for planning and regulating land use are to be substantially increased.

The use of land is at the root of many of our environmental problems. We do not imagine that our proposed land use policy will lead to utopian bliss. In fact, More's *Utopia* was to have three-story rowhouses "so uniform, that a whole side of a street looks like one house . . ." a dreadfully boring prospect.[8] Improvements to land have a permanence about them that generally survives their builder. Yet the uncertainty, delicacy and tension involved in people's relationship to their property and to the elected officials who purport to tell them what to do with it is captured in the homeowner's gloomy cliché "there goes the neighborhood."

Into this relationship now enters the Federal Government with some courage and at long last.

DISCUSSION

VICE CHAIRMAN YANGGEN: I have a question for Mr. Reilly. Mr. Reilly, how optimistic are you of the Administration's proposal, in view of your experience on the Council of Environmental Quality, where you review the impact of various federal proposals on the environment? In other words, how do you see this referee role of the states and/or Federal Government?

MRS REILLY: The implementation of Section 102(2)C of the Environmental Act, which I assume is what your are referring to, has gotten a good bit of publicity during the past year. We at the Council have somewhat mixed impressions.

In our review of environmental impact statements we admittedly see many poor ones. Some are poor because they represent an agency's fledgling effort at comprehensive environmental analysis. Others are inadequate because they are retrospective justifications of actions decided well before enactment of the National Environmental Policy Act.

But I would suggest two hopeful signs. First, we are seeing more good statements as time goes by. Second, agencies which in the past have been most criticized by environmental groups are producing very solid impact statement procedures. If future statements of these agencies are held to the high standards of their own procedures—by the public, the Congress, the courts and the Council—then statements will improve significantly.

The implications for National Land Use Policy are that it takes time to alter basic decision-making processes. State programs will no doubt be rudimentary in some respects, at first. But we need to start sometime.

MR. JIM MORRISON (Bureau of Outdoor Recreation): Now that the Corps of Engineers and the Highway Department have staffed themselves so they can prepare an environment statement for the Council, I wonder if you are making any recommendations as to how the agency proposes to review this massive amount of paperwork and make a meaningful evaluation out of it.

MR. REILLY: I see you have your problem and we have ours.

In connection with our procedure, we recently reformulated a draft of the

[8]Quoted in John W. Reps, *Town Planning in Frontier America*, Princeton University Press, 1965, p. 12.

proposed procedures which are now available for comment. They would allow a longer period of time for reviewing agencies, such as BOR to consider proposed action. They would require that major fedreal actions on administrative matters rather than legislative matters be reported on in a draft environment impact statement available to the public a minimum of 15 days prior to conducting a public hearing on the matter and a minimum of 90 days before the taking of any action.

I know that some expert agency comments are being held up now. We frankly have not seen this as a serious concern because most of the agencies taking action have been pretty good about agreeing to alow a longer period of review when necessary. Now if this becomes a more serious problem later on, and it may, I think that maybe we will have to alter the current system and we may have to assist commenting agencies increase their budgets and staffs.

CHAIRMAN SCHULMAN: Thank you very much for your comments. You know, a few years ago, everyone would have been pleading to have this opportunity to comment and put in their nickel's worth of environmental commentary. However, I think that these are the kind of problems which make us pleased with ourselves in a state where our problems are professional rather than political problems, such as we had several years ago getting public attention.

EASEMENTS FOR MAINTAINING ENVIRONMENTAL VALUES

J. MARTIN WINTON

President, Grassland Water District; National Trustee, Ducks Unlimited; Los Banos, California

Sportsmen and conservationists from all parts of America come to Merced County to view the marshland during the late fall and early spring. Each fall and winter a vast inland sea covering some 72,000 acres is established. Every acre foot of this native pasture land is man-controlled. Two hundred and ninety-seven landowners, and four public waterfowl areas, create waterfowl habitat at the time migratory waterfowl will arrive. At today's land prices, the investment by the duck hunter in these wetlands for hunting and for public service is enormous. The capital investment is well over $30,000,000.00.

Landowners within the grasslands of California believe there is a substitute or the continued land acquisition by state and federal sub-divisions.

Many hunting license buyers, sportsmen and other conservationists are of the opinion agents of our government cannot continue to buy real estate as they have been and stay in business. There are those of us who believe that under certain conditions private lands could provide open space, scenic values, recreation and living space for wildlife, as well or better than is now provided on public lands.

The question is, how do we insure our open space resources, at public expense, and at the same time protect the taxpayer?

There is talk in some government circles every year about the need to sell or transfer public lands. It is often difficult for the wildlife administrator, let alone John Q. Public, to determine the value received, in relation to the cost, when talking "environmental quality." The complete landscape, the complete river, complete planning, and complete conservation would be great, *if we could do it.*

Can we agree that the future of land use and open space will depend, as it has in the past, upon the achievements of the individual? Can we say that the private property owner will have to become more involved with conservation if our heritage is to be available for those who follow? Somehow, those of us who are here today must formulate a program, before too long, which will guarantee land and water for people, wildlife, living space and wetlands. How? That I do not know.

Many of those who have provided leadership for conservation could well be labled "squares." During the industrial and agri-business growth of California, the farmers, bankers, lawyers, teachers, businessmen, government employees and others, who were involved in the protection of the natural resources, were "squares." Men who stood square against the complete destruction of our natural resources by a bureaucratic government, and would look the dam builders square in the eye and say it is a mistake to dry up the rivers and the marshlands. Too few have asked what is a "square deal" for conservation.

Unfortunately, "squares" are not doing too well today. We do not fit in with the current crop of minority militants, angle players and corner cutters. We are burdened with old-fashioned ideas of honesty, loyalty, courage and responsibility. We believe the future of conservation will be decided by legislation, not destruction of the "system."

The greatest challenge to conservations comes from those of us who enjoy it most, yet fail to defend it vigorously when our resources need our support. Too few will share their funds, carry their share of responsibility and become involved.

Let me tell you how getting involved can lead to a land-use easement, improved environmental values, and in the end provide this paper for your program today.

It was hot and dusty on the 100,000 acres of grasslands in western Merced County in the summer of 1949. For six years cattlemen had been trying to supply water from the Federal Government on an interim basis, for their livestock economy. Their failure was reflected in the heat waves of the burned native pasture, and the cattle dead from "red water" lying near the water holes.

The U. S. Bureau of Reclamation, Central Valley Project, Southern

Division, had been completed. Friant Dam, built as a diversion reservoir on the second largest river in the State of California, was in operation. The waters of the San Joaquin were being carried to the flood plains of the Kern River for agricultural use. The lands to be irrigated with San Joaquin River water were more than 100 miles from the arid grasslands of Merced County.

In the Valley of the San Joaquin, some 200 miles long and up to 100 miles in width, agri-business was to come into its own. Federal water projects, built for flood control and navigation, would dry up major river beds and provide, under the federal 160-acre irrigation laws, the life blood for the row crops—cotton, sugar beets, and melons—as well as water for the vineyards and orchards, and low-cost gravity water would be available for the righest agri-business empire the world has ever known. In the "Cradle of the Grapes of Wrath," reclamation project water would create agricultural wealth beyond the wildest imagination. The arguments used by corporate farmers over the use of project water on more than 160 acres, with federal subsidies, goes on and on, while the overproduction of farm crops gluts the market.

In the same area of the valley is Delano, a farm community, holding the destiny of the farm laborers of America. Prior to 1949 the arguments in the southern San Joaquin Valley were over water shortages. Today there is a fight for stronger local water control. The landowner is asking for the elimination of the 160-acre federal water quantity law, and a battle between labor unions, social workers, labor contractors, and agri-business over the paychecks of the highest paid agricultural workers in America is a dispute among friends—Big Labor, Big Government, Big Religion, and Big Business. They all want a part of the action. The problems of conservation, open space, wildlife and our natural resources have never been given consideration in the Kern County dispute. Yet this could be the way to reduce overproduction of crops, control water quality and quantity, and change the land use from agri-business to open-space through the exchange of values owned by the government, the farmer and the taxpayer. *A land-use easement could be the answer.*

There is a need for new thinking on the part of every professional wildlife administrator in America. The ideas which produced the overabundance of agri-business have long been outmoded. Rules to dry up large rivers, eliminate fish and wildlife, have had their day. Water must be provided for live streams, productive fisheries, open space on private lands, as well as for agricultural, industrial and domestic use.

Why can't we say to the landowner "The Government (the people)

will provide you with water for your agri-business venture, but you supply an easement on a part of your land for open space and wildlife"? Crops will not be grown on the easement lands, but the landowner can control the public trespass and expect the same services from the local wildlife administrator he now gets from the local farm advisor. A reduction in the cost of the federal water supply could be one incentive for the easement. A reduction in county taxes on real property could be another. Yet when the landowner requests a change in the land use of his property, he should be expected to pay all back taxes and water cost benefits to the agency which has provided the service. The longer the easement runs, the more costly the real property would be to redeem.

Let me tell you how this principle was applied to the grasslands of Merced County, California. During the 1930's when the Federal Government was planning the California Central Valley Project, duck hunters and others interested in the overflow lands of the rivers asked that the government buy the 100,000 acres of land at a price of from $7.50 to $25.00 per acre. The Government agencies refused. From 1927 to 1936 the 100,000 acres were sold to duck hunters and cattle men. Some land went for sub-marginal agriculture. It took ten years for the owner of the land to sell his property at the above prices.

In 1950 the San Joaquin River from the Sack Dam at Firebaugh to the mouth of the Merced River became a "dead" river. This is true in 1971. The willows, the wildlife and the fishery of the San Joaquin are no more. The river sand burns in the 100-degree noonday sun. Three million ducks were delegated to a 2000-acre state refuge without a firm supply of water. The spring run of silver salmon was traded for a cotton patch. The winter run of salmon died below the wooden weirs of the irrigation ditches.

In the planning for the construction of the multi-million dollar Central Valley Project no plans were made for fish and wildlife. Commercial fishermen and sportsmen's groups sought relief in the state and federal courts to no avail. It was not until the duck hunters of California asked the state legislature to make the use of water in California a beneficial use for fish and game under the water code of the state that the problem started to resolve itself. Urged by the same group of duck hunters, the Congress of the United States approved legislation to re-authorize the entire Central Valley Project and make project water available for wildlife.

The legislation stipulated that the Government could make a charge for such water, not to exceed $1.50 per acre foot. In the settlement of a lawsuit, the duck hunters had filed against government officials and

agencies, a contract was signed making water available for forty years for waterfowl purposes on private property.

Early in 1960 the future of the wetlands in California became tied to the assessed valuation of agricultural lands. Taxes soared from $.50 an acre on the 100,000 acres of grasslands to more than $3.50 per acre. As tax costs increased so did every other management expense of the wetlands. Duck hunters who had been able to establish a waterfowl habitat on 45,000 acres of private property, and at the same time help state and federal officials establish some 22,000 acres of grasslands in waterfowl management for public use, realized the economy of the duck club-cattle combination would squeeze out one or the other if costs could not be cut. There was no question but what the waterfowl use would have to be restricted, and perhaps this land go to irrigated pasture.

With this problem the directors of the Grassland Water District asked for a meeting of state and federal wildlife officials at the last meeting of the North American Wildlife Conference in San Francisco. The Washington staff of the U. S. Fish and Wildlife Service, along with the director and his staff of the California State Department of Fish and Game, reviewed the problems of the waterfowl of the grasslands of Merced County. The outcome of the San Francisco meeting was the establishment of a Task Force. The purpose of the Task Force was to find a way to cut costs for waterfowl management on private property and at the same time guarantee that land use would remain in waterfowl habitat. The land-use easement was the logical solution. The United States would reduce water costs to the District *if* the District could persuade the landowners to restrict their land use to wetlands and waterfowl. Funds released from the cost of water could reduce the landowner's cost of operation.

After some four years of meetings, task force reports and planning, the proposed Grasslands Wildlife Management and Water Plans were formulated. To insure the continued use of the wetlands for waterfowl habitat on 46,000 acres of private property and 8000 acres of public property a Cooperative Agreement and Habitat Management Plan would be signed by the United States of America represented by the Regional Director, Region 1, Bureau of Sport Fisheries and Wildlife; the Regional Director, Region 2, Bureau of Reclamation; and the Officers of the Grassland Water District. The agreement would coincide with the terms of the Water Contract of the District for Waterfowl Purposes, or any extension thereof.

The convenants were restrictive for water for waterfowl and native pasture. Winter water furnished by the Government, on a non-reimbursable basis, between September 15 and November 30 of each

year, would create for waterfowl a large wintering area on the Pacific Flyway. Spring and summer water would be held on the landowners' property if available for waterfowl production habitat. Summer water was made available by the Grassland District to the wetlands. This water, return flow drainage from agriculture, and spill from the federal water project, would be available only for waterfowl and native pasture.

This Cooperative Agreement and Habitat Management Plan was presented to the Directors of the Grassland Water District by Officers of the United States at a public meeting in Los Banos, California late in 1969. A provision of the agreement required 80 percent of all landowners to sign a restrictive land-use covenant with the District prior to the management plan becoming effective.

Because the District could not obtain the benefit of the land-use easement until 80 percent of the landowners had signed the covenant with the District, the District was given two years to provide the Government with proof of intent by the landowners. In part, the landowner must agree that the contract would run with the land within the District, for the period of the federal water contract, and that said agreement shall be binding upon the heirs, executors, administrators, and assignees of the landowner. In exchange for a water supply for wildlife the landowners further agreed to:

1. Under conditions of the agreement to allow government agents and wildlife personnel to have the right to enter upon his land to inspect the land and water use for wildlife. Landowner agreed to include 100 percent of his land within the covenant.
2. Maintain and repair 120 miles of canals and ditches and a water distribution system beneficial to wildlife.
3. As assurance the land would remain in waterfowl habitat, the landowner agreed, under the covenant, to repay the District a cash penalty equal to the cost of the water for each year his land received the benefit of the land use easement agreement, providing the landowner ask for a change of land use.

Contracts were mailed to landowners early in 1970. By June of 1970 more than 80 percent of the landowners had returned their restrictive land-use covenants signed and ready to file with the County of Merced as a deed restriction to the use of their real property. During the first year better than 90 percent of the landowners had signed the covenant.

Today landowners are paying district taxes, county taxes, and a waterbill for winter water, which, as the district facilities are improved, will decrease, and are receiving spring and summer water for waterfowl habitat at reduced rates.

We believe you will agree the Cooperative Habitat Plan of the

Grassland Water District is a landmark effort of cooperation between the U.S. Bureau of Reclamation, the Fish and Wildlife Service, and a water district representing private interests.

The value of this contract to the landowner with his duck-club cattle economy, to the farmer with tail water from irrigation, and to the public for wetland and waterfowl habitat control, is undisputed. However, the steady and unrelenting reduction of marshlands in the San Juaquin Valley of California has resulted in the crowding of wintering waterfowl on areas of limited size. Consequently, the remaining habitat base, the Grasslands, is vital to the maintenance of waterfowl resources of the Pacific Flyway. The private landowners of the Grassland Water District will be unable to continue their livestock-duck club operations without some provision to resolve current economic problems.

In recognition of the national and international value of the waterfowl resources, and the international treaty responsibilities involved, the United States should take such action as is deemed necessary to preserve the Pacific Flyway waterfowl resources.

The participation of the Grassland Water District in the Cooperative Agreement and Habitat Management Plan will assure that nearly one-half of the remaining habitat of the San Joaquin Valley will be maintained and improved, making the program the most logical approach to the problem.

In conclusion may we always be mindful of the basic powers of our State Governments, the various Districts with taxing authority, zoning and restrictive powers of city and county officials for fee simple property.

The idea of using tailing water from agri-business for wetlands is not new. Western irrigation districts, both in the United States and in Canada, have been providing the run-off from irrigation for wildlife ever since reclamation laws were passed. Why? Because in many cases the water has picked up a mineral content from the soil, rendering it unfit for further crop use. For native pasture and wildlife the Grassland Water District has found water of 3000 parts per million of solids will do the job.

In reviewing hunting and fishing easements, the terms "the general public shall have the right" discourages many landowners. While the grantor may reserve the right to use his property, the thought of the "thundering herd" is more than most landowners can stand.

Flowage easements in California were developed under western water law. The landowner owns to the center of the stream, not the high water mark. Again "trespass" is the key. Water for hunting and fishing is available to the public *if* he has permission to trespass.

Scenic easements are in need of tax relief, along with conservation easements. Political subdivisions should consider paying tax bills for easements with the idea if the landowner of the future wishes to redeem his deed restriction, he should pay all back taxes plus a penalty. This is the basic principle of the easement of the landowners within the Grassland Water District.

The ideal easements, as far as I know, are those written by Ducks Unlimited (Canada) with their private landowners and government agencies. The easements with the private landowners in Canada are usually written to include the terminology "in consideration of a dollar." The easements themselves are free. The water rights for Ducks Unlimited (Canada) are acquired at no cost. The easements with governments are free. The tenure of easements on private property are usually in perpetuity, while the easements for involving government agencies are usually of 20 years duration. Ducks Unlimited (Canada) pays no taxes as they own no land.

North America is richly blessed with natural resources. Some we are caring for. Conservation easements for the resources may provide a technique whereby our goals can be achieved.

DISCUSSION

VICE CHAIRMAN YANGGEN: Thank you, Mr. Winton.

MR. WINTON: I have been asked how much we have saved the Federal Government through the use of these easements. Well, on 70,000 acres in relation to the Grasslands Water District and 50,000 of private property, it cost $5.00 per acre to the landowner for waterfowl management and with a comparable cost to government agencies in the same area. Therefore, as long as waterfowl management can remain in private enterprise we are benefiting the taxpayer through the use of the land.

There is no shortage of hunting opportunity nor is there any shortage of birdwatching opportunity or shortage of any other outdoor activity in these communities. This project is certainly paying dividends.

ESTABLISHING UNDERWATER PARKS WORLDWIDE

ORTHELLO L. WALLIS
National Park Service, U.S. Department of the Interior, Washington, D.C.

Coral reefs and undersea gardens, tide pools, bays and estuaries, scenic coastlines and beaches, offshore islands, and other marine environments are important assets. Those which remain unaltered throughout the World are becoming exceeding rare. Many uses and abuses are detrimental to these fragile ecosystems and to marine life.

To perpetuate significant natural oceanic ecosystems and geologic and historic resources for their inherent esthetic, scientific, educational and recreational values, many countries have set aside selected submerged lands and waters as underwater parks, preserves and related protected areas. Faced with the demands of an expanding human population and the disruptive impact of many marine activities, the need for the creation of additional protected underwater zones becomes apparent. Many writers have recognized this need (Beard, 1960; Eissler, 1968; Grater, 1964; Polunin, 1969; Randall, 1969; Ray and Ciampi, 1956; Ray, 1961, 1962, 1963; Sandburg and Crile, 1969, Spilhaus, 1963; Tzimoulis, 1968; Wallis, 1961; and others).

PAST MARINE CONSERVATION

Conservation action in the past has stopped, to a great extent, at the edge of the sea; resources beyond were "out of sight and out of mind." The vastness of the seas and their resources were impressive and appeared to be without limit. Knowledge about marine resources was limited for centuries to information gained from specimens that could be dredged from the bottom or netted from the waters. Resources of the seas, of course, are not boundless; Man's actions can damage underwater environments and can deplete marine life.

Regulation of the harvest of some sea life by local restrictions and international conventions has resulted in the survival of certain species; but for others, the regulations have come too late. Protection has been extended less frequently to ocean environments. It is of little consequence, for example, to prohibit the taking of sea shells or tropical fishes if the coral reefs are allowed to be buried in silt, polluted by oil or sewage, or blasted for ship channels.

Oceans have acted as a buffer between Man and his planet. They have provided him with avenues of transportation; with zones for defense; with sources for food; with a bottomless dumping area; and with opportunities for research, education, recreation and inspiration.

It is becoming abundantly clear that we now have the capacity to exceed this buffering action and the productivity of the seas.

THREATS TO MARINE RESOURCES

Many activities poise a direct threat to the marine world. Most obvious include: pollution from sewage, oil, pesticides, silting, thermal sources and disposal of wastes; underwater construction, dredgind and filling; oil drilling; and mineral exploration and extraction.

Collecting of corals, shells, tropical fishes, and other forms of marine life by amateur collectors for personal uses and by commercial interests for local tourist trade and for export has denuded selected reefs in Kenya, Florida, and Australia and elsewhere. Methods used frequently cause much destruction to the coral reef habitats. Commercial, sport, and spearfishing have an impact. Marine turtles in many part of the world are endangered through overharvest of adults and unlimited collecting of eggs and the loss or reduction of suitable nesting areas by the construction of resorts and other developments and the fouling of the beaches. Local populations of certain species such as resident fishes, lobsters, abalones, and clams have been reduced to low levels through overexploitation and habitat destruction. Reef areas have been impaired by the mining of coral for building purposes.

MODERN MARINE TECHNOLOGY

Modern technology has expanded Man's ability to develop and use ocean resources as never before. Methods for undersea exploration and resource extraction are being refined. Advances in packaging, processing, and transporting of perishable sea products have increased the availability and demand for sea foods. A shrimp, oyster, or lobster dinner is as common on the menus of restaurants in Omaha, Nebraska, as they are in Portland, Oregon.

Use of SCUBA and other underwater breathing devices and submersibles enables Man to work in the oceans. As mineral and oil deposits, marine life resources, and scenic and recreational opportunities are discovered, claims are being staked out for the variety of uses on the submerged lands and in the oceans. Careful planning on the local, national, and international levels will be required to accommodate these demands.

MARINE REVOLUTION

Man's relationship to the sea and its resources has changed significantly. The world has entered into what Dr. Carlton Ray

describes as the "marine revolution" (Ray, 1970). As in any revolution there is a good deal at stake. Now this advanced technology for ocean research and development is employed within the next few years may well determine the future of marine environments and marine resources.

Increasing leisure creates demands for scenic, non-urban areas for recreation, relaxation, and inspiration. These demands have stimulated many nations to recognize the economic values associated with tourism to underwater parks. On the Great Barrier Reef, for example, fishermen have found that guiding tourists is more rewarding than pulling nets. While countless thousands of tourists flock to coastal resorts apparently satisfied by the relatively simple formula of sun, sand, and surf, ever-increasing numbers of people are attracted to undisturbed natural underwater areas where they can more fully experience and appreciate the great diversity of life in the sea.

MANY USES OF OCEANS

Oceans are used for many purposes—fisheries, minerals and oil, transportation, waste disposal, military, and recreation and conservation. The relative values of these many uses are being recognized and basic philosophies and management strategies are being developed. For example, on June 11, 1970, in his message to Congress, President Richard Nixon urged for legislation to avoid further marine pollution in the Santa Barbara Channel of California, recommended the establishment of a marine sanctuary and the termination of certain leases, and stated:

> This proposal for Santa Barbara illustrates our strong commitment to use offshore lands in a balanced and responsible manner . . . this recommendation is based on the belief that immediate economic gains are not the only, or even the major, way of measuring the value of a geographic area. The ability of that area to sustain wildlife and its capacity to delight and inspire those who visit it for recreation can be far more important characteristics. This proposal recognizes that technology alone cannot bring national greatness, and that we must never pursue prosperity in a way that mortgages the nation's posterity.

NAMES APPLIED TO MARINE AREAS

Many names have been applied to underwater protected areas. It is sometimes confusing, for a name may be used for a series of areas that are managed for entirely different purposes. There is a need for the development of standard nomenclature; a name should relate to

the purposes for which the area was set aside and consequently to the uses deemed appropriate.

We are discussing a marine park or preserve as an area that is dedicated to and managed for the conservation and the protection of the marine features it contains that are of biological, geological, historical, cultural, scientific, recreational, and esthetic significance. An underwater marine park or preserve is a portion of a marine park or preserve that consists totally of submerged lands and the water column above. A marine coastal park or preserve is an area that is essentially a terrestrial park or preserve located adjacent to or surrounded by the ocean. It may be on an island, a peninsula, a cape, a beach, or a seashore. Although its boundaries may or may not extend into the ocean, its recreational, educational and scenic attractions are marine-orientated and it is managed so that activities on land will not damage or impair the marine resources in the adjoining waters.

PURPOSES OF UNDERWATER PARKS

Underwater parks, preserves, and similar areas are established to accommodate one or many purposes including: (1) perpetuation of a unspoiled natural submerged area and the significant features it possesses without the impact of damaging uses; (2) restoration and rejuvenation of an area that is submerged that has been degraded; (3) protection and restoration and perpetuation of individual species of marine life; (4) research and education; (5) recreation and tourism; (6) provision of a buffer zone.

Acceptable uses and activities that may be permitted within an underwater park or preserve are governed by the primary purposes for which it was established. Many visitor use activities, such as swimming, skindiving, surfing, boating, nature study, photography, are nonconsumptive and are appropriate within a national marine underwater park although some of these activities might be disruptive to animal life in an area dedicated as a research reserve.

The taking of all forms of marine life and the collecting of historical or geological features are prohibited in national underwater parks in some countries while in others commercial and sport fishing are permitted under strict control.

A specific underwater protected area may be zoned to accommodate varying degrees of protection and management. Within Biscayne National Monument, where commitments provide for the continuation of regulated commercial and sport fishing, areas will be designated totally for research, education, underwater observation and full pro-

tection; all forms of consumptive uses will be excluded from these zones.

CONCEPT OF UNDERWATER PRESERVATION

The concept of the preservation of underwater areas probably is not new. Some native peoples on oceanic islands, who were almost solely dependent on products of the sea for survival, established taboos that prohibited or restricted use of certain inshore areas and specific forms of marine life centuries ago. These efforts although largely local in nature illustrate an almost universal fascination of man for the seas.

When the boundaries of Everglades National Park, Florida, were authorized in 1934 they included the submerged lands and waters of Florida Bay and the coastal zone that extended for four miles into the Gulf of Mexico. Then the following year, the vast submerged lands and waters of the Dry Tortugas in the Gulf were set aside for protection as a large underwater park when Fort Jefferson National Monument was created by a Presidential Proclamation.

Subsequently, in 1957, the Government of the Bahamas created the Exhumas Cays Land-and-Sea Park to protect not only the unique coral reefs and marine features but terrestrial environments and animal life as well. California followed in April 1960 with the establishment of the Point Lobos Marine Preserve. Also, in 1960, a Presidential Proclamation provided protection for the reefs off the Florida Keys that extend beyond the three-mile zone by designating the area as the Key Largo Coral Reef Preserve. State of Florida next set aside the portions of the reef and waters that are located shoreward from the preserve and incorporated them in the John Pennekamp Coral Reef State Park, dedicated in December, 1960.

UNDERWATER PARKS URGED

At the Sixth Biennial Wilderness Conference, sponsored by the Sierra Club in San Francisco in 1959, recognition of the need for underwater wilderness areas came in the form of a resolution that recommended:

> . . . the extension of jurisdiction of agencies administering existing shoreline parks and preserves beyond the present boundaries at high-tide line so that they may include an adequate portion of the underwater plant and animal community . . . (Brower, 1960)

Participants at the First World Conference on National Parks in Seattle, Washington, in 1962, after discussing underwater preservation passed Resolution No. 15 that stated:

> Whereas it is recognized that the oceans and their teeming life are subject to the same dangers of human interference and destruction as the land, that the sea and land are ecologically interdependent and indivisible, that population pressures will cause man to turn increasingly to the sea, and especially to the underwater scene, for recreation and spiritual refreshment, and that the preservation of unspoiled marine habitat is urgently needed for ethical and esthetic reasons, for the protection of rare species, for the replenishment of stocks and valuable food species, and for the provision of undisturbed areas for scientific research.
>
> The First World Conference on National Parks invites the governments of all those countries having marine frontiers, and other appropriate agencies, to examine as a matter of urgency the possibility of creating marine parks or reserves to defend underwater areas of special significance from all forms of human interference, and further recommends the extension of existing national parks and equivalent reserves with shorelines, into the water to the ten fathom depth or the territorial limit or some other appropriate off-shore boundary.

This recommendation stimulated much interest and several countries have since established underwater parks or preserves or have conducted surveys of potential sites. These developments will be discussed later.

INTERNATIONAL UNDERWATER PRESERVES

The need for international underwater marine preserves for scientific research has been recognized also (Spilhaus, 1963; Wallen, 1970; Peterken, 1968). A proposal to create a system of international marine scientific preserves was presented to the United Nations in 1968. Although no action was taken, further consideration is being directed toward the proposal. A draft of a Convention on international seabeds, submitted by the United States for discussion last year, included provision for the designation as international parks or preserves of specific portions of the international seabed that are determined to have unusual educational, scientific or recreational value.

Antarctica an area larger than the United States is *in toto* an international nature preserve, set aside for 25 years by a treaty signed by the countries participating in the exploration of this region. The Antarctica represents a vast international marine preserve, as well, as uses of all marine life in the seas below 60 degrees latitude south are restricted to scientific purposes.

OCEANIC ISLANDS

An inventory of the oceanic islands of the Pacific is being conducted as a project of the International Biological Program in cooperation with the International Union for the Conservation of Nature and Natural Resources and the Pacific Science Association. Efforts are being made to determine how the unique island ecosystems may be preserved and incorporated into an international "islands for science" program (Chapman, 1969, Nicholson and Douglas, 1970). The status and problems of islands will be reviewed at the 12th Pacific Science Congress to be held in Canberra, Australia later this year.

A comprehensive inventory of the recreational, scenic, natural and historic values of America's islands has been completed by the U.S. Bureau of Outdoor Recreation. The report proposes cooperation at all levels of government for island conservation and recommends that states provide protective zones for underwater areas adjoining islands (Anon. 1970a).

INTERESTED ORGANIZATIONS

IUCN has been long interested in underwater parks and marine resources, even before the First World Conference on National Parks which it sponsored. At most of its recent meetings, papers on this subject have been discussed. This year, the IUCN established a 15-member committee on the conservation of marine life and marine habitats. Among the projects the committee plans to undertake will be an inventory of the underwater parks and preserves around the world. This survey will determine the status of these areas, their development and use. The committee plans to prepare guidelines for the establishment and operation of underwater parks and preserves, and to establish an international list of underwater protected areas similar to the United Nation's list of national parks prepared by Harroy and Elliott (1971).

Status of underwater parks programs will be further reviewed at the Second World Conference on National Parks in 1972 in Grand Teton National Park.

The African Leadership Foundation, the World Wildlife Fund and other international conservation organizations have encouraged the development of underwater parks and have supported studies of coastal and marine resources and potential sites for parks. The U.S. National Park Service has provided advice and assistance on underwater park development to many countries.

DEVELOPMENT OF UNDERWATER PARKS

Progressive stages in the establishment of underwater parks vary from country to country according to existing laws, procedures, jurisdictions, and public acceptance. However, the following steps may provide an orderly sequence for the development, acquisition, development, operation, management, and use of marine areas:

1. Establish the concept of marine resource conservation and a public understanding and appreciation of the needs to preserve marine environments.

2. Inventory coastal environments to determine types of environments present, their state of preservation, uses now being made, impact of these uses, and the identification of significant species, features and areas that require special protection.

3. Based upon this inventory, classify the environments into theme groups, such as tide pools, coral reefs, kelp beds, etc.

4. Conduct detailed studies of individual sites to determine their significance and boundaries required for desired degree of protection. Determine the feasibility of establishing the areas as underwater protected areas and define procedures that must be followed.

5. Selection of the most representative areas and those that most urgently need protection from the areas that received detailed study.

6. Prepare a master plan of the specific area to indicate the primary purposes, the proposed boundaries, the type of facilities and developments that are needed, the types of uses and activities that are permissible and those that should be prohibited, and the management and operational requirements.

7. Secure authorization for the area by legislative action, declaration, proclamation, or other methods available.

8. Establish appropriate rules and regulations.

9. Acquire the lands and waters if not covered in the establishment procedure.

10. Develop the area in accord with the master plan.

11. Operate, manage, protect and use the area. This involves adequate enforcement of necessary rules and regulations, provision for health and safety of visitors, protection for marine life and other park features, the maintenance of facilities, and the interpretation of park features.

NEED FOR INTERPRETATION

For a fuller understanding and appreciation of the marine ecosystems in a marine park, it is important that an imaginative interpretive program be developed. It should tell the story of the marine

world to the visitor in terms he can readily understand and by methods that will place him in closer contact with the underwater environment (Randall, 1969; Schulz, 1966; Wallis, 1961).

Among methods that are currently being used are: glass-bottomed boats; underwater observation rooms; self-guiding underwater nature trails with submerged markers that explain specific features; illustrated guide booklets; movies; illustrated lectures; conducted trips along the shoreline, in the tidepools, and in the water. Two underwater observation towers are in operation in two marine parks in Japan and others are being constructed (Taylor, 1969; Anon., 1969).

Creative imagination must be employed to develop additional means that may be used to effectively interpret undersea life. Procedures and devices and methods to be used are those that will not destroy, damage, or impair the features being displayed. Some methods may be for use by swimmers while "dry methods" will be required for individuals who do not go into the water. Closed-circuit television and hydrophones, plastic covered guide books or plates that identify the common forms of marine life for the swimmer to carry into the water, passenger-carrying submersibles, underwater tubes and walkways, floating craft with submerged viewing rooms, and underwater observation rooms are among some of the possible methods.

WORLDWIDE REVIEW

Some of the developments in underwater parks and preserves, on a country by country basis, are discussed below. It is recognized that the listing is incomplete but these discussions will illustrate some of the types of areas that are being protected.

UNITED STATES

In the United States, two underwater preserves have been created under authority of the Outer Continental Shelf Act. Key Largo Coral Reef Preserve was established by a Presidential Proclamation in 1969 and the Santa Barbara Ecological Preserve was designated by order of the Secretary of the Interior in 1969. The former adjoins a Florida State Park and the latter is adjacent to the State Santa Barbara Oil Sanctuary that California designated in 1955. Although commercial development, oil exploration and drilling, and other detrimental activities are forbidden in these federal preserves in which the natural environments are protected, regulated sport and commercial fishing are permitted.

National Park Service. The National Park Service administers over 50 areas that are located in or along the nation's coastline. Hartzog (1968) has discussed the Service's role in the conservation and management of underwater areas.

Half of the areas are historical units in which primary emphasis in management is placed upon the preservation of the marine environments that relate to the portrayal of the historic setting.

Eight national seashores are located along the oceans to provide for ocean-related recreation and the protection of natural values (Rose, 1967). The national seashores are: Cape Cod, Massachusetts; Fire Island, New York; Assateague, Virginia-Maryland; Cape Hatteras and Cape Lookout, North Carolina; Gulf Islands, Florida and Mississippi; Padre Island, Texas; and Point Reyes, California.

National parks and national monuments that contain extensive underwater submerged lands and adjoining waters and, therefore, are considered as underwater parks are: Buck Island Reef National Monument, and Virgin Islands National Park, American Virgin Islands; Biscayne National Monument, Fort Jefferson National Monument, and Everglades National Park, Florida; Channel Islands National Monument, California; and Glacier Bay National Monument, Alaska. Because of the unique marine species and ocean environments the vicinity includes, it has been proposed that Channel Islands be expanded to include additional islands and be made into a national park.

Other areas located along the ocean include: Acadia National Park, Maine; Cabrillo National Monument and Redwoods National Park, California; Olympic National Park, Washington; Katmai National Monument, Alaska; and Hawaii Volcanoes and Haleakala National Parks, and the City of Refuge National Historical Park, Hawaii.

Also included within the National Park System are four national lakeshores located on the shores of the Great Lakes—Sleeping Bear Dunes, Pictured Rocks, Indiana Dunes, and Apostle Islands—and Isle Royale National Park located in Lake Superior. All contain offshore boundaries and are for the protection of natural values.

Bureau of Sport Fisheries and Wildlife. A national wildlife refuge system, administered by the Bureau of Sport Fisheries and Wildlife, contains over 100 coastal areas that are managed for birds and mammals and other species. Boundaries of most of the refuge system areas do not include offshore waters.

Department of Defense. Under a cooperative memorandum of agreement, the National Park Service administers the wildlife resources of San Miguel Island that is under the jurisdiction of the Department of Defense.

Florida. In addition to the John Pennekamp Coral Reef State Park, Florida administers a number of other state parks and beaches along the coastlines. A series of 24 aquatic preserves were established by the Florida Trustees of the Internal Improvement Fund in 1969 upon the recommendation of the Florida Interagency Advisory Committee on Submerged Lands for the purpose of protecting unique marine life resources. Several of these underwater preserves are located adjacent to existing state parks, national parks, and national wildlife refuges and thus complement the conservation objectives of these areas (Anon., 1968).

Massachusetts. By an Act of the Massachusetts Legislature, the State Cape Cod Ocean Sanctuary was created on July 15, 1970 to provide offshore protection for Cape Cod National Seashore by prohibiting any exploitation or development of activities in the zone that extends from the Seashore's offshore boundary to the end of the three-mile territorial sea.

Washington. Boundaries of nine existing state parks in Washington were extended in 1970 to preserve marine environments against developments and aderse uses in the adjoining waters and on the submerged lands. Investigations are being conducted on additional potential underwater state park sites. The Washington State Park System, also, includes 40 park sites located on salt water and 57 undeveloped islands. Thirty-six of these are "marine parks" that are accessible only by boat. Action has recently been taken by the State Department of National Resources to reserve the submerged lands to one-quarter mile offshore fronting each state park.

California. Several types of underwater parks and preserves have been established in California in addition to the areas administered by the National Park Service. An intial underwater preserve, the Point Lobos State Preserve, was created in 1960. Recently two underwater parks, Julia Pfeiffer Burns Marine Park and Salt Point Underwater Park, were authorized upon the recommendations of the Advisory Board on Underwater Parks and Preserves for the California State Park and Recreation Commission. Each of these new areas is adjacent to an existing terrestial state park. The California Sea Otter Game Refuge, set aside in 1937, is located within the Burns Park. Sites for other prospective underwater parks are being investigated. (Lea, 1970.)

The San Diego City Council, by an ordinance passed on August 13, 1970, created the San Diego-LaJolla Underwater Park on city-owned submerged lands that extend 1½ miles offshore in the vicinity of LaJolla. In a subsequent ordinance, the council established an under-

water park advisory committee to assist in the development and protection of the new park.

The City of Avalon has requested that waters and submerged lands at Catalina Island be declared an underwater park for the protection of the natural resources. County of Marin manages Bolinas Lagoon as a marine preserve.

The California Department of Fish and Game administers six marine life refuges in connection with research and educational programs of major universities. They are Hopkins, San Diego, Bodega, Laguna Beach, South Laguna Beach and Newport Beach. All resources receive full protection except that collecting is permitted in connection with approved projects and that regulated sport fishing is allowed in the last three. Two other state refuges are the Pacific Grove Marine Gardens Fish Refuge and the Pismo Clam Refuge in San Luis Obispo County.

The University of California's Natural Land and Water Resources System include two marine areas, Scripps Shoreline-Underwater Reserve and the Ana Nuevo Island, off San Mateo County.

Hawaii. The Hawaiian Board of Land and Natural Resources designated the Hanauma Bay and Kealakekua Bay Marine Life Conservation districts in 1967 and 1969 to protect underwater resources. Development of additional underwater parks and preserves at sites on Maui, Molokai, and Kauai is recommended in the state's plan for marine development, ***Hawaii and the Sea*** (Beller, 1969).

CANADA

Canada has several national parks located along scenic coastlines in the maritime provinces, namely, Fundy, New Brunswick; Prince Edward Island; and Cape Briton Highlands, Nova Scotia. Their boundaries extend to the mean low tide line.

Three recently authorized national parks will have offshore boundaries and will be considered as underwater parks. Long Beach National Park on the Pacific Coast of Vancouver Island consists of three units; its offshore boundary extends for 1,000 yards. Formal establishment of this park, authorized in April, 1970 awaits Cabinet approval.

Kouchibouguac National Park, New Brunswick, established in October 1969, incorporates an offshore boundary. Since commercial fishing is not in keeping with the Canadian national park policies, fishermen who have lost their traditional fishing areas will receive compensation and assistance from the Federal Government.

Scenic coastal areas of Newfoundland's Long Range Mountains are

within Gros Morne National Park created in October, 1970. Plans call for an underwater section of the park and a study is being undertaken to define appropriate underwater boundaries.

Studies of the coastlines of Canada to provide a classification of the major divisions and their marine resources is being made for the National Parks Branch of the Department of Indian Affairs and Northern Development. The survey will identify significant examples of the coasts that require special protection and that are suitable for national park status and will define appropriate uses for each area and will develop a program for a system of national underwater parks for Canada.

In 1970, the Minister of Fisheries and Forestry, proposed that the entire Straits of Georgia in British Columbia be designated as a national marine underwater park. He explained his proposal with the participants at a special symposium he sponsored in Vancouver in October 1970 (Newman, 1970).

A document that would designate the Straits of Georgia as a general marine preserve and that calls for detailed plans or specific park units has been submitted to the Federal Cabinet for approval by the National Parks Branch. Following the Cabinet's approval of the proposal in principle, the Parks Branch will undertake further studies and develop appropriate master plans.

There are a number of provincial coastal parks but they do not include offshore boundaries. In British Columbia, a series of 12 parks are designated as "marine parks." These are recreational sites that are accessible only by boat that provide good anchorage and moorings in scenic surroundings.

Need for additional aquatic parks has been recognized as areas protected against man's developments and pollution and for recreational enjoyment and scientific study and preservation of scenic and natural values (McAllister, 1970).

MEXICO

An underwater park that includes a large submarine canyon off the tip of Cape San Lucas, Baja California, has been authorized in Mexico. A university study is now being conducted to inventory the resources and to provide recommendations for regulations. It has been recommended that the boundaries extend 10 miles on either side of the cape and out to the three-mile limit.

ECUADOR

Although Ecuador designed the Galapagos Islands as a national

park in 1965, the waters surrounding the islands that are scientifically significant are not included. It has been recommended that the park be enlarged to incorporate the marine environments. (Bowman, 1963).

JAPAN

Japan's interest in marine parks was especially stimulated by Recommendation No. 15 of the First World Conference on National Parks. It supported a marine parks symposium in Tokyo at the Pacific Science Congress in 1963. Between 1963 and 1970, the Preparatory Committee on Marine Parks and the Marine Parks Center of Japan conducted investigations of 50 potential sites for underwater marine parks. The Japanese Government in 1970 designated Marine Park Districts as part of the system of natural parks by a partial amendment of the Natural Parks Law.

Ten marine park districts that consist of 35 separate units were established in July 1970. These units are located within the designated areas of a national park or quasi national park. These marine park sites are: Kushimoto, Tomioka, Amakusa, Ushibuka, Sakurajima, Sata Cape, Ashizuri, Uwakai, Genkai, and Nichinan.

Tamura discusses these park developments in several reports (Tamura, 1966a, 1966b, 1968, 1969).

AUSTRALIA

Green Island and Heron Island that each contain coral reefs, turtle beaches, and bird nesting areas and are popular tourist attractions are national parks in Queensland, Australia. More than 110 islands along the coast have been declared as national parks but protection generally does not extend to the offshore resources and coral reefs. It has been proposed that the entire Great Barrier Reef and significant portions of the adjacent coastlines should be established as a national park (Worrell, 1966).

The concept of terrestrial and coastal parks is not new in Australia. The scenic coastline of Royal National Park in Queensland was set aside as a preserve in 1879 and made a public park in 1886. Ku-Ring-Gai Chase National Park that protects 74 miles of coastline was originally dedicated as a national parkland in 1891. Other national parks that have coral reefs and marine resources in the adjacent waters include: Noosa, Magnetic Island, Dunk Island, Hinchinbrook Island, Conway and Whitsunday Islands, and the Southern Barrier Reef Islands National Parks (Morcombe, 1969). Additional underwater parks and preserves have been recommended (Mosley, 1969).

TASMANIA

Tasmania has 12 coastal preserves and Freycinet Peninsula National Park that contain marine resources.

FALKLANDS ISLANDS

Under authority of an ordinance passed in May 1964 provision has been made for the establishment of nature preserves in Falklands Islands. Uninhabited Kidney Island and Cochon Island Nature Preserves afford total protection for sea lions and marine birds. Visits to these preserves is strictly regulated and are possible only to permit holders.

NEW ZEALAND

The Hauraki Gulf Maritime Park, embracing islands and coastal areas, was created in New Zealand in 1967. Proposals for other underwater parks and preserves have been made (Chapman, 1968).

PHILIPPINES

President Ferdinand E. Marcos, during a visit with Gen. Charles A. Lindbergh, a director of the World Wildlife Fund, on April 24, 1970, endorsed the establishment of 11 marine parks in various parts of the Philippines to serve as sanctuaries and as tourist attractions (*Manila Chronicle*, April 25, 1970). After appropriate boundaries have been determined, the parks will be created by proclamation. Three previously established marine parks include: Hundred Islands National Park at western side of the Gulf of Lingay, Manila Bay Beach Resort, and the shore and terrestrial features from Agoo to Camortis.

CEYLON

The Wildlife Protection Society of Ceylon proposed that the government establish marine reserves along both coasts and a dugong marine reserve in Portugal Bay and Dutch Bay (Hoffman, 1969).

FIJI

An ordinance in Fiji provides for the establishment of national parks. Ravileon and Nandarivatu islands are nature reserves and Bustard (1970) has recommended that the Cays of Heemsqerek reef and other uninhabited turtle nesting areas be declared as strict turtle sanctuaries.

WEST MALAYSIA

In West Malaysia, members of the Malayan Sub-aqua Club passed an unanimous resolution at their annual meetings in 1967 and 1968

that the fringing reefs on several of the islands be regarded as marine nature preserves and urged the government to provide needed protection. Voluntarily the members agreed not to collect in these localities pending government action (Wycherley, 1969).

TAIWAN AND KOREA

Dr. George C. Ruhle, of the U.S. National Park Service, conducted surveys of potential sites for national parks and reserves in Taiwan and Korea under the sponsorship of IUCN. He recommended that a system of marine national parks and public seashores be established (Ruhle, 1966, 1968).

CARIBBEAN REGION

Underwater parks and preserves have been proposed for several countries in the Caribbean Region including Guyana, Barbados, St. Vincent, and the British Virgin Islands. In Tobago, the colorful coral reefs and the marine life of Buccoo Reef are protected under government control.

Costa Rica. Tortuguero National Park, Costa Rica, was established to protect natural values including the important nesting beaches of the green turtles. The boundaries of the park extend out to sea for three miles. Further to the South a few miles along the eastern coast, Costa Rica has created the Cahuta National Monument to protect a series of reefs which also contain the wreckage of ancient ships.

Surinam: Surinam recently authorized three nature preserves for the protection of marine turtles.

Puerto Rico: The bioluminescent bays, including Phosphorescent Bay, and other marine areas around Puerto Rico were investigated by the U. S. National Park Service at the invitation of the Commonwealth. This study recommended that outstanding marine sites would be preserved as parks (Anon. 1968a).

Colombia: On its Caribbean coast, in Tayronas National Park, Colombia has embayments that are endowed with coral reefs that are in a fine state of preservation.

REPUBLIC OF SOUTH AFRICA

By proclamation in 1964, Tsitsikama Coastal National Park was created in the Republic of South Africa. It includes 40 miles of coastline and extends one-half miles offshore. Commercial exploitation of marine resources is not permitted (Robinson, 1969). Guidebooks on fishes and seaweeds of the park, illustrated in color, have been issued for the park visitors (Smith and Smith, 1966).

SUDAN

The Government of Sudan has proposed the creation of a marine national park on the shores of the Red Sea.

KENYA

Malindi and Watami Marine National Parks, containing more than five square miles of coral reefs, were established by Kenya in 1968. Connecting the two parks are two national marine preserves that buffer the parks with 70 square miles of offshore land and water. Dr. Carleton Ray made a survey of the parks in 1969 and provided the government with specific recommendations for the management of these areas. Although regulated consumptive uses are included in the reserves, all forms of marine life are protected in the parks. (Ray, 1968, Saw, 1969).

ETHOPIA

Potential sites for marine parks and reserves at the Dhalac Islands, off the Eritrean Coast of the Red Sea of Ethiopia were studied in 1969.

ISRAEL

Eilat Gulf Nature Reserve on the Red Sea in Israel, created on September 10, 1964, provides total protection for marine life and its coral reefs. A law passed in 1963 allows for the development of natural reserves and national parks with the distinction that reserves are for scientific and conservation purposes and that the national parks are primarily for recreation (Harroy and Elliott, 1971).

LITERATURE CITED

Anon.
1968a. The bioluminescent bays of Puerto Rico, a plan for theijr preservation and use. Prepared for the Commonwealth of Puerto Rico by the U. S. National Park Service. Department of the Interior; Washington, D. C. 48 p.
1968b. Marine national parks. National Parks Assoc. of Queensland News. October. p. 3.
1968c. A proposed system of aquatic preserves. Report No. 2 to the Trustees of the International Improvement Fund by the Florida Inter-agency Advisory Committee on Submerged Land Management. November 12. 46 p. unpublished.
1969. Sightseeing under the sea soon to be realized: Dawning of the age of underwater tourism. Japan Illustrated. 7: 3. pp. 17-21.
1970a. Islands of America. Department of the Interior, Bureau of Outdoor Recreation. U. S. Government Printing Office: Washington, D. C. 95 p.
1970b. The reef, the glimmering world of undersea coral glades. Life M. 69: 17 (Oct. 23). pp. 50-56.

Beard, Daniel B.
1960. Plants and animals in natural communities. *In*: The meaning of wilderness to science. Proc. Sixth Biennial Wilderness Conf. Sierra Club: San Francisco. pp. 3-17.

Beller, William S.
1969. Hawaii and the sea, a plan for state action. Report to the Governor's Task Force on Oceanography. Hawaii Dept. of Planning and Economic Development.

Bowman, Robert I.
1963. The scientific need for island reserve areas. Proc. XVI International Congress of Zoology, Washington. Volume 3. pp. 394-399.

Brower, David. ed.
1960. The meaning of wilderness to science. Proc. Sixth Biennial Wilderness Conf. Sierra Club: San Francisco. 130 p.
Bustard, H. Robert
1970. Turtles and an iguana in Fiji. Oryx. 10: 5 (Sept.). pp. 317-322.
Chapman, V. J.
1968. Underwater reserves and parks. Biol. Conserv. 1: 1 (Oct.). p. 53.
1969. Conservation of island ecosystems in the South-West Pacific. Biol. Conserv. 1: 2 (Jan.). pp. 159-165.
Eissler, Frederick
1968. Toward an underwater wilderness system. Sierra Club Bull. 53: 1. p. 26.
Grater, Russell K.
1964. National aquatic parks. Trends in Parks & Recr. 1: 1 (July).
Harroy, Jean-Paul and Hugh Elliott
1971. United Nation's List of National Parks and equivalent reserves. 2nd ed. Hayez Publications: Brussels. 601 p.
Hartzog, Jr., George B.
1968. Conservation and management of seashore and underwater areas for public enjoyment. Proc. Latin Amer. Conf. on the Conserv. of Renewable Natural Resources. Publ. NS No. 13: IUCN: Morge, Switzerland. pp. 350-361.
Hoffman, T. W.
1969. The status of national reserves in Ceylon. IUCN Bull. NS 2: 13 (Oct.-Dec.). pp. 111, 112.
Lea, Albert
1970. Here come the underwater parks. Westways. 62: 6 (June). pp. 40-44, 57.
McAllister, D. E.
1970. Proposal for aquatic parks and reserves in Canada. The Canadian Field-Naturalist. 84: 2 (April-June). p. 97.
Marsh, John S.
1971. Marine parks: and annotated bibliography. Council of Planning Librarians. Exchange Bibliography No. 176. 11 p.
Morcombe, M. K.
1969. Australia's national parks. Lansdowne Press: Melbourne. 232 p.
Newman, Murray
1970. Gulf of Georgia symposium. Vancouver Public Aquarium Newsletter. 14: 6 (Nov.-Dec.). pp. 7-8.
Nicholson, E. M. and G. L. Douglas
1970. Conservation of oceanic islands. Papers and Proceedings, IUCN 11th Technical Meeting, New Delhi, India, November 25-28, 1969. Vol. 1. pp. 200-211. IUCN Publ. NS. No. 17.
Peterken, G. P.
1968. International selection of areas for reserves. Biol. Conserv. 1:1 (Oct.) pp. 55-61.
Polunin, N. V. C.
1969. Coral reefs. aquaria and conservation. Biol. Conserv. 1: 4 (July). pp. 278-279.
Randall, John E.
1969. Conservation in the sea: a survey of marine parks. Oryx. 10 (Oct.). pp. 31-38.
Ray, Carleton and Elgin Ciampi
1956. The underwater guide to marine life. A. S. Barnes & Co.: New York. 338 p.
Ray, Carleton
1961. Marine preserves for ecological research. Trans. 26th No. Amer. Wildl. & Natural Resources Conf., 1960. pp. 323-328.
1962. Inshore marine conservation. Proc. of the First World Conf. of National Parks, Seattle, Washington, 1962. Dept. of the Interior: Washington, D. C. pp. 79-87.
1963. The scientific need for shallow-water marine sanctuaries. Proc. XVI Intern. Cong. of Zool., Washington. Vol. 3. pp. 406-411.
Ray, Carleton
1968. Marine parks for Tanzania, results of a survey of the coast of Tanzania by invitation of the Trustees of Tanzania National Park. Conservation Foundation: Washington, D. C. 47 pp.
1969. Marine parks and inshore conservation in Kenya. Report made to Director of Parks, Nairobi, Kenya, on behalf of African Wildlife Leadership Foundation. 33 pp. (unpublished report)
1970. Ecology, law and the 'marine revolution.' Biol. Conserv. 3: 1 (Oct.). pp. 7-17.
Robinson, Gilbert A.
1969. The Tsitsikama coastal national park. Biol. Conserv. 2: 1 (Oct.). pp. 72-73.
Rose, Robert H.
1967. Public seashores—their preservation and use. Proc. and Papers of the IUCN Technical Meeting, Lucerne, June 1966. *In:* Part I: Ecolog-

ical impact of recreation and tourism upon temporate environments. IUCN Publ. NS. No. 7. pp. 146-152.

Ruhle, George C.
1966. Advisory report on the national parks and reserves for Taiwan, 1965. Spec. Publ. No. 19. Amer. Committee for Intern. Wild Life Protection: Bronx, New York. 77. p.
1968. Advisory report on national parks and reserves for the Republic of Korea, 1966. Spec. Publ. No. 20. Amer. Committee for Intern. Wild Life Protection: Bronx, New York. 102 p.

Sandburg, Helga and George Crile, Jr.
1969. Above and below, a journey through our national underwater parks. McGraw-Hill Book Co.: New York. 302 p.

Saw, Pauline
1969. A year after their founding, let's look at Kenya's marine parks. Africana. 3: 11 (Sept.). pp. 6-9.

Spilhaus, Athelstan
1963. Exploration of the sea. *In:* Tomorrow's Wilderness. Sierra Club: San Francisco. pp. 107-115.

Smith, J. L. B. and Margaret M. Smith
1966. Fishes of the Tsitsikama coastal national park. National Parks Board of Trustees of the Republic of South Africa. The Swan Press: Johannesburg. 161 p.

Schulz, Paul E.
1967. Public use of underwater resources. *In:* Part I. Ecological impact of recreation and tourism upon temperate environments. Proc. & Papers of the IUCN 10th Technical Meeting, Lucerne, June 1966. IUCN Publ. NS. No. 7. pp. 153-159.

Tamura, Tuyosi, et al
1966a. Marine parks—papers presented at the special symposium on marine parks. 11th Pacific Science Congress, Tokyo, September 4-9, 1966. Nature Conservation Society: Tokyo. 57 p.
1966b. Marine parks in Japan, a collection of five papers. Nature Conservation Society: Tokyo. 34 p.
1968. The Marine Parks Center of Japan. Biol. Conserv. 1: 1 (Oct.). pp. 89-90.
1969. Japan's initial project for a marine parks research institute. Biol. Conserv. 2: 1 (Oct.). pp. 66-68.

Taylor, Donald M.
1969. Observation towers for undersea parks. Ocean Industry. 4: 12 (Dec.). pp. 48-49.

Tzimoulis, Paul J.
1968. The buffalo hunters. Skin Diver M. 17: 7 (July). pp. 3, 20.

Wallen, I. Eugene
1970. Preserving the quality of the oceans. BioSci. 20: 9 (May). p. 522.

Wallis, Orthello L.
1961a. Coral reefs, a challenge to conservation. National Park Service: Washington, D. C. 23 p.
1961b. Interpreting marine and freshwater life in national parks. Park Practice Guideline, National Conference on State Parks. 2: 7. pp. 25-28.

Worrell, Eric
1966. The Great Barrier Reef. Tri-Ocean Books: San Francisco. 128 p.

Wycherley, Paul R.
1969. Conservation of coral reefs in West Malaysia. Biol. Conserv. 1: 3 (April). 1: 3 (April). pp. 259-260.

DISCUSSION

VICE CHAIRMAN YANGGEN: Thank you very much Mr. Wallis. That was certainly a very fascinating subject to discuss.

MR. HAROLD COOLIDGE (IUCN): I was very much interested in this paper and I feel that this is a subject that I hope is going to be of increasing interest to people who attend these conferences as the years go by. It does seem to me that it is too bad that in the underwater areas that the states have created I heard no mention of Oregon. In other words, I wonder if the speaker knows whether Oregon has made any move to extend public ownership in underwater park categories.

MR. WALLIS: I regret to say that I don't know what the status is with regard to Oregon. Perhaps somebody from Oregon can help us out.

FROM THE FLOOR: I don't think the speaker made any reference to the Australian parks, but there are several important underwater parks in Australia, aside from the barrier reef.

VICE CHAIRMAN YANGGEN: Are there any other questions or comments for Mr. Wallis?

If not, we can make this a question and answer period in relation to any of the presentations of any of the speakers.

Are there further comments?

MR. KEITH HAY (API, Washington, D.C.): I would like to address this question to Mr. Eschweiler.

I understood from your remarks that you do not have any ecologists on your staff. I wonder if I could get your opinion on how you see the role of the ecologist in a planning process—whether you see it merely as an advisory element in your conservation council or do you think he can be used as a full-time staff assistant among your council?

MR. ESCHWEILER: We certainly would welcome any ecologist on our staff as a full-time advisor if we could possibly get one. We function at the local planning level, the level at which the basic land use controls are going to be implemented, I think is probably too low a level for the government to expect to have a full-time ecologist as a professional advisor to that local government. In that respect then perhaps the next higher level of government, the county in our case, can make this staff ecologist available on an advisory basis to the local government. The Conservation Advisory Council still would attempt to fill part of this void and not at least give the professional advice that the trained ecologist might give but, on the other hand, to sensitize the politicians, the land use control and the local planning boards in relation to these considerations. Am I directing my answer to your question?

MR. HAY: Yes, let me ask you one more question.

We have a lot of unemployed wildlife biologists. In fact, we are producing more than we have jobs for. They have a good general background in ecology. Could they be utilized in the planning process or would they necessitate additional education?

MR. ESCHWEILER: In our operation, it would be completely compatible. Our job standards for staff members embrace a very wide spectrum of training and experience level, so that at least in our particular county level, there would be no trouble whatsoever in accommodating them on the basis of their present experience. However, ours happens to be a relatively large agency and possibly agencies with some of the smaller staffs might not be able to take in that type of background. Now, in the final analysis, we are limited more by our budget than our professional qualifications.

VICE CHAIRMAN YANGGEN: I would like to ask Mr. Hamilton if he would care to respond to the question in relation to the ecologist?

MR. HAMILTON: Well, I cannot speak for Westchester but some of our graduates have moved into planning offices. The Hudson River Valley Commission, at the moment, is in the process of hiring one of our people as an ecologist. This does not involve a big ground swell as yet but they are looking for people, I think, not with a wildlife background but more with a general ecology, geography kind of training. I don't know what we are going to do with all of the extra foresters that we have hanging around.

I cannot speak for the planning offices nationwide but I do know of a few instances where this has happened.

I wonder if I can ask a question of Mr. Wallis.

I presume that the initial hang-up in creating these underwater parks was public indifference—not knowing what was there. Another of the hang-ups was the fact of whether it was complete jurisdiction with regard to Federal versus state or one nation versus another. What is the major impediment now?

MR. WALLIS: I think it is probably lack of real understanding in many cases of marine environments that require full protection. There, also, is the matter of jurisdiction as you know.

For example, in connection with the United States, the Submerged Lands Act gives the states jurisdiction generally to the zone that extends for three miles from shore. Beyond that jurisdictions are different. In Canada, the federal government has jurisdiction over the coastal zone. Some other countries have not

defined who has jurisdiction on the continental shelf. This has apparently been one of the hang-ups in connection with the establishment of marine parks in Australia.

In some programs the federal and state activities compliment one another. For example, in Florida the aquatic preserves are located adjacent to national parks, wildlife refuges and state parks. Therefore, these marine areas are serving as buffer zones—as complementary management to the estuarine areas. So there are some places where I think that the jurisdictional matters can be resolved but in total it is rather complicated. Some matters relating to sea beds and other factors may be resolved in a few years with new decisions regarding the international law of the seas.

MR. DAVID CHARLTON (Oregon): This is directed to Professor Hamilton. I understand that Governor Rockefeller set up a commission two or three years ago to deal with the preservation of agricultural land. I wonder if you can tell me what progress has been made on that?

PROFESSOR HAMILTON: The usual report has been published and turned in. In addition there are two follow-up actions.

First of all, a new position of liaison officer between the State Departments of Agriculture and Transportation has been set up. It was felt that highways were one of the major factors removing good land from agricultural use. This man's job is review all preliminary road corridors to determine what their impact would be on agricultural land and to suggest new locations to minimize adverse impact. He is doing precisely that job and is able to change initial route locations. We view this as a major step forward, to have an ecologist (soils-agronomy) in on Transportation's highway planning.

The second thing is that legislation is being drafted to implement one of the recommendations of the Commission on the Preservation of Agricultural Lands. This concerns the setting up of Agricultural Districts and providing for land assessment on the basis of present use in these districts.

Thus, the work is going on, though the report is in. Copies of the report are available.

MR. CHARLTON: Just one more word. My advice on that matter has been made public in a letter that I wrote.

PROFESSOR HAMILTON: I would like to say one more thing on the subject of the use of ecologists in planning efforts.

I have had, within the last three weeks, five requests for ecological planning consultation from land developers. These have been engendered by the new H.U.D. requirements for ecological studies as part of major housing developments. Apparently the number of planning consulting firms competent to do this kind of thing is inadequate. I believe that this kind of thing will become Standard Operating Procedure and if so, it offers opportunities for students trained in ecology, but with some "people orientation" to find useful and challenging careers.

VICE CHAIRMAN YANGGEN: I will entertain one last question or comment and while we are waiting for that I would like to thank the members of the audience and the members of the panel for a very productive afternoon.

MR. LONG (Oregon): I would like to make one remark with regard to the matter of the marine type of park and that is that the waters off the coast of Oregon are too cold for coral or any other of the marine life that would normally justify such a park.

However, the state has its chain of parks along the coast which are of great interest and used extensively to the point of exclusion of some of the people from Oregon.

Another comment is that we have an oceanography research laboratory located at Newport, which is a very important element in connection with these waters off of the coast of Oregon and California.

CHAIRMAN SCHULMAN: Ladies and gentlemen, this will conclude our session for the afternoon. I also would like to express our thanks to our panelists and to you for your fine questions and comments.

This session is now adjourned.

TECHNICAL SESSION

Monday Afternoon—March 8

Chairman: J. ANTHONY KEITH
Pesticides Coordinator, Canadian Wildlife Service, Ottawa, Canada

Discussion Leader: JAMES O. KEITH
Biologist, Denver Wildlife Research Center, Bureau of Sport Fisheries and Wildlife, Denver, Colorado

CHEMICAL CONTAMINATION

THE OCCURRENCE AND SIGNIFICANCE OF POLYCHLORINATED BIPHENYLS IN THE ENVIRONMENT

E. H. DUSTMAN, L. F. STICKEL, L. J. BLUS, W. L. REICHEL, AND S. N. WIEMEYER

Patuxent Wildlife Research Center, Bureau of Sport Fisheries and Wildlife, Laurel, Maryland

The natural world today contains a vast array of man-made chemicals, many of them with biological potency in quantities scarcely measurable two decades ago. Wild animals encounter these chemicals in multifold combination, but man's knowledge of their effects on wild species progresses haltingly. While research focused on DDT, dieldrin, and related chemicals that were obvious suspects for cause of environmental problems, other compounds, some unidentified, spread and increased.

Polychlorinated biphenyls (PCB's) constitute one such group. PCB's are products of modern industrial chemistry that have escaped to the environment by routes still largely unknown. They have become ubiquitous in the world ecosystem in quantities similar to those of DDE. Their presence has caused concern and stimulated research to evaluate their role in the biosphere.

CHEMISTRY

PCB's are named for their chemical structure, which consists of phenyl groups with chlorine substitution. They are not obtainable as single compounds, but as mixtures of compounds of the same basic structure with different numbers of chlorine atoms in different positions. In theory at least, 189 different arrangements are possible for molecules containing from one to eight chlorine atoms (Jensen, 1970). In practice, however, Jensen found that there usually were four to eight chlorines per molecule; even for this number there still would be 102 different possibilities.

The basic structure of the PCB molecule is shown in Figure 1 for comparison with other familiar chemicals that also are composed of benzene rings with chlorines attached. Some of these chemicals, such

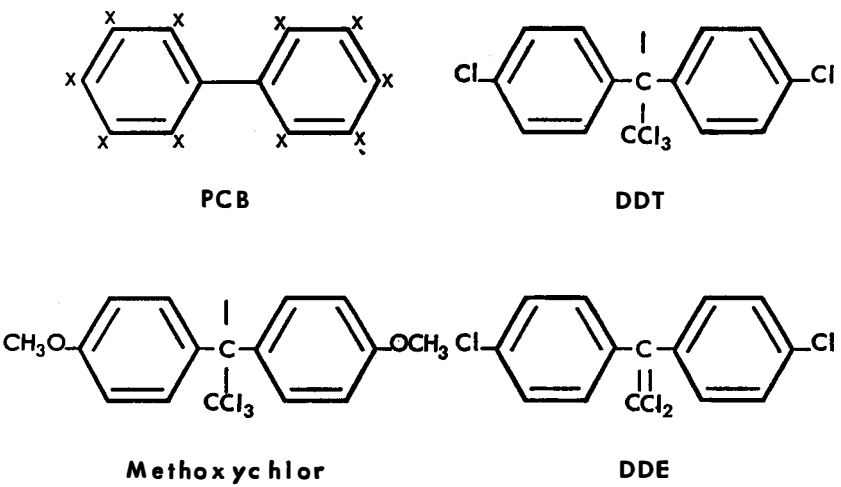


Figure 1

as DDE, are stable and long-lasting; others such as methoxychlor are rapidly broken down and only rarely are found in the tissues of warm-blooded animals. Environmental hazard, therefore, should not be judged on the basis of benzene rings and chlorine atoms alone. The molecular structure of a compound is related to its biological activity, but the relationships are intricate, not obvious (Bitman and Cecil, 1970).

PCB's, which are composed of many different compounds, produce many different peaks on the gas chromatograph; since some of these coincide with the peaks produced by organochlorine pesticides, they

complicate analysis. Certain PCB peaks come very close to the peaks for DDT and DDD and are particularly troublesome. The PCB peaks did not go unnoticed in the past, but since they could not be identified, they were rarely reported (Simmons and Tatton, 1967). The troublesome "unknowns" were identified as PCB's by Sören Jensen in 1966.

We had an early experience at Patuxent that alerted us to the problems that could be caused by these "unknowns." At a time when our first gas chromatograph was new and somewhat suspect, it produced a reading for 8 ppm of DDT in a sample of herring gull liver in which no DDT was detected by thin-layer chromatography. The chemists resolved the problem by treating the sample with potassium hydroxide, and then re-analyzing it. Potassium hydroxide treatment changes DDT to DDE and a re-analysis would show no DDT and a greater amount of DDE. This did not happen in the sample in question. The peak in the location for DDT did not change, showing that it was not DDT.

We solved the problem of PCB interference in pesticide analysis by developing a method in which chemicals are separated into four zones on a thin-layer plate and each zone is analyzed on two different columns by gas-liquid chromatography (Reichel *et al.*, 1969). Other laboratories have developed methods to prevent interference of PCB's with analysis for organochlorine pesticides (Simmons and Tatton, 1967; Holden and Marsden, 1969; Reynolds, 1969; Armour and Burke, 1970).

Even when PCB's have been separated from other chemicals, it still is difficult to measure the amounts, because of the many different compounds that are involved. Several methods have been used to make approximate estimates by gas chromatography (Risebrough *et al.*, 1969), and our laboratory has recently developed a thin-layer chromatographic procedure (Mulhern, 1971).

Positive identification of PCB's was made possible by the mass spectrograph, an instrument that fragments molecules into their component parts and provides the information necessary to derive actual chemical formulas. Jensen used this instrument to make the first identifications of PCB's in tissues of wild animals in Sweden (1966, 1970). Koeman *et al.* (1969) confirmed the presence of PCB's in Netherlands wildlife by the same method, and in the United States Bagley *et al.* (1970) at our laboratory used the mass spectrograph to identify 19 different PCB compounds in the tissues of bald eagles (*Haliaeetus leucocephalus*). Biros *et al.* (1970) examined human tissues and found PCB's there also.

USE AND SOURCE

Polychlorinated biphenyls were introduced in 1929 for use in electrical transformers and condensers, where their flame-resistant qualities were highly valued. These are their primary uses today. They have found many other uses, and from some or many of these they have escaped to the world environment to become ubiquitous components of wild animal tissues. They are used in marine antifouling paints, in cardboard cartons (Bailey *et al.,* 1970), in insecticide formulations (as inert ingredients or carriers), and even as dust-allayers in some detergents. PCB's are marketed as mixtures that contain different percentages of chlorine and that have different characteristics. For example, Aroclor 1242 contains 42 percent chlorine and is a light fluid, whereas Aroclor 1260 contains 60 percent chlorine and is a viscous resin. Production figures are secret and the proportional uses in different products are largely unknown. Overall production in the United States probably is on the order of hundreds of millions of pounds annually.

We do not fully understand how the PCB's permeated the environment, although they have been traced to the source in certain areas. In the United States, Duke *et al.* (1970) traced PCB's in fish and shellfish up the Escambia River to their source in a factory leakage. In the Netherlands, Koeman *et al.* (1969) found that discharge from the River Rhine was the source of most of PCB's present in the fish and seabirds on the Atlantic coast of the Netherlands and in the Wadden Sea. Holden (1970) sampled marine fish and molluscs from many Scottish waters, and when he found that the highest residues of PCB's were in animals from the Firth of Clyde, he began a search for the source. He found the answer in sludge from sewage treatment plants which was being carried out and dumped in the deep water of the estuary. He estimated that PCB's from this source entered the Clyde estuary at the rate of 1 ton per year. Similar amounts were dumped into the North Sea from the sewage plants of Manchester and into the Thames from the sewage plants of London. Hundreds of factories are linked to the sewers, and it was not possible to trace the PCB's to specific units.

OCCURRENCE

Knowledge of PCB's in the environment is continuously increased as new samples are analyzed from new areas. Jensen's report of PCB's in Swedish wildlife was followed in close succession by reports from Great Britain (Holmes *et al.,* 1967; Prestt *et al.,* 1970), Scotland (Holden and Marsden, 1967), the Netherlands (Koeman *et al.,* 1969),

and the United States (Risebrough *et al.*, 1968b; Anderson *et al.*, 1969; Reichel *et al.*, 1969; Bagley *et al.*, 1970; Mulhern *et al.*, 1970), and more extensive reports from Sweden (Jensen *et al.*, 1969). In Sweden, Jensen *et al.* (1969) found the highest residues of PCB's in animals of the Baltic Sea and near the Archipelago of Stockholm; residues were much lower in animals in the Gulf of Bothnia, remote from industrial areas. In California, Risebrough *et al.* (1968) found that residues of PCB's were considerably higher in animals of San Francisco Bay and San Diego Bay than in those from the Farallon Islands, 27 miles west of the Golden Gate. Holden and Marsden (1967) found that seals taken from the east coast of Scotland, where estuarine pollution is greater, contained higher residues of PCB's than those from the west coast.

PCB's also have been found in rainwater (Tarrant and Tatton, 1968) and in the air (Jensen, 1966; Risebrough *et al.*, 1968a), and in 1969, a black snow containing PCB's fell on a 10,000 km^2 area in southwestern Sweden (Smithsonian, 1970).

Measurements made at Patuxent of residues[1] of PCB's in the eggs of wild birds collected in the late 1960's have shown some interesting contrasts:

In 12 Alaskan bald eagle eggs, median PCB residues were 1.65 ppm, considerably lower than the median of 9.7 ppm for 11 eggs from Maine, Michigan, Minnesota, and Florida.

Connecticut ospreys (*Pandion haliaetus*) laid eggs containing a median concentration of PCB's of 15.9 ppm and a maximum of 29.9 ppm, with none lower than 6.9 ppm. In contrast, eggs of Maryland ospreys contained a median concentration of 2.5 ppm and a maximum of 4.4 ppm.

Median concentrations of PCB's were 5.5 ppm in eggs of brown pelicans (*Pelecanus occidentalis carolinensis*) from South Carolina and 5.0 ppm in eggs of royal terns (*Thalasseus maximus*) nesting in the same area. Median concentrations in eggs of Florida pelicans (*P. o. carolinensis*) were 1.4 ppm, and in eggs of California pelicans (*P. o. californicus*) were 5.0 ppm.

In Great Britain, Prestt *et al.* (1970) found that PCB residues in eggs of 46 species of wild birds generally were below 5 ppm, but there were notable exceptions. For example, PCB residues in heron (*Ardea cinerea*) eggs averaged 5 ppm, and 10 of 101 eggs contained more than 10 ppm, including one with 40 and one with 80 ppm. The egg of a great crested grebe (*Podiceps cristatus*) contained 40 ppm and an egg of a great skua (*Stercorarius skua*) contained 25 ppm.

[1]All residues listed in this paper are on a wet weight basis.

Anderson *et al.* (1969) reported 8 ppm of PCB's in cormorant (*Phalacrocorax auritus*) eggs and 0.6 ppm in eggs of the white pelican (*Pelecanus erythrorhynchos*). Jensen *et al.* (1969) found guillemot (*Uria aalge*) eggs to contain an average of 16 ppm (7.9 to 21 ppm) of PCB's.

It would appear from these records that residues of PCB's of 10 ppm or above in eggs are high by today's standards and that in areas where such residues occur, birds of varied kinds and food habits should be studied to determine whether population problems are occurring.

FOOD CHAINS

PCB's build up in biological food chains. In two simple food chains, fish to eagles (*Haliaeetus albicilla*) and fish and mussels (*Mytilus edulis*) to seals (*Phoca vitulina* and *Pusa hispida*), concentrations increased hundreds to thousands of times from prey to predator (Jensen *et al.*, 1969). PCB's in the fish were measured in hundredths to tenths of ppm; in fresh mussels they measured hundredths of ppm; in seal blubber they measured 5-21 ppm; and in the muscle of the white-tailed eagle they measured 150-240 ppm.

PCB residues in terrestrial species of birds throughout Britain were closely related to their food habits (Prestt *et al.*, 1970). The highest concentrations were in birds that feed on birds or mammals, next in those that have a mixed diet, and lowest in those that feed on insects (Prestt *et al.*, 1970). Highest residues were in the fish-eating herons from the southeast of England.

In many species of California birds, PCB's measured hundredths to tenths of ppm; peregrines (*Falco peregrinus*) contained greater amounts, one as high as 98 ppm in muscle (Risebrough *et al.*, 1968), while fish in the same area contained only thousandths of ppm.

Residues of PCB's in the industrially polluted Escambia Bay increased in the expected order. Water contained a maximum of 275 ppb, and sediment a maximum of 486 ppm. Oysters (*Crassostrea virginica*) contained 2-3 ppm, shrimp (*Panaeus duorarum*) 1.5-2.5 ppm, blue crabs (*Callinectes sapidus*) 1-7 ppm, and pinfish (*Lagodon rhomboides*) 6-12 ppm (Duke *et al.*, 1970).

TOXICITY

Outright mortality of wild animals can affect populations, particularly those of long-lived species. Measurements of direct toxicity are therefore important first steps in evaluation of a chemical. Other laboratory studies also are needed for proper interpretation of field

observations. These include studies to diagnose cause of death by behavior of poisoned animals, tissue changes, and concentrations of chemical in critical tissues.

Birds

The toxicities of different PCB's to pheasants (*Phasianus colchicus*), mallards (*Anas platyrhynchos*), bobwhite quail (*Colinus virginianus*), and coturnix quail (*Coturnix coturnix*) were tested at Patuxent and compared with the toxicities of DDT, dieldrin, and other insecticides (Heath *et al.*, 1970). Tests of six PCB mixtures, containing 32 to 62 percent chlorine, showed that the toxicity increased with the percentage of chlorine. In general, toxicities were similar to those of DDE. There were some differences in sensitivity of the species. Bobwhites were most sensitive, followed in turn by pheasants, mallards, and coturnix quail. Bobwhite were 3-4 times as sensitive as coturnix. Special tests with coturnix quail showed that the toxic effects of DDE and Aroclor 1254 were additive but not synergistic.

In other studies at Patuxent, comparisons were made of the toxicity of PCB's (Aroclor 1254) and DDE to four species of blackbirds: grackles (*Quiscalus quiscula*), cowbirds (*Molothrus ater*), starlings (*Sturnus vulgaris*), and redwings (*Agelaius phoeniceus*) (W. H. Stickel, unpublished data). The two compounds had very similar toxicities as measured by the time to 50 percent mortality. Redwings were somewhat more susceptible to DDE than to PCB's. Signs of poisoning included sluggishness first with slight tremors, then continuous tremors of moderate amplitude, much as with chemicals of the DDT group. Internally, livers frequently had hemorrhagic streaks or spots and the gastrointestinal tract commonly contained blackish fluid, but these signs were not sufficiently consistent for distinctive diagnosis.

Prestt *et al.* (1970) estimated that PCB's (Aroclor 1254) were approximately 1/13 as toxic as DDT to Bengalese finches (*Lonchura striata*). Tremoring and other signs were similar to those we observed among blackbirds; the finches had enlarged kidneys and some had hydropericardium.

In tracing the cause of mortality of chicks kept in batteries recently painted with an epoxy-resin paint, McCune *et al.* (1962) identified the toxic ingredient as Aroclor 1242. Chickens that died in feeding studies showed hydropericardium and enlarged livers and kidneys.

Egg injection studies showed that Aroclor 1242 had a relatively high toxicity (McLaughlin *et al.*, 1963).

Polychlorinated biphenyls supplied by three different manufactur-

ers gave strikingly different results in toxicity tests with domestic chickens although all formulations contained 60 percent chlorine (Vos and Koeman, 1970). The PCB's tested were: Phenoclor DP6, manufactured in France; Clophen A60, manufactured in Germany; and Aroclor 1260, manufactured in the United States. At a dietary dosage of 400 ppm for 60 days, all 24 birds fed Phenoclor died; all had liver necrosis and 18 had hydropericardium. Results with Clophen were similar: 22 of 24 died, all with liver necrosis and 20 with hydropericardium. Results with Aroclor differed in that only 3 of 24 died, none had liver necrosis, and only 3 had hydropericardium. Atrophy of the spleen was common to all groups and the presence of excess quantities of porphyrins was found as a general PCB effect. These differences were later largely explained by the identification of chlorinated dibenzofuran and chlorinated naphthalene as contaminants in Phenoclor and Clophen (Vos *et al.,* 1970). Contamination of contaminants thereby increases the complexity of the problems of environmental pollution.

Insects

The toxicity of PCB's to insects also is related to the chlorine content, but in the reverse order to the result with birds. PCB's with lower amounts of chlorine were more toxic to flies than PCB's with higher chlorine content (Lichtenstein *et al.,* 1969), and the toxicity of mixtures with more than 48 percent chlorine was very low. Toxicity of dieldrin and DDT was enhanced beyond an additive effect by the addition of the lower chlorinated PCB's.

A latent toxicity at molt time was shown to be produced by topical applications of Aroclor 1254 to a grasshopper (*Clorthippus brunneus*) (Moriarty, 1969).

Fish and Aquatic Invertebrates

Shrimp (Duke *et al.,* 1970) are sensitive to low concentrations of PCB's. A 48-hour exposure to flowing seawater containing 100 ppb of Aroclor 1254 killed all individuals; 80 percent died in 24 hours. These shrimp accumulated 3.9 ppm in their tissues. Shrimp exposed to 10 ppb did not die, but accumulated 1.3 ppm of PCB's in their tissues. Pinfish were not killed by these exposures, but those exposed to 100 ppb for 48 hours accumulated 17 ppm.

Shell growth of oysters was completely stopped by a 96-hour exposure to 100 ppb of PCB's. A concentration of 10 ppb for the same length of time reduced shell growth by 40 percent and resulted in the accumulation of 33 ppm of PCB's in the tissues.

In a 20-day exposure, 5 ppb of Aroclor 1254 killed 72 percent of the

juvenile shrimp, and the tissues accumulated 16 ppm. Crabs were less sensitive but accumulated an average of 23 ppm in a 4-week exposure at 5 ppb and still contained 22 ppm after a week in clean water and 11 ppm after 4 weeks in clean water.

Residues in Birds Killed by PCB's

Residues of PCB's in brains of chickens killed by PCB dosage in the studies of Vos and Koeman (1970) generally ranged from 120 to 420 ppm, but included values as low as 40 ppm and as high as 700 ppm. Residues of PCB's in the livers of the birds in the same series ranged from 120 to 2,900 ppm. Residues of PCB's in livers of Bengalese finches that died of PCB poisoning ranged from 70 to 697 ppm; residues in birds that died on reduced rations ranged from 69 to 1,214 ppm; and residues in birds that were sacrificed at the end of the experiment were 3 to 634 ppm. Residues in brains were somewhat lower; the proportion in the brain in relation to the amount in the liver averaged higher in the birds that died than in those that were sacrificed.

A bald eagle found sick in the field contained high residues of both DDE and PCB's in its brain, suggesting that PCB's may have contributed to its death. Residues of DDE in the brain were 385 ppm, which is within the lethal range for DDE (Stickel *et al.*, 1970). However, the brain also contained 230 ppm of PCB, 6 ppm DDD, 2.2 ppm of dieldrin, and 0.4 ppm of heptachlor epoxide.

PHYSIOLOGY

The effects of PCB's on reproduction and other physiological processes of wild animals are apt ultimately to have the most serious impact on the populations. Yet these effects are the most difficult to evaluate.

Metabolic and physiological inter-relationships of PCB's are beginning to receive study. Jensen *et al.* (1969) found that lower organisms such as mussels and fish contained a greater preponderance of PCB's with lower chlorination than did birds and suggested that the compounds with fewer chlorines were metabolized or excreted faster than those with more chlorines, so that the latter are subject to greater increase in the food chain.

Koeman *et al.* (1969) found the lower PCB's to be more common in fish (*Leuciscus rutilus*) than in sea birds, and reached the same conclusion, which he confirmed in an experiment with Japanese quail; the gas chromatographic pattern of PCB's in the quail tissues was considerably altered from that of the fed material and many of the peaks representing lower chlorinated compounds disappeared. Heath

et al. (1970) found a similar pattern difference between ingested Aroclor 1254 and the compounds present in the egg of a mallard duck. Differences in absorption of the compounds, as well as metabolism, could enter into the proportional changes observed.

PCB's have been shown to increase breakdown of estradiol in experimental studies with domestic pigeons (Risebrough *et al.*, 1968b) and kestrels (*Falco sparverius*) (Lincer and Peakall, 1970) demonstrating the capability of PCB's to induce microsomal enzyme activity. These studies involved substantial dosage of the birds with PCB's by injection (pigeons) or ingestion (kestrels), subsequent sacrifice of the birds, and *in vitro* laboratory studies with the homogenized livers.

PCB's of lower chlorination (21 percent to 48 percent) showed estrogenic activity in tests made by Bitman and Cecil (1970) with laboratory rats. The higher chlorinated mixtures (54 percent to 68 percent) did not show this activity. In the same series, a lesser activity was shown by p,p'-DDT, and none by p,p'-DDD or p,p'-DDE.

The possibility of interacting effects between PCB's and disease organisms was shown by Friend and Trainer (1970) in an experiment with mallard ducklings. Ten-day-old ducklings exposed for 10 days to a dietary dosage of 25, 50, or 100 ppm of Aroclor 1254 showed 35 to 44 percent mortality upon subsequent exposure to duck hepatitis virus, whereas mortality among birds exposed only to the virus was 14 percent, significantly lower.

Pheasants given a capsule dose of 50 mg of Aroclor 1254 weekly for 17 weeks produced fewer eggs than controls, and higher percentage of chicks pipped the shell but did not hatch (Dahlgren and Linder, 1971). Chicks that hatched weighed less and survived more poorly than controls. Eggshell thickness was not affected. In behavioral tests of the offspring on a visual cliff, more of the chicks from the dosed parents made the undesirable choice of jumping to the deep side, or made no choice, in the 5-minute test period. None of these effects occurred among the groups whose female parents were dosed with 12.5 mg.

Long-term studies of the reproductive effects of PCB's on mallards and bobwhite quail have been conducted at Patuxent (Heath *et al.*, 1970). Mallards fed a dietary dosage of 25 ppm of PCB's from about 11 weeks before their first breeding season and through their second year of laying laid eggs with shells of normal thickness. The number of eggs laid, hatchability of eggs, and survival of young were not significantly different from those of the untreated controls. In another

test, dosage of mallard ducks with 10 or 500 ppm of Aroclor 1254 for about 5 weeks did not result in eggshell thinning. Bobwhite quail fed diets containing 50 ppm of PCB's or 30 ppm of DDE or a combination of 25 ppm of PCB's plus 15 ppm of DDE for about 11 weeks before their first breeding season showed no obvious differences from controls in reproductive performance. These tests were made with Aroclor 1254, because the greater proportion of the PCB compounds in wild bird tissues match those in this mixture. However, fish have been reported to contain a greater proportion of the compounds with fewer chlorines (Jensen *et al.*, 1969), so that tests with other mixtures also will be important.

Tests with the 42 percent mixture (Aroclor 1242) have been made for the Monsanto Chemical Company by the Industrial Bio-Test Laboratories. They found that Aroclor 1242 at 10 ppm or 100 ppm and Aroclor 1254 at 100 ppm in the diet of chickens reduced egg production and hatchability and caused thin eggshells. No measurable effects were produced by Aroclor 1242 at 1 ppm; by Aroclor 1254 at 1 ppm or 10 ppm; or by Aroclor 1260 at 1 ppm, 10 ppm, or 100 ppm.

The studies with chickens and with ducks differed in dosage levels and in the type of PCB employed, so that the differences cannot necessarily be ascribed to the difference in species. Further tests with ducks and with other species are needed in order to understand the potential for PCB's to affect reproduction of wild birds.

In recent studies at Patuxent, a statistical evaluation of the role that different chemicals may play in thinning the shells of brown pelicans in the field has shown that DDE residues correlate better with shell thinning than do residues of dieldrin or PCB's. Anderson *et al.* (1969) reported similar results from their studies of shell thinning and residue content of the eggs of cormorants and white pelicans.

SUMMARY

Polychlorinated biphenyls constitute a group of chlorine-bearing compounds of industrial origin that have permeated the natural environment throughout the world.

Their chemical structure resembles that of some of the organochlorine pesticides. They are troublesome interferences in gas chromatographic analysis of these pesticides. Although methods have been developed to overcome analytical problems, measurements of quantity still are only approximate.

Special studies in the United States, Netherlands, and Great Britain have traced PCB's to industrial effluent, but other possible sources have not been followed. Their use in paints, cartons, and

insulating fluids suggests that environmental pollution may be from many different sources.

PCB's are present in fish and wildlife in many countries of the world. Quantities are higher in animals living near industrial areas. PCB's build up in biological food chains with increases of tens to thousands of times from lower to higher organisms.

Experimental studies have shown that PCB's have a toxicity to mallards, pheasants, bobwhite quail, coturnix quail, red-winged blackbirds, starlings, cowbirds, and grackles that is of the same order as the toxicity of DDE to these species. Overt signs of poisoning also are similar to those caused by compounds of the DDT group. Toxic effects of DDE and Aroclor 1254 to coturnix chicks were additive, but not synergistic.

PCB's containing higher percentages of chlorine are more toxic to birds than those containing lower percentages. PCB's of foreign manufacture contained contaminants to an extent that greatly increased their toxicity.

Toxicity to insects of PCB's of different degrees of chlorination is the reverse of the pattern in birds: the lower chlorinations are more toxic to insects. PCB's enhanced the toxicity of dieldrin and DDT to insects.

Shrimp are very sensitive to PCB's and most will die as a result of 20-day exposure to a concentration of 5 ppb. PCB's also inhibit shell growth of oysters. Fish and crabs are less sensitive; all accumulate residues to many times the concentrations in the water, and a test with crabs showed that they lost the residues very slowly.

Residues of PCB's in the brains of birds killed by these compounds measure in the hundreds of parts per million. PCB's may have contributed to mortality of some birds in the field.

PCB's induce microsomal enzyme activity in birds and mammals and the lower chlorinated mixtures have estrogenic activity in rats.

Exposure to PCB's increased the susceptibility of mallard ducklings to duck hepatitis virus.

Offspring of pheasants whose parents received high dosages of PCB's made poor choices in visual cliff tests. Egg production and hatching after pipping also were affected.

Long-term studies of the reproductive effects of Aroclor 1254 on mallards and bobwhite quail and of Aroclor 1254 plus DDE on quail showed no significant differences from controls. In studies of chickens, however, egg production, hatchability, and shell thickness were impaired by high doses of Aroclor 1254 and by low doses of Aroclor 1242.

Statistical evaluations of the role that different chemicals may play

in thinning of eggshells of brown pelicans show that DDE residues correlate better with shell thinning than do residues of dieldrin or PCB's.

Studies of the effects of PCB's in the environment are as yet insufficient for well-rounded conclusions. The evidence available indicates that they must be viewed as potential problems until fuller data can be assembled.

LITERATURE CITED

Anderson, Daniel W., Joseph J. Hickey, Robert W. Risebrough, Donald F. Hughes, and Robert E. Christensen.
1969. Significance of chlorinated hydrocarbon residues to breeding pelicans and cormorants. Canadian Field-Naturalist 83:91-112.

Armour, Judith A., and Jerry A. Burke.
1970. Method for separating polychlorinated biphenyls from DDT and its analogs. Journal of the Association of Official Analytical Chemists 53:761-768.

Bagley, G. E., W. L. Reichel, and E. Cromartie.
1970. Identification of polychlorinated biphenyls in two bald eagles by combined gas-liquid chromotagraphy-mass spectrometry. Journal of the Association of Official Analytical Chemists 53:251-261.

Bailey, S., P. J. Bunyan, and F. B. Fishwick.
1970. Polychlorinated biphenyl residues. Chemistry and Industry No. 22: 705.

Biros, Francis J., Annita C. Walker, and Angela Medbery.
1970. Polychlorinated biphenyls in human adipose tissue. Bulletin of Environmental Contamination and Toxicology 5:317-323.

Bitman, Joel, and Helene C. Cecil.
1970. Estrogenic activity of DDT analogs and polychlorinated biphenyls. Agricultural and Food Chemistry 18:1108-1112.

Dahlgren, Robert B., and Raymond L. Linder.
1971. Effects of polychlorinated biphenyls on pheasant reproduction, behavior, and survival. Journal of Wildlife Management 35:315-319.

Duke, T. W., J. I. Lowe, and A. J. Wilson, Jr.
1970. A polychlorinated biphenyl (Aroclor 1254) in the water, sediment, and biota of Escambia Bay, Florida. Bulletin of Environmental Contamination and Toxicology 5:171-180.

Friend, Milton, and Daniel O. Trainer.
1970. Polychlorinated biphenyl: interaction with duck hepatitis virus. Science 170:1314-1316.

Heath, R. G., J. W. Spann, J. F. Kreitzer, and C. Vance
1970. Effects of polychlorinated biphenyls on birds. Presented at and to be published in proceedings of 15th International Ornithological Congress. The Hague—1970.

Holden, A. V.
1970. Source of polychlorinated biphenyl contamination in the marine environment. Nature 228:1220-1221.

Holden, A. V., and K. Marsden.
1967. Organochlorine pesticides in seals and porpoises. Nature 216:1274-1276.

Holden, A. V., and K. Marsden.
1969. Single stage clean-up of animal extracts for organochlorine residue analysis. Journal of Chromatography 44:481-492.

Holmes, D. C., J. H. Simmons, and J. O'G. Tatton.
1967. Chlorinated hydrocarbons in British wildlife. Nature 216:227-229.

[Jensen, Sören].
1966. Report of a new chemical hazard. New Scientist 32:612.

Jensen, Sören.
1970. PCB as contaminant of the environment—history. Environment Protection Board, PCB Conference, Uppsala, September 29, 1970. [a restatement of the original report, "PCB, a New Pollutant," presented in November 1966].

Jensen, S., A. G. Johnels, M. Olsson, and G. Otterlind.
1969. DDT and PCB in marine animals from Swedish waters. Nature 224: 247-250.

Koeman, J. H., M. C. ten Noever de Brauw, and R. H. de Vos.
1969. Chlorinated biphenyls in fish, mussels and birds from the River Rhine and the Netherlands coastal area. Nature 221:1126-1128.

Lichtenstein, E. P., K. R. Schulz, T. W. Fuhremann, and T. T. Liang.
1969. Biological interaction between plasticizers and insecticides. Journal of Economic Entomology 62:761-765.

Lincer, Jeffrey L., and David B. Peakall.
1970. Metabolic effects of polychlorinated biphenyls in the American kestrel. Nature 228:783-784.
McCune, E. L., J. E. Savage, and B. L. O'Dell.
1962. Hydropericardium and ascites in chicks fed a chlorinated hydrocarbon. Poultry Science 41:295-299.
McLaughlin, Joseph, Jr., Jean-Pierre Marliac, M. Jacqueline Verrett, Mary K. Mutchler, and O. Garth Fitzhugh.
1963. The injection of chemicals into the yolk sac of fertile eggs prior to incubation as a toxicity test. Toxicology and Applied Pharmacology 5:760-771.
Moriarty, F.
1969. The effects of polychlorobiphenyls on *Chorthippus brunneus*. (Saltatoria: Acrididae). Ent. Exp. and Appl. 12:206-210.
Mulhern, Bernard M., William L. Reichel, Louis N. Locke, Thair G. Lamont, Andre Belisle, Eugene Cromartie, George E. Bagley, and Richard M. Prouty.
1970. Organochlorine residues and autopsy data from bald eagles 1966-68. Pesticides Monitoring Journal 4:141-144.
Mulhern, Bernard M., Eugene Cromartie, William L. Reichel, and Andre A. Belisle.
1971. Semi-quantitative determination of polychlorinated biphenyls in tissue. samples by thin layer chromatography. Journal of the Association of Official Analytical Chemists 54:548-550.
Prestt, Ian, D. J. Jefferies, and N. W. Moore.
1970. Polychlorinated biphenyls in wild birds in Britain and their avian toxicity. Environmental Pollution 1:3-26.
Reichel, William L., Eugene Cromartie, Thair G. Lamont, Bernard M. Mulhern, and Richard M. Prouty.
1969. Pesticide residues in eagles. Pesticides Monitoring Journal 3:142-144.
Reichel, W. L., T. G. Lamont, E. Cromartie, and L. N. Locke.
1969. Residues in two bald eagles suspected of pesticide poisoning. Bulletin of Environmental Contamination and Toxicology 4:24-30.
Reynolds, Lincoln M.
1969. Polychlorobiphenyls (PCB's) and their interference with pesticide residue analysis. Bulletin of Environmental Contamination and Toxicology 4:128-143.
Risebrough, R. W., R. J. Hugett, J. J. Griffin, and E. D. Goldberg.
1968a. Pesticides: transatlantic movements in the northeast trades. Science 159:1233-1236.
Risebrough, R. W., P. Reiche, D. B. Peakall, S. G. Herman, and M. N. Kirven.
1968b. Polychlorinated biphenyls in the global ecosystem. Nature 220:1098-1102.
Risebrough, R. W., P. Reiche, and H. S. Olcott.
1969. Current progress in the determination of the polychlorinated biphenyls. Bulletin of Environmental Contamination and Toxicology 4:192-201.
Simmons, J. H., and J. O'G. Tatton.
1967. Improved gas chromatographic systems for determining organochlorine pesticide residues in wildlife. Journal of Chromatography 27:253-255.
Smithsonian Institution Center for Short-lived Phenomena.
1970. SW Sweden snow pollution. Smithsonian Institution Center for Short-lived Phenomena. Event 19-70, Item 876.
Stickel, William H., Lucille F. Stickel, and Francis B. Coon.
1970. DDE and DDD residues correlated with mortality of experimental birds. pp. 287-294 *in* "Pesticides Symposia," edited by W. B. Deichmann, Helios & Associates, Miami.
Tarrant, K. R., and Tatton, J. O'G.
1968. Organochlorine pesticides in rainwater in the British Isles. Nature 219:725-727.
Vos, J. G., and J. H. Koeman.
1970. Comparative toxicologic study with polychlorinated biphenyls in chickens with special reference to porphyria, edema formation, liver necrosis, and tissue residues. Toxicology and Applied Pharmacology 17:656-668.
Vos, J. G., J. H. Koeman, H. L. van der Maas, M. C. ten Noever de Brauw, and R. H. de Vos.
1970. Identification and toxicological evaluation of chlorinated dibenzofuran and chlorinated naphthalene in two commercial polychlorinated biphenyls. Food and Cosmetics Toxicology 8:625-633.

DISCUSSION

DISCUSSION LEADER KEITH: What is the knowledge on the occurrence of PCB's in the environment, let's say, when compared with DDT in metabolites? Are we finding it as widespread as some of these more commonly understood and known

materials, or is it something in a reduced occurrence like dieldrin or even some of the lesser persistent materials? And in that same regard, what has been the past analytical confusion? I believe you implied that we were on top of this now, but I know there's a great concern among many people about what the confusion may have been in the past.

DR. DUSTMAN: Those are very good questions. PCB's are rather well distributed in our environment. It makes one very uncomfortable to see them showing up at the present rate and in their present quantities. Compared with DDE, I don't think it is as plentiful or as widespread, but it comes close. Especially around aquatic areas wherever you look, in such instances, you will find PCB's in animals. They're rather generally distributed and uncomfortably so.

Now, as to the difficulty that arose over analysis. Some laboratories, not all, were at one time confusing certain of the organochlorine pesticides with PCB's. This was true of DDT and DDD, primarily, and to a much lesser extent DDE. Inasmuch as they are both chlorine bearing and the gas chromatograph retains them for about the same length of time, we were having these big blobs showing up on our graphs, where DDT and DDD especially could not be separated from the PCB's, if use was made exclusively of the gas chromatograph.

There are other methods which are now known to split off PCB's. Our chemists early recognized that there were some unknowns showing up in our graphs; and without knowing quite what to do with them in the way of identification, we did learn to separate them out by thin-layer chromatography and zoning, splitting our samples into four zones, scraping the zonings and then running these through our gas-liquid chromatography columns. This enabled us to pull off the PCB's and not confuse them with DDT and other things.

There are other methods which are now known to split off PCB's—wet chemistry methods that are very nicely applied—but we still are not very astute in our measurements of PCB's. But we are becoming so, and hopefully within the very near future we will be able to measure them much more accurately than we do now.

DR. CLARENCE COTTAM (Welder Wildlife Foundation, Sinton, Texas): Of the criticism we've offered against DDT in the past, do you have any estimate as to how much of that is really chargeable to PCB, or do we have any clear-cut idea as to the relative seriousness of PCB in our pelicans or bald eagles?

DR. DUSTMAN: I think we're on pretty safe ground. The experimentation, the observations that have been made relative to the effects of the environmental pollutants have been made largely on the strength of two bases; one, laboratory experimentation, coupled with field observation, and it's through this coupling that we eventually arrive at what truth we are able to uncover relating to these compounds.

And so, when you come to things like eggshell thinning, this has been established as a cause and effect relationship under laboratory conditions, by the use of DDT, which eventually breaks down into DDE and thereby becomes the very bad culprit; and then this, coupled with the fact that we know that DDE is to be found everywhere in our environment and that the eggshell thinning, for example, that has occurred and been observed by Dr. Hickey and Dr. Anderson in their work and in the work of others since then, has demonstrated the correlation between DDE and eggshell thinning.

Other observations of the same nature, where we can couple laboratory experimentation with environmental observation and can come up with suitable correlations, are what lead us to have confidence in such results.

DR. COTTAM: Thank you very much. Are there any synergistic effects between the two? Is DDT or DDE more serious if PCB is added to it? Is there any synergistic effect?

DR. DUSTMAN: Dr. Lichtenstein did some work on this as I recall, and it was in regard to insects, where he was using some of the lower chlorinated compounds. I don't remember what the numbers are—1242 perhaps, or somewhere lower in the

scale. And he found that these lower-scaled chlorinated PCB's were serving to enhance the action of such things as dieldrin and DDT, and it was very fine experimentation.

DR. J. J. HICKEY (Wisconsin): But this did not occur with mallard ducks.

DR. DUSTMAN: Oh, no. This has not been observed. There were no synergistic effects here with birds—but with insects. yes.

DR. WAGNER: I was just going to ask where they come from. Are PCB's breakdown products of pesticides?

DR. DUSTMAN: I'm sorry I didn't mention that. They come from a great variety of sources. They are plasticizers; they are used as heat transfer agents; they are used as lubricants; they are very freely employed in the construction of electrical condensers; they are used as insulation on wire; they are completely compatible with synthetic resins and paints and waxes, and they are being freely used in such compounds. They enhance the water repellent qualities of such materials and the chemical resistance of such coatings; and I suspect there are many other things that they are being used for that we know nothing about. This is largely due to the fact that it's kind of a trade secret; and although we have attempted to find out in what magnitude such compounds are being used in this country, it's being kept very close to somebody's belt and all we can do is sort of say, "Well, in the United States it's probably millions—hundreds of millions of pounds." That's as good as we can do.

MR. KEITH: I'm afraid we must move on. Thanks again, Dr. Dustman.

CHAIRMAN KEITH: Wildlife ecologists who are looking for chemical contamination and its effects perhaps sometimes overlook sources of data that are not taken by members of their own fraternity; for example, surveys are conducted by public health authorities of residues of many of these same compounds in food products. An example of this is in the next paper.

HEAVY METALS IN UNITED STATES FISH

RICHARD J. RONK

U.S. Food and Drug Administration, Washington, D.C.

This is not a scientific paper. The universe of the title, "Heavy Metals in United States Fish," is so broad that no presentation short of book length could begin to cover the ground. This is an attempt to present an overview of the extensive metals surveys which are being carried out by the Food and Drug Administration. It is also an attempt to provide some insights into how surveys of this type are built to provide the necessary data to strengthen our consumer protection programs. These data will also serve to provide a greater knowledge of metal constituents.

During the past few years there has been a growing concern about the metallic contamination of the environment. Pollution of our lakes and streams with industrial wastes has had a great impact on the quality of water and upon all marine species. While there has always been an appreciation for the metals cycles that exist in nature, only recently have the analytical tools been developed which can define in precise terms what the natural backgrounds for these metals are in

fish. Certain metals, of course, have very specific and vital functions in the metabolic processes of all living organisms. Zinc, magnesium, iron, and copper are indispensable to the living cell. Other metals which occur in the natural environment in small quantities are not only known not be be useful, but can produce toxic effects. These metals such as lead, mercury, cadmium and arsenic are priority items in any metals survey work contemplated by FDA. It is beyond the scope of this paper to consider the toxicological implication of these metals save to say that at certain levels under certain conditions any metallic element can be hazardous, as can most other chemicals.

The programs which FDA has to monitor fish and shellfish are various. The fresh-water fish survey and the wholesale fish survey are directed toward mercury. The recently completed canned tuna program and the on-going swordfish program are also mercury programs. FDA will soon initiate a Metals in Fish survey which will include 12 metals: lead, arsenic, cadmium, selenium, chromium, cobalt, nickel, zinc, antimony, copper, tin and manganese.

The results of these programs have been the subject of many press releases and the data from them is available to interested investigators.

Let me try and bring my subject Heavy Metals in United States Fish into some sort of focus by concentrating on one program within FDA which would be very indicative of the problems of metals in the aquatic environment.

The FDA National Shellfish Sanitation program metals survey of shellfish growing waters is an excellent example of the kinds of judgments necessary in building a scientifically sound program. It is a multi-benefit program. The goal is safe and wholesome oysters and clams. Growing water of very high quality is the essential ingredient to achieve this end. The result is an estuary which has a greater degree of ecological health and recreational viability.

The decision on which metals are selected is a complex one. The following approach was used for metals in this program. The degree of pollution potential of the specific metal was considered, based upon:

1. Physical and chemical characteristics of the metal.
2. Rate of accumulation or biological turnover.
3. Toxicity of the solubility product.
4. Dissociation activity.
5. Stability of related derivatives.
6. Species of salts related to solubility.
7. Kinetics of the ecology of bottom sediments.

Naturally the metal must be biologically available to the aquatic organism.

The suggested concentrating pathways for chemical contaminants in oysters are:

1. Particulate ingestion of suspended material from seawater.
2. Ingestion of elements via their pre-concentration in food materials.
3. Complexing of metals by coordinate linkages with appropriate organic molecules.
4. The incorporation of metal ions into important physiological systems.
5. Uptake by exchange—for example onto the mucous sheets of the oyster.

Using these criteria, one group of workers saw the pollution potential of metals in the following order:

VERY HIGH
Ag Au Cd Cr Cu Hg Pb Sb Sn Tl Zn

HIGH
Ba Bi Ca Fe Mn Mo P Ti U

MODERATE
Al As B Be Br Cl Co F Ge
K Li Na Ni V W

LOW
Fa I La Mg Nb Si Sr Ta Zr

This potential, of course, is relative to the well-being of the oyster, as well as the animal that will consume the oyster—man. This might be phrased as an evaluation of the modes of toxic action. As far as the oyster is concerned these modes of toxic action are:

1. Reactivity with proteins, especially enzymes.
2. Behaving as antimetabolites.
3. Catalysing decomposition of essential metabolites.
4. Forming stable precipitates or chelates with essential metabolites.
5. Replacing structurally or electro-chemically important elements in the cell which fail to function.

Based on these criteria and other judgments relative to human toxicity and availability of analytical methods, the following metals were selected as indicative of water quality for shellfish growing areas: zinc, copper, iron, manganese, cadmium, lead, chromium,

nickel, and cobalt. Table 1 is a comparison of actual trace metal levels in Atlantic Coast shellfish.

TABLE 1. TRACE METAL LEVELS IN SHELLFISH FROM ATLANTIC COAST WATERS (Maine through North Carolina)

Element	Eastern Oyster		Northern Quahaug		Softshell Clam	
	Range	Ave.	Range	Ave.	Range	Ave.
Zinc	180 –4120	1428	11.50-40.20	20.6	9.0 – 28	17
Copper	7.0 – 517	91.50	1.0 –16.50	2.6	1.20– 90	5.80
Iron	31 – 238	67	9.0 –83.0	30	49.70–1710	405
Manganese	0.14– 15.0	4.30	0.7 –29.70	5.8	0.10– 29.90	6.70
Cadmium	0.10– 7.80	3.10	0.10– 0.73	0.19	0.10– 0.90	0.27
Lead	0.10– 2.30	0.47	0.10– 7.50	0.52	0.10– 10.20	0.70
Chromium	0.04– 3.40	0.40	0.19– 5.80	0.31	0.10– 5.0	0.52
Nickel	0.08– 1.80	0.19	0.10– 2.40	0.24	0.10– 2.30	0.27
Cobalt	0.06– 0.20	0.10	0.10– 0.20	0.20	0.10– 0.20	0.10

Note: trace metal values are given in ppm of shellfish wet tissue weights as determined by atomic absorption analyses.

These data will be used to develop alert levels for metals in the various growing areas. When the alert level is exceeded in a growing area an engineering survey of the estuary will be conducted to pinpoint the cause. Abatement of this source of pollution would follow. If this is not possible or if the new metal level in the shellfish has any adverse health significance the growing area will be closed to shellfishing.

It has been found by analysis of data developed in this program that species and temperatures of the growing water are the principal indicators of the metals content of shellfish. Oysters and clams are selective in the metals which they choose to use in their feeding cycles. Table 2 demonstrates the effect of temperature on the copper uptake of a particular shellfish species *Mercenaria.*

TABLE 2. SHELLFISH TRACE-METAL LEVELS AFTER SEVERAL WEEKS IN A SIMULATED NATURAL ENVIRONMENT*

METALS		SHELLFISH							
			Metal Levels (milligrams of metal per kilograms of shellfish wet tissue)**					Total	Final
Element	Environmental Levels (ppm)	Species	Initial	5-Week	10-Week	15-Week	20-Week	Accumulation (mg/kg)	Update Ratios ***
Lead	0.025	Oyster	0.17	17.0	37.9			37	223
	0.5		0.17	30.3	48.5			48	285
	0.1		0.17	71.8	115.9			115	682
	0.2		0.17	174.3	328.8			328	1934
	0.1	Quahaug	0.17	14.67	33.61(9)			33.44	198
	0.2		0.17	29.10	70.02(9)			69.85	412

Shellfish have also been held in simulated natural environment in equilibrium with metals at various concentrations.

As would be expected, there is a relatively even uptake and

concentration of the lead to high total accumulation levels. This same type data is available for each of the other metals.

These are types of data that are being developed in the FDA. I won't comment on the significance of this information in terms of other fish. The contemplated metals in fish survey will provide this data.

Note: The data presented in this paper was developed in the laboratories of Dr. Benjamin H. Bringle, North East Services Technical Center, Davisville, Rhode Island.

DISCUSSION

MR. KEITH: Thank you for an exposure to the consideration of these other things with which we are now living. Are there questions?

MR. PETER PEARCE (Canadian Wildlife Service, New Brunswick, Canada): I read somewhere that one of the effects of cadmium, especially in fairly high levels, is decalification of bone. I wonder if in any of your investigations with shellfish or fin fish or any other kinds of animals you've encountered any evidence of this phenomenon?

MR. RONK: No, we haven't concentrated on that particular phenomenon. I won't say that it isn't being considered, because probably the most important element of the entire metals program in terms of human health is a 3,000-steer slaughter program that USDA is engaged in, and this may very well be part of the considerations of that program, to look at the autopsy data and others in terms of that and then relate it to the levels that are found.

MR. PEARCE: The reason I asked, of course, is that there may be implications for fish-eating birds, consuming fish with high levels of cadmium. Presumably this will be accumulated in food chains and might conceivably have some repercussions on the strength of long bones, for instance, of these birds.

MR. RONK: I'll look into that and drop you a note.

UNIDENTIFIED: What do you mean by a 3,000-steer slaughter program?

MR. RONK: USDA is killing and autopsying 3,000 steers for metals. They're looking at the liver, muscle tissue and brain tissue and other factors. They are considering the same metals that we mentioned in the proposed fresh-water fish survey. They hope to particularize this to the point where they will select specific steers from specific areas based on pollution problems in that area.

MR. JEFFREY GODFREY (Portland State University): The recent disclosure of the presence of mercury in tuna fish, if I remember correctly, was made by a university professor in New York. It distresses me that the Food and Drug Administration wasn't on top of this problem right from the beginning. To your knowledge, were you aware of the problem before this disclosure came to the public attention?

MR. RONK: My job since last May, among other things, has been to serve as program manager for mercury problems in foods in general. We had looked at probably about 75 samples of canned tuna for mercury. There are a number of reasons why we didn't discover the .5. One of the reasons would be that there are five species differences. There is skipjack tuna, yellow fin, blue fin, big eye, and albacore. Albacore, being the prime tuna, is the most desirable economically. FDA samples included a great number of skipjack tuna in the 75. Out of the next thousand samples of skipjack tuna that were looked at, none was found above .5—even though the fish go up to 25 pounds, which I had thought was a fairly large fish. The tuna that Dr. McDuffy looked at was large yellow fin; it was packed in Puerto Rico. Most of this tuna that was in the size range that he happened to examine would present a problem. The average of these fish was more than 150 pounds.

After the 5,000 samples were looked at in the tuna program, we came back to about the same conditions that we had with the 75, so that instead of having a 23% defect rate, the defect rate was about 3 to 4% depending on how you wanted to calculate it.

We certainly welcome consumer groups, university groups, other people that have instrumentation available to them to look at foods for defects and let us know about these problems. It seems strange that a regulatory agency with as much funds available to it as FDA does not discover these problems first, but this is one of the things that happened in this particular case.

DR. PAUL SPRINGER (Bureau of Sports Fisheries and Wildlife, North Dakota): You had, on one of the slides, interim standards of .2 of a part per million of mercury in shellfish. Is that in the shellfish themselves or in the environment?

MR. RONK: This is in the shellfish themselves. This is a proposed standard that will be talked about at the shellfish sanitation workshops this year. I don't know whether the workshop will adopt this standard. This would be a standard that would relate to the closing of waters to shellfishing.

It's very difficult to consider fish, as far as metals contamination is concerned, all in the same range. For instance, if you want to talk about fish that are high on the food chain, such as tuna and all the large mackerel, swordfish, you have one problem. If you're talking about filter feeders, such as shellfish, you have another problem. Filter feeders will recover very rapidly as soon as the pollution source is abated. The entire area will recover. There is an instance in Lavaca Bay in Texas, for instance, where the shellfish ran 5 parts per million in May and they were down to .3 by the 29th of December. So, in applying standards, you would apply for either shellfish conservation or shellfish consumption, you would particularize this to the area. You could have a much lower level for some fish species than you could for another.

CHAIRMAN KEITH: Of the work done in Canada on mercury, that done in the prairie provinces has been divided between terrestrial wildlife and aquatic wildlife work. Some of the terrestrial work has already be published in the *Canadian Field Nationalist*, and this afternoon Kees Vermeer is going to speak about a survey that he made of "Mercury Residues in Aquatic Bird Eggs in the Canadian Prairie Provinces."

A SURVEY OF MERCURY RESIDUES IN AQUATIC BIRD EGGS IN THE CANADIAN PRAIRIE PROVINCES

KEES VERMEER

Canadian Wildlife Service, Edmonton, Alberta

There appear to be three chief sources where aquatic birds in Western Canada may acquire toxic mercury residues in their tissues. One source is the occurence of natural mercury deposits. Livers from red-necked grebes, *Podiceps grisegena*, taken within one kilometer of a Cominco mercury mine at Pinchi Lake, British Columbia, averaged 17.4 ppm of mercury (Fimreite *et al.*, in press). A second source is from alkyl mercury derivatives originating from fungicides to protect grain and seeds from fungi. Fimreite *et al.*, (1970) found that mercury concentrations both in seedeaters and in their avian predators were significantly higher in specimens from Alberta, where the use of the mercury seed dressings was widespread, than in Saskatchewan

where seed treatment was much less common. They also found that livers of seed-eaters, shot on fields sown with treated grain, contained significantly higher mercury levels than those shot on untreated fields. The third source is from inorganic or phenyl mercury compounds going as industrial wastes into streams and lakes and which are converted by anaerobic bacteria (Jensen and Jernelov, 1969; Wood *et al.*, 1968) to the more toxic methyl mercury compounds. Two main sources of industrial contamination have been revealed by surveys of mercury residue levels in fish in Saskatchewan by Wobeser *et al.* (in press) and in Manitoba and western Ontario by Bligh (1970a). Wobeser *et al.* found that fish collected from sites on the Saskatchewan River below Saskatoon had a much higher mercury content than fish collected in the same river upstream of that city. Fishes in the Saskatchewan River at Cumberland House, where the author collected eggs of fish-eating birds for analysis in 1970, averaged 5.0 ppm of mercury residues in their muscles. Fishes in the Wabigoon—English River, downstream of Dryden in western Ontario, averaged from 1.17 to 12.1 ppm of mercury residues (Bligh, 1970b). These findings led to the discovery that chlor-alkali plants at Saskatoon and Dryden were main contaminators of industrial mercury wastes for rivers of Manitoba and Saskatcheyan (Fig. 1). These contaminators may have also contributed to the 0.66 ppm of mercury residues found in meat of *Beluga* whales in Hudson Bay (Bligh, 1970b).

A survey was conducted to determine the organochlorine residues present in aquatic bird eggs, particularly those of larids and fish-eating birds in Alberta, Saskatchewan and Manitoba in 1968 and 1969 (Vermeer and Reynolds, 1970). As little is known about the extent of mercury residues present in aquatic birds of the Canadian Prairie Provinces, those eggs were also analyzed for mercury residues. As fish at Cumberland House were highly contaminated with mercury residues (Wobeser *et al.*, in press), eggs of fish-eating birds were collected at Cumberland Lake in 1970 for mercury analyses. Eggs were chosen as samples to be analyzed for mercury residues as they were easy to collect and constitute distinct units of comparison between species.

METHODS

Composite samples of eggs were collected during egg-laying and incubation from aquatic birds in Alberta and Saskatchewan in 1968 and from Manitoba and Cypress and Old Wives Lakes in Saskatchewan in 1969. Each composite sample consisted of 10 eggs, representing one egg from each of 10 nests of the same species. Composite rather than individual samples were collected to reduce costs of

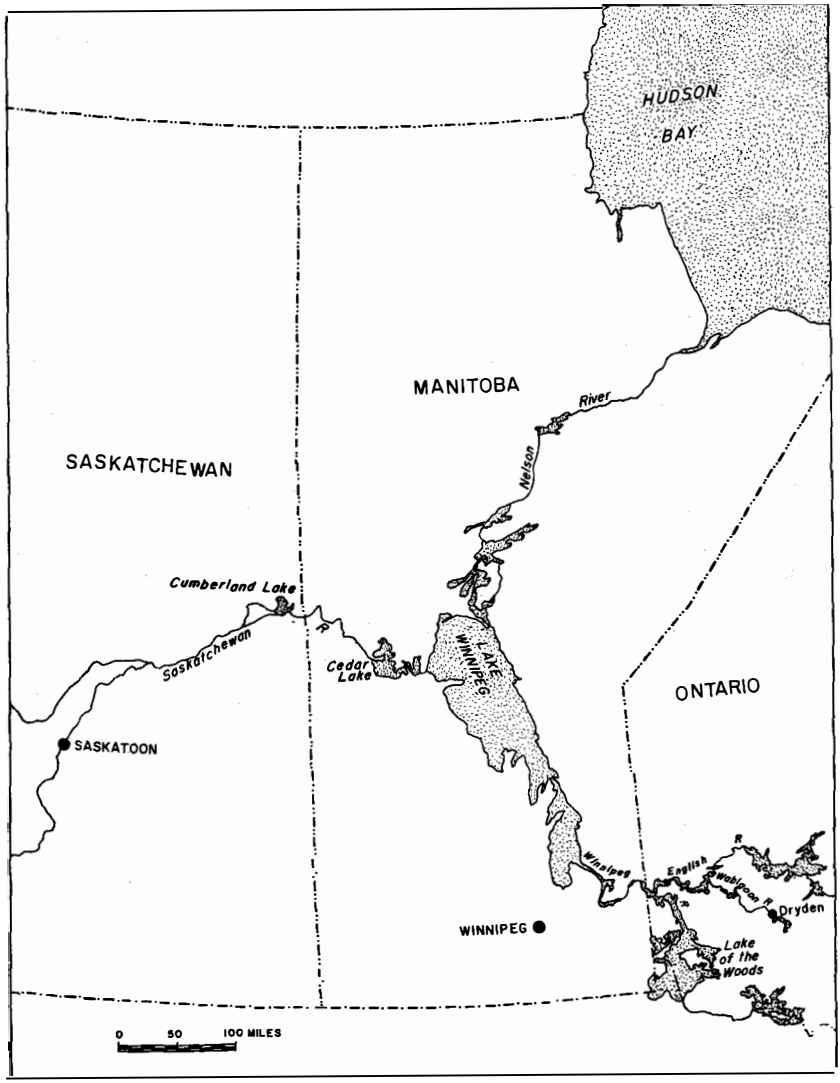


Figure 1.—Location of major mercury-polluted waterways.

analyses. In addition, ten California gulls, *Larus californicus*, and two of their eggs each were taken from their nests at Joseph Lake and Miquelon Lake (seven miles from the former) in Alberta during egg-laying and their first week of incubation in the first week of May,

1969. The livers and eggs of the gulls were analyzed for the purpose of relating mercury residue levels in eggs to those in the livers of the incubating females. Livers were chosen for analysis as they are major organs of metabolism and are known to concentrate mercury residues (Westermark, 1967).

In 1970, 34 eggs of herring gulls, *Larus argentatus,* 10 eggs of common terns, 40 eggs of white pelicans, *Pelecanus erythrorhynchos,* and 10 eggs from ring-billed gulls, *Larus delawarensis,* were collected during egg-laying and early incubation at Cumberland Lake, Saskatchewan. One egg was collected from each nest except for four herring gull clutches from which two eggs were taken from each clutch. The eggs were analyzed individually.

The livers and contents of eggs were stored in glass jars and preserved by freezing. The samples collected in 1968 and 1969, except for great blue herons, *Ardea herodias,* were analyzed by the neutron activation technique of Gulf General Atomic Incorporated, California, which has been described by Fimreite *et al.,* (1970).

The samples collected in 1970 and those of great blue herons collected in 1969 were analyzed by the flameless atomic absorption spectrophotometry technique by Dr. L. M. Reynolds from the Ontario Research Foundation in Ontario. The procedure is quoted:

> About 0.5 gm. of homogenized tissue is accurately weighed into a 50 ml. Erlenmeyer flask, 10 ml. of concentrated H_2SO_4 is added and the flask placed in a hot water shaker bath at 60°C until complete solubilization occurs (1-2 hrs.). The sample is then cooled in an ice bath and the mixture oxidized by the addition of 15 ml. of 6% $KMNO_4$, slowly and with swirling. The solution is allowed to stand at room temperature overnight.
>
> The AAS determination is carried out by first reducing the excess $KMnO_4$ with 20% hydroxylamine hydrochloride (aqueous) dropwise and making to 50 ml. volume with distilled water. The total volume of solution is placed in a Drechsel gas washing bottle with a fritted tip. One ml. 40% $SnCl_2$ is added and by use of the air purging method, the absorption at 2537A is read, using a mercury hollow cathode lamp as the energy source and a 15 cm. length absorption cell.
>
> The curve height is monitored on a recorder and compared with a standard curve.
>
> The instrument used is a Varian Techtron model AA-120 atomic absorption spectrophotometer with the Varian model G 2500 recorder.

Mercury residue levels in tissues analyzed by neutron activation

and atomic absorption techniques corresponded well, except for one tissue (Table 1). Mercury residues are given in parts per million (ppm) wet weight.

TABLE 1. COMPARISON OF MERCURY RESIDUE LEVELS IN PPM WET WEIGHT FOUND IN BIRD EGGS BY NEUTRON ACTIVATION (NAA) AND ATOMIC ABSORPTION SPECTROPHOTOMETRY (AAS) TECHNIQUES

Tissue Sample	Mercury residue level		% Variation
	NAA	AAS	
Herring gull egg	0.48	0.46	4
" " "	0.33	0.33	0
" " "	1.02	0.62	39
" " "	0.56	0.48	14
" " "	0.53	0.39	16
" " "	0.57	0.48	16
White pelican egg	0.26	0.26	0
" " "	0.20	0.20	0
" " "	0.28	0.28	0
" " "	0.31	0.30	0

RESULTS AND DISCUSSION

The numbers in Fig. 2 denote the locations where the egg samples were collected and relate to those in Table 2. Table 2 shows the mercury residue levels present in aquatic bird eggs.

The differences in mercury residue levels betwen species at the same locations may reflect differences in feeding habits, biological magnification of mercury and lengths of exposure to mercury contamination

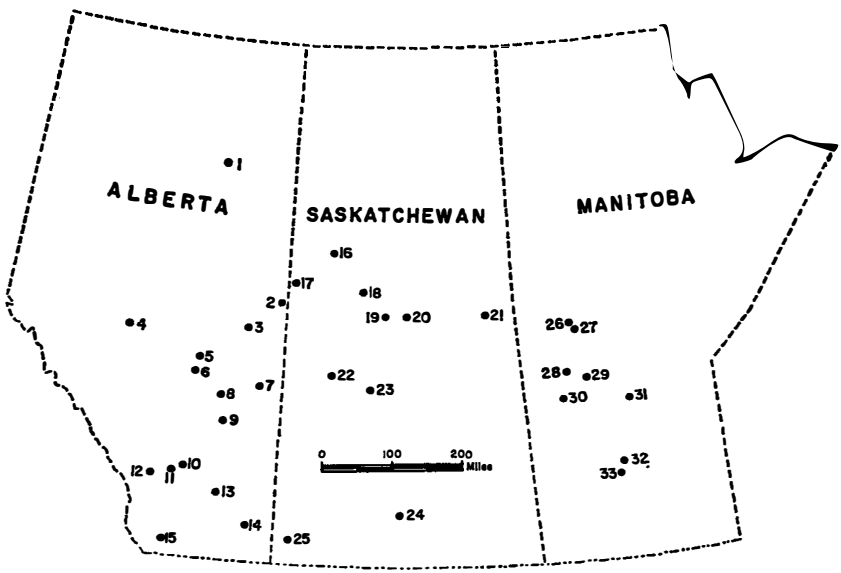


Figure 2.—Sample locations of acquatic bird eggs in Alberta, Saskatchewan and Manitoba.

TABLE 2. MEAN PPM RESIDUES OF MERCURY IN COMPOSITE SAMPLES OF 10 AQUATIC BIRD EGGS IN THE PRAIRIE PROVINCES

Sample location	California gull	Ring-billed gull	Franklin's gull	Herring gull	Common tern	Double-crested cormorant	White pelican
1. Namur Lake	0.370			0.435			0.419
3. L. Therien Lake	0.163	0.223			0.274	0.453	
4. Chip Lake	0.414	0.356			0.304		
5. Miquelon Lake	0.128	0.415					
9. Dowling Lake	0.148	0.351					
13. Lake Newell	0.130(156)[a]	0.715	0.135		0.615	0.419(0.665)[a]	
14. Murray Lake	0.159	0.606					
16. Kazan Lake	0.114					0.451	0.294
17. Primrose Lake	0.147	0.443			0.162	0.390	0.228
18. Doré Lake	0.103	0.393					
19. Lavallée Lake					0.314	0.459	0.245
20. Montreal Lake					0.277		
21. Suggi Lake		0.510		0.914		0.726	
22. Jack Fish Lake		0.415	0.105				
23. Redberry Lake	0.337	0.427				0.435	0.314
24. Old Wives Lake	0.166	0.262			0.390	0.429	0.244
25. Cypress Lake	0.255	0.227				0.391	0.285
26. Talbot Lake				0.564		0.453	0.249
27. Moose Lake				1.02		0.497	0.286
28. Lake Winnipegosis[b]		0.210		0.333	0.374	0.326	0.203
29. Kawinaw Lake		0.285					0.218
30. Pelican Lake	0.437	0.147		0.533		0.464	0.314
31. Lake Winnipeg (St. Martin Is.)				0.483	0.788	0.473	0.199
32. Dog Lake						0.376	0.262
33. Lake Manitoba		0.212				0.402	0.233

Sample location	Great blue heron	Western grebe	American avocet	Canada goose	Mallard	Gadwall	Lesser scaup
2. Cold Lake		0.087					
3. L. Therien Lake							0.202
4. Chip Lake	0.37					0.300	0.032
5. Miquelon Lake					0.065		
6. Battle River (Wetaskiwin)	0.31						
7. Jamieson Lake	0.27						
8. Battle River (Forestburg)	0.42						
9. Dowling Lake				0.037			
10. Stobart Lake			0.158				
11. Bow River (Carseland)	0.35						
12. Sheep River (Black Diamond)	0.35						
13. Lake Newell[c]			0.160	0.031	0.055(0.201)[a]	0.100	0.161
14. Murray Lake	0.32						
15. Belly River (Glenwoodville)	0.28						
22. Jackfish Lake		0.097			0.066		
24. Old Wives Lake[d]					0.029	0.116	
25. Cypress Lake				0.052	0.064		
29. Kawinaw Lake		0.174					

[a] Mean residue value from sample collected at end of egg-laying season.
[b] Mean residue value at this location for Caspian Terns: 0.419 ppm.
[c] Mean residue value at this location for Eared Grebes: 0.069; Coots: 0.076; American Widgeon 0.047 ppm and Blue-winged Teal: 0.210 ppm.
[d] Mean residue value at this location for Black-crowned Night Herons: 0.152; Pintail: 0.036 and Canvasback: 0.061 ppm.

on the breeding grounds. The generally higher mercury levels found in the eggs of ring-billed gulls than in those of California gulls may result from the ring-billed gulls eating more grain in the spring than the California gulls (Vermeer, 1970a). I observed that a substantial number of grain pellets regurgitated by ring-billed gulls on their nesting ground at Miquelon Lake in the spring of 1965 had been treated with a reddish-colored seed-dressing. The gulls fed evidently on grain treated with fungicides. The lower residue levels in eggs of Franklin's gulls, *Larus pipixcan* than those in California and ring-billed gulls may be related to their dominantly insectivorous diet (Guay, 1968). The high residue levels found in herring gulls may possibly be explained by their scavenging and fish-eating habits in their inland habitat (Mendall, 1939; Ludwig, 1962). The relatively high residue levels observed in common terns may be related to a diet of fish and crustaceans (Mendall, 1935). The higher residue levels found in the eggs of double-crested cormorants, *Phalacrocorax auritus* than in those of white pelicans may result from differences in feeding habits between the species. Double-crested cormorants obtain fish by diving (Bartholemew, 1942) while white pelicans scoop usually smaller fish from the water surface (Hall, 1925). Great blue herons feed extensively on fish and aquatic arthropods (Cottam and Uhler, 1937). It is not understood why the fish-eating (Palmer, 1962) western grebes, *Aechmophorus occidentalis,* have lower residue levels in their eggs than the other fish-eating species. Perhaps the lakes where the grebes were sampled were less mercury-polluted. The comparatively lower residue levels in American avocets, *Recurvirostra americana,* than those in larids and fish-eating birds (except the western grebe) may be related to its chiefly invertebrate diet (Stout *et al.,* 1967). The low mercury residue levels found in Canada geese, *Branta canadensis,* may possibly be related to their feeding by grazing and that they chiefly lay their eggs in April (Vermeer, 1970b) before mercury-dressed seeds are planted in May. Table 2 shows that ducks which lay eggs early in the season, such as the mallard, *Anas platyrhynchos,* pintail, *Anas acuta,* American widgeon, *Mareca americana* and canvasback, *Aythya valisineria* generally have lower residue levels than those which lay later, such as the gadwall, *Anas strepera,* blue-winged teal, *Anas discors,* and lesser scaup, *Aythya affinis.* Perhaps the difference in residues between these two groups of ducks is related to an interspecific variation in diet and/or the time of sowing of mercury-dressed grain. Additional support for this hypothesis comes from the much higher mean residue levels observed in mallard eggs laid in June than in those laid in early May at Lake Newell (Table 2).

The survey, besides indicating the most contaminated species, also shows locations where extensive mercury pollution is occurring. The eggs of herring gulls and double-crested cormorants at Suggi Lake averaged 0.914 and 0.726 ppm respectively of mercury residues in their eggs while eggs of herring gulls at Moose Lake and common terns at Lake Winnipeg averaged 1.02 and 0.788 ppm respectively.

Suggi Lake is in an almost uninhabited and in an extensively forested area, 15 miles north of the Saskatchewan River. Mercury residue levels in fish from Suggi Lake are not known but contamination of fish from industrial wastes or seed-dressings is thought to be low as the lake drains through the Grassberry River into the Saskatchewan River. Goldeye fish, *Hiodon aloscodes,* from Cumberland Lake, which is part of the Saskatchewan River and 30 miles southwest of Suggi Lake, averaged 5.0 ppm in mercury residues (Wobeser *et al.,* in press) in their tissues. I observed that double-crested cormorants, white pelicans, herring gulls, ring-billed gulls and common terns fed extensively on fish below the Squaw Rapids Dam in the Saskatchewan River in April and May of 1970. The nearest known colonies of those fish-eating species nesting to the Squaw Rapids Dam are those at Suggi and Cumberland Lakes both 50 miles northeast from the dam. Hence it is likely that the source of mercury contamination of the fish-eating birds at Suggi Lake may be derived from mercury polluted fish of the Saskatchewan River. Additional support for this hypothesis comes from the 1.02 ppm mercury residue level observed in herring gulls at Moose Lake, which is 20 miles north of Cedar Lake. Cedar Lake is part of the Saskatchewan River. Northern pike, *Esox lucius,* walleye, *Stizostedion vitreum* and sauger, *Stizostedion canadense,* averaged 0.68, 0.55 and 0.59 ppm of mercury respectively at Cedar Lake while pike and walleye at Moose Lake averaged only 0.15 and 0.10 ppm of mercury respectively in their tissues (Bligh, 1970a).

The higher mercury residue level of 0.788 ppm observed in common tern eggs from the northern half of Lake Winnipeg may also have been acquired from the same source. The Saskatchewan River drains into the northern part of Lake Winnipeg at the Grand Rapids Dam where the mercury residue levels in northern pike, walleye and sauger averaged 0.40 0.33 and 0.43 ppm respectively (Bligh, 1970a). The common tern eggs from Lake Winnipeg were collected on July 16, while the large majority of other composite egg samples, shown in Table 2, were taken in May amd the first half of June. I observed that most of the tern eggs collected at Lake Winnipeg on that date were fresh, only a few eggs were slightly incubated. This appears to be a late date for clutch initiation as common terns at Miquelon Lake, 53°

15′ N; 112° 55′ W in Alberta, at a similar latitude as the Lake Winnipeg colony, 52° 22′ W; 98° 04′ W, were observed to start most of their egg laying in the latter half of May and the first week of June in 1964 (Fig. 3). Approximately similar laying periods for terns, as

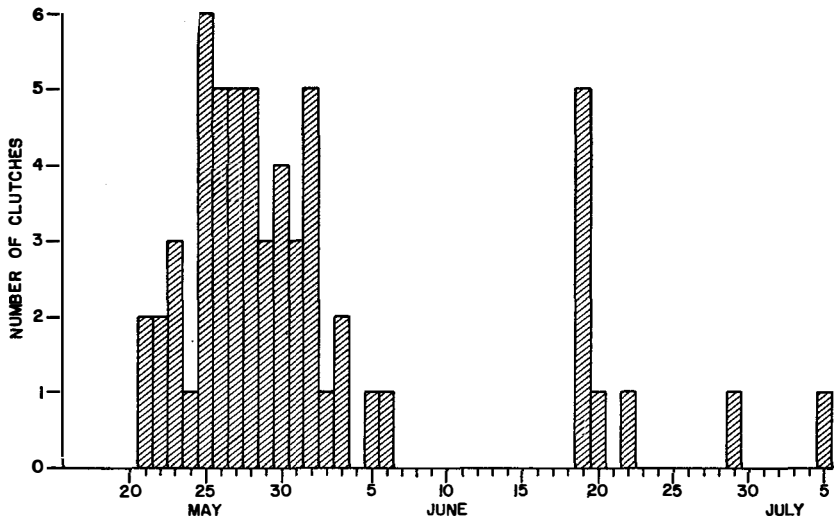


Figure 3.—Distribution of clutch initiation of 58 clutches of common terns at Miquelon Lake, Alberta in 1964. Clutches initiated after June 6 probably are renesting attempts (Vermeer, 1967).

at Miquelon Lake in 1964, were observed at other lakes at similar latitudes in Alberta in different years. Hence a long exposure period of terns to mercury contamination at Lake Winnipeg may have possibly contributed to the observed high mercury residue levels in the eggs of those birds.

As fish at Cumberland House were highly contaminated with mercury residues (Wobeser *et al.*, 1970), I spent the latter half of May and several days in June and July of 1970 at Cumberland Lake in order to determine whether mercury residue levels could be correlated with a possible hatching failure of the fish-eating birds nesting there. Mercury residue levels in individual egg samples of four fish-eating bird species from Cumberland Lake are compared with one another and with the approximate time the eggs were laid in Table 3. Table 3 shows, although statistically just not significant, differences in residue levels between pelican eggs laid in May and those laid in June. The higher levels in the latter, as in the tern eggs from Lake Winnipeg, may possibly be explained by the longer

TABLE 3. MEANS AND 95% CONFIDENCE INTERVALS OF MERCURY RESIDUES IN PPM IN INDIVIDUAL SAMPLES OF FISH-EATING BIRD EGGS AT CUMBERLAND LAKE IN 1970

Species	Sample no.	Time eggs laid	Mean ± 95% C.I.
Herring gull	30	Mid to end May	1.03 ± 0.17
White pelican	10	Mid to end May	0.25 ± 0.13
White pelican	30	Mid to end June	0.48 ± 0.14
Ring-billed gull	10	End May	0.46 ± 0.26
Common tern	10	Begin June	0.40 ± 0.10

exposure of pelicans to mercury contamination on the breeding grounds.

It can be seen that the herring gulls contained significantly higher mercury residue levels in their eggs than those of white pelicans, ring-billed gulls and common terns. Herring gulls may feed more on dead or sick fish than the other species which are perhaps more contaminated with mercury than healthy fish. The higher levels observed in the eggs of this species do not result from a later start with egg-laying than in the other species (Table 3).

One egg each was taken from 26 clutches and two eggs each from 4 clutches with three eggs each of herring gulls at Cumberland Lake in 1970 for the purpose of relating residue levels in those eggs to the hatching success of eggs of the same clutches. This procedure was justified as a highly significant correlation of residue levels between eggs from the same clutch, of 10 California gull females from Joseph and Miquelon Lakes and 4 herring gull females from Cumberland Lake, was found ($r = 0.9920$). Chicks did not hatch in only two of the 30 herring gull clutches from Cumberland Lake. Mercury residue levels in the eggs of the clutches, from which chicks failed to hatch, were 1.30 and 2.35 ppm. Of the 28 clutches from which at least one chick hatched each, 24 clutches had residue levels between 0.5 and 2.0 ppm in one of their eggs (Table 4). Hence herring gull chicks hatch at these levels which is in contrast to the findings of Fimreite (in press) who observed in an experimental study that the hatching success of pheasant eggs with mercury residue levels of 0.5 to 1.5 ppm was significantly less than the controls. Hence it appears that the threshold levels for mercury residues, at which bird eggs fail to hatch, vary between species.

TABLE 4. MERCURY RESIDUE LEVELS IN ONE EGG EACH OF 28 SUCCESSFUL HERRING GULL CLUTCHES AT CUMBERLAND LAKE IN 1970

Mercury in ppm	Total no. eggs
0 –0.49	4
0.50–0.99	11
1.00–1.49	9
1.50–1.99	4
Mean ratio---SE	0.97 ± 0.08

Of the 30 white pelican eggs laid in June at Cumberland Lake, 9 appeared to have an alive embryo, while the other 21 appeared to be foul. The mean and 95 percent confidence intervals for eggs with alive embryos were 0.32 ± 0.13 ppm; for the foul ones 0.54 ± 0.20 ppm of mercury. As the difference in residues between alive and foul eggs was not significant, other factors may have been responsible for the extensive egg mortality of the pelicans.

A comparison is made in Table 5 between the mercury residue

TABLE 5. MERCURY RESIDUES IN PPM IN LIVERS AND TWO EGGS EACH OF CALIFORNIA GULL FEMALES AT MIQUELON AND JOSEPH LAKES, ALBERTA IN 1969

Liver	Eggs		Liver/mean egg ratio
0.401	0.053	0.037	8.9111
0.433	0.067	0.100	5.1547
0.587	0.064	0.095	7.3375
0.326	0.082	0.104	3.5053
0.184	0.036	0.044	4.6000
0.226	0.049	0.041	5.0222
0.372	0.087	0.068	4.7692
0.422	0.096	0.073	4.9647
0.382	0.098	0.114	3.6037
0.511	0.071	0.068	7.3000

Mean ratio liver/egg ± SD ± SE : 5.5168 ± 1.7575 ± 0.5557

levels in livers and those of the means of two eggs of 10 California gull females during the egg-laying period. It can be seen that residue levels in livers averaged 5.5 times higher than those in eggs. Hence mercury residue levels in the livers of egg-laying California gulls may be roughly predicted when known in their eggs. The liver/egg ratios for mercury residues differs considerably from that of DDE and dieldrin residues. The mean liver/egg ratios for DDE and dieldrin in the same gull tissues were 0.81 and 1.48 respectively (Vermeer and Reynolds, 1970).

SUMMARY

A survey was conducted of mercury residues in 22 aquatic bird species at 33 locations in Alberta, Saskatchewan and Manitoba. Mercury levels in eggs of larids and fish-eating birds were generally higher than those in geese and ducks, presumably reflecting differences in feeding habits and biological magnification. Interspecific differences of mercury residues observed in aquatic bird eggs at the same breeding localities may reflect interspecific differences in diet as well as time and length of exposure to mercury. The highest mercury levels were found in herring gulls, which may be related to their scavenging and fish-eating habits. However herring gull eggs, with mercury levels between 0.5 and 2.0 ppm, hatched successfully. Mercu-

ry residues in livers of California gull females averaged 5.5 times higher than in their eggs.

LITERATURE CITED

Bartholemew, G. A.
1942. The fishing activity of double-crested cormorants in San Francisco Bay. Condor 44:13-21.

Bligh, E. G.
1970a. Mercury and the contamination of fresh water fish. Manuscript Report Series No. 1088. Fisheries Research Board of Canada, Freshwater Institute, Winnipeg. 27 pp.

———.
1970b. Mercury contamination in fish. Annual Institute for Public Health Inspectors, Winnipeg, October 19-23, 1970. 17 pp.

Cottam, C. and F. M. Uhler.
1937. Birds in relation to fishes. Wildlife research and management leaflet. BS-83. United States Department of Agriculture. Bureau of Biological Survey, 16 pp.

Fimreite, N.
(In press). Effects of dietary methyl mercury on ring-necked pheasants, with special reference to reproduction.

Fimreite, N., R. W. Fyfe and J. A. Keith.
1970. Mercury contamination of Canadian Prairie seed eaters and their avian predators. Canadian Field-Naturalits 34:269-276.

Fimreite, N., W. H. Holsworth, J. A. Keith, P. A. Pearce and I. M. Gruchy.
(In press). Mercury in fish and fish-eating birds near sites of industrial contamination in Canada.

Guay, J. W.
1968. The breeding biology of Franklin's gull (*Larus pipixcan*). Unpublished Ph.D. thesis, University of Alberta, Edmonton. 129 pp.

Hall, G. R.
1925. Pelicans versus fishes in Pyramid Lake. Condor 27:147-160.

Jensen, S. and A. Jernelov.
1969. Biological methylation of mercury in aquatic organisms. Nature 223 (5207):752-754.

Ludwig, J. P.
1962. A survey of the gull and tern populations of lakes Huron, Michigan and Superior. Jack-Pine Warbler 40:104-119.

Mendall, H. L.
1935. The relationship of certain sea birds to the fishing industry of the State of Maine. Bulletin of the Department of Sea and Shore Fisheries. Maine. 27 pp.

———.
1939. Food habits of the herring gull in relation to fresh-water game fishes in Maine. Wilson Bulletin 51:223-226.

Palmer, R. S. (ed.)
1962. Handbook of North American birds. Volume 1. Yale University Press. 567 pp.

Stout, G. D., P. Matthiessen, R. V. Clem and R. S. Palmer.
1967. The shorebirds of North America. The Viking Press, New York. 270 pp.

Vermeer, K.
1967. Common terns nesting at Miquelon Lake, Alberta. Canadian Field-Naturalist. 81:274-275.

———.
1970a. Breeding biology of California and ring-billed gulls: A study of ecological adaptation to the inland habitat. Canadian Wildlife Service Report Series No. 12. Department of Indian Affairs and Northern Development. 52 pp.

———.
1970b. A study of Canada geese. *Branta canadensis*, nesting on islands in south-eastern Alberta. Canadian Journal of Zoology. 48:235-240.

Vermeer, K. and L. M. Reynolds.
1970. Organochlorine residues in aquatic birds in the Canadian prairie provinces. Canadian Field-Naturalist 84:117-130.

Westermark, T.
1967. Mercury content in feathers of Swedish birds from the past 100 years. Oikos Supplement. 9:39-40.

Wobeser, G., N. O. Nielsen, R. H. Dunlop and F. M. Atton.
(In press) Mercury concentrations in tissues of fish from the Saskatchewan River.

Wood, J. M., F. Scott Kennedy, and C. G. Rosen.

1968. Synthesis of methyl-mercury compounds by extracts of a methanogenic bacterium. Nature 220(5163):173-174.

DISCUSSION

MR. KEITH: Thank you very much, Kees, for an exploration into the mercury dilemma. In what form was the mercury measured in the residues that you've presented; and in your review of the literature and your own personal experience, what can we expect from the various forms of mercury? Are the seed-eating birds receiving exposure to the same kinds of mercury as are the fish-eating birds? What is the difference? Could you explore this a bit for us?

DR. VERMEER: The seed-eating birds usually obtain alkyl mercury compounds. In Sweden, the alkyl mercuries have been banned and they have substituted an alkoxy alkyl mercury. Aquatic birds can obtain, as well, alkyl mercury because gulls, mallards, and pintais may feed on grain. But inorganic mercury and phenyl mercury acetate which is released by chlor-alkali plants and pulpmills in the form of slimicides, respectively, may be methylated by anaerobic bacteria, as has been found by Jensen and Jernelov and Wood, into the highly poisonous form of methyl mercury.

MR. CHARLES BUCKNER (Canadian Forestry Service, Ottawa): You mentioned that the major source of mercury contamination in Lake Winnipeg was from the Saskatchewan River system and the Winnipeg River system. Now, if this is true, there are two other major river systems that flow into Lake Winnipeg—the Assiniboine system, which drains southern Manitoba and neighboring Saskatchewan, and the Red River, which drains southern Manitoba and the northern Lake States.

I wonder if you could explain why these rivers, which are in extremely dense grain-growing areas, don't contribute to mercury pollution as well.

DR. VERMEER: These rivers definitely contribute to mercury contamination of Lake Winnipeg, but the chlor-alkali plants in Canada are among the worst polluters. In 1969 there were about 300,000 pounds of mercury used and two-thirds of that was by the chlor-alkali plants; only 25,000 pounds, I believe, was used in the treatment of grain. So the chlor-alkali plants are the main contributors to the mercury pollution. I don't know the situation with the Assiniboine and the Red River; I don't know if chlor-alkali plants have been established along them in the United States.

CHAIRMAN KEITH: If I may, I'd like to add to that answer. I think it's a fair generalization to say that the mercury used on seed grain does not enter the aquatic environment. That's to say, aquatic pollution in Canada is generally due to other resources such as chlor-alkali and pulp plants.

MR. BOB GOLDWIN (Clatsop College): In reference to migratory birds, what is the percent mercury content in these birds compared to birds that live in one locality?

Is there a higher percentage in migratory birds that leave and go to another place and come back than in resident birds?

DR. VERMEER: In Canada, the fish-eating birds and the Larids, the gulls and terns, are all migratory at least in the prairie provinces. The waterfowl migrate to the southern part of the States. I deal mostly with migratory birds, not with local residential breeding populations.

MR. KEITH: How do your figures compare with other surveys in Canada of resident birds that were eating treated grain seed—the pheasant and Hungarian partridge?

DR. VERMEER: The fish-eating birds, migratory birds or aquatic birds generally seem to be more polluted. It all depends which species you take. The herring gull was among the most polluted. In certain locations, they average 1 part per million in their eggs; and I found that this may mean that if they have 1 part per million in their eggs, they may have about 5½ times, on the average, that amount in the liver. Those were the highest levels we have found, but there may be certain

locations of extensive mercury pollution in the English-Wabigoon River system where bald eagles and great blue herons nest. They may have very high levels as well as ravens which scavenge fish—but I have not heard of it.

MR. RONK: Do you expect the other tissues to contain more methyl mercury, than say, the brain tissue? Or are you running that type of research?

DR. VERMEER: I'm not doing tissue comparisons on mercury.

I have found that in California gulls, the mercury residues in the livers of the females were on the average 5½ times higher than in their eggs during incubation. That is the only tissue comparison I have.

MR. RONK: There are many people who suggest that methyl mercury may not be concentrated in tissue of the organs, such as the liver.

DR. VERMEER: That is possible, yes.

DR. RICHARD TABER (Washington State University): I was going to ask if you had correlated the amounts of mercury found in the eggs with the amounts that would be found in the other body parts. And secondly what procedure did you use to determine these levels? Was it atomic absorption?

DR. VERMEER: Well, first of all, to your question, I did not determine the mercury levels in or make tissue comparisons. We have done this for organochlorine residues but not for mercury residues except in livers and eggs. That's the only tissue comparison we have made. The composite samples were mostly analyzed by neutron activation and individual samples which I collected in 1970 at Cumberland Lake—pelicans and herring gulls—were done by atomic absorption. The two methods seem to compare fairly favorable to one another in eggs.

MR. KEITH: In the case of each of the pesticides, each of the PCB's, and now mercury, we begin with an awareness that the material is present in the environment. We do surveys to identify the incidence of its presence, the magnitude of its residue in various forms of substrates from the environment. We finally work our way into assessments of hazard to wildlife, in our case.

Could you give us a brief resume of what your feelings are as to what the hazard of mercury may ultimately become as we become more aware of its effects?

DR. VERMEER: I can only speculate on this. We have an idea what mercury will do. For instance, it has been found that the 0.05 part per million level mercury residues in onion cells can cause chromosome breakups, duplications, and translocations. At Niigata in Japan, about 26 people died from mercury poisoning. These people lived on a diet of fish—the Japanese and the Scandinavians eat more fish than North Americans—which averaged 5.0 part per million in their muscles. We have found similar levels, of course, in Canada, but fortunately Canadians don't live that extensively on fish.

What will happen in the future? As I mentioned before, the chlor-alkali plants were among the main contributors in the production of chlorine and caustic soda. For every ton of caustic soda, about half a pound of mercury was lost. I think I've heard that remedies have been taking place and that only 5% is lost of what was lost in the past.

What will happen in the future, I don't know. How long some of the mercury which has been spilled in the waterways will be around I don't think we know, and it can be stirred up in the silt again. It is present and it can affect the oceans, as well, very much. It showed up in tuna fish, for instance, extensively. It's hard to predict what the effects will be.

MR. KEITH: That was a rather unfair question. I thought you might have some guess on it.

MR. HUGO S. MALIEPAARD (Saskatchewan): Several questions were asked here obviously trying to determine how these levels of mercury compare in light of the eggs of other nonmigratory species. I cannot answer that but somebody can stick his neck out about the relationship between the contents in the eggs and the contents in the muscle tissue. You can interpolate that we have carried out as a sampling on upland game birds, pheasants, Hungarian partridges or sharptail grouse collected all in the southern part of the province. By the atomic absorption

analysis method it was determined that the level of mercury in the muscle tissue only in one case exceeded .05 parts per million, so the background there is exceedingly low. And that is in areas where a limited amount of mercury fungicide is being used on weed seed treatment, but it is very limited, so if somebody can obtain this relationship maybe we can satisfy some people here. I saw it as about 2½ times when I worked on this but I may be wrong.

DR. VERMEER: Besides the upland game, we collected about 230 ducks in 1969 and 1970 and had the muscle analyzed. Of course, we picked muscle because this is the tissue which people consume. As Hugo found, we did not find very high levels compared to the present standard at which the Canadian government is supposed to take action, which is, I believe, now, 0.5 parts per million. Mallards averaged usually below the 0.1 part per million, but the scaup, bufflehead, and blue-winged teal average from 0.1 to 0.4 per million. Only mergansers were at levels in the tissues above the 0.5 part per million. I believe that in a composite sample of merganser muscle tissue, the level was 0.8 part per million. Fortunately, mergansers are rarely hunted, so I don't think we have too much of a problem, that is, in general; however, at certain locations along the English-Wabigoon River system, ducks which were analyzed by Bligh, from the Fresh Water Institute, had over 5.0 parts per million. He didn't mention in which tissue that level was found.

MR. HOWARD SEARS (Alaska): You mentioned that fish-eating ducks generally were higher in mercury content. Did you make any analysis on fish tissues, and if so, how did the mercury residues stack up in the fish tissues that these birds were feeding on?

DR. VERMEER: No, I did not do any analysis except at a few locations. Most of the analyses are done by the Fresh Water Institute in Winnipeg, and levels in fish are usually higher than in birds. For instance, downstream of Saskatoon I mentioned 5.0 part per million and in the Wabigoon-English River system, it may be 10 parts per million, but this is just a figure in that range. That's much higher than in aquatic or fish-eating birds.

MR. SEARS: I was curious because we're just starting a mercury analysis program on our fish and I was wondering how they compare. Thank you.

MR. FIELD: Thank you again, very much, Kees, for your discussion and paper on mercury.

CHAIRMAN KEITH: For those students of effects of pesticides and similar compounds in the wild, the mercury story is changing very rapidly. In Canada, the use of mercury in cereal grain seed treatments has stopped at the wholesale level and only that still remaining in retail hands may be used this coming spring. So this coming spring may be the final time that seed treatment with mercury will be done extensively in the Canadian prairies. That never did constitute an environmental contamination problem so levels in seed-eating animals and their predators will drop quite rapidly.

In aquatic systems, of course, the drop will be much slower and although, as Kees mentioned, mercury emissions from chlor-alkali plants as of a year ago have been very sharply cut back, these contaminations will remain, and they will remain as areas for study when the point of emission has been essentially cut off.

Now, to turn from the wide scale of a cross-prairie survey to a much more internal subject, Tom Barber is going to talk about effects of pesticides on rumen bacteria of mule deer.

EFFECTS OF PESTICIDES ON MULE DEER RUMEN BACTERIA

THOMAS A. BARBER AND JULIUS G. NAGY

Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado

INTRODUCTION

During the past decade laboratory and field research have extensively augmented knowledge of pesticide toxicities for wildlife. Penned animals of common wildlife species have been tested for sensitivity to a large number of pesticide chemicals (Tucker and Crabtree, 1970), and the extrapolation of this data to field situations has proven useful in estimating ecological impacts of chemical toxicants.

Recently ecologists have begun to turn their attention from gross toxicities of pesticides to such secondary effects as reproductive failure and shell thinning in the eggs of birds (Porter and Wiemeyer, 1969) and the estrogenic activity which some pesticides may have in mammals (Bitman *et al.*, 1968). The realization is being gained that problems inherent to pesticide use extend far beyond the short-term direct toxic effects.

Microbial ecologists have been concerned for some time over the influence of high application rates of agricultural chemicals on soil and aquatic microorganisms (Bollen, 1961). In addition, animal scientists have found that pesticides are capable of altering the *in vitro* metabolism of the bovine rumen microflora (Howes and Dyer, 1968) and decreasing the efficiency of *in vitro* total digestibility (Kutches, *et al.*, 1970). Wildlife nutritionists are presently beginning to investigate the effects of pesticide-containing forage on the rumen fermentations of wild ruminants.

The objective of this study was the determination of the *in vitro* effects of compounds representative of several classes of fungicides, insecticides, and herbicides on the rumen microflora of mule deer (*Odocoileus hemionus*). *In vitro* rumen bacterial growth and function in the presence of pesticides was quantified by: (1) enumeration of deer rumen bacteria growing in non-selective media; (2) determination of amounts of cellulose decomposition in enrichment cultures; and (3) measurement of production of volatile fatty acids (VFA) in a mixed carbohydrate medium.

MATERIALS AND METHODS

Pesticides were selected on the basis of their being widely used, representative of important toxicant classes, or because of the possi-

bility of their application on mule deer range. Compounds tested[1] were: Mema RM, Agrox, Ceresan L, Ceresan M, Black Leaf-40, Baygon, Mobam, Zectran, malathion, parathion, EPN, 2, 4-D, bordeaux mixture, DDT, dieldrin, aldrin, toxaphene, and Actidione. Due to the low water solubility of most of these pesticides, acetone was used as a solvent for serial dilution of pesticides for addition to media. This use of an organic carrier liquid resulted in a much finer dispersion of pesticide particles in media than occurred when pesticides were added alone. In addition, small amounts of Polysorbate 80 were added to media to enhance suspension of pesticide compounds and prevent their settling to the bottoms of culture tubes.

Rumen fluid for inoculum and as an additive to media was obtained from wild deer collected near Kremmling, Colorado, on winter range. Immediately after collection of the animals, rumen fluid was separated from solid ingesta by straining through four layers of cheesecloth and placed in gas-release stoppered thermos bottles for the trip to the laboratory. In no case was the time between collection of rumen fluid and culturing greater than 3 hours. Twenty pure cultures of *Ruminococcus albus, Bacteroides succinogenes, Streptococcus bovis,* and *Butyrivibrio fibrisolvens* used in the study were isolated from the collected rumen fluid and one isolate of each species was obtained from the Virginia Polytechnic Institute Anaerobe Laboratory.

Effects of pesticides on growth of deer rumen bacteria in nonselective reumen fluid medium were examined by culturing mixed inocula (10^4 bacterial cells) diluted in anaerobic diluting fluid (Bryant and Burkey, 1952) in pesticide-containing liquid medium. Both the liquid medium used to expose bacteria to pesticides and the solid medium used for roll tubes were based on the improved rumen fluid medium of Bryant and Robinson (1961). Control cultures and tubes containing 1-1000 ppm of pesticides were incubated for 24 hours prior to making roll tube total counts. Effects of pesticides on the growth of pure cultures were assayed in the same manner. Anaerobiosis was attained by the method of Hungate (1950) in which a washed CO_2 atmosphere and prereduced media are used to enhance the growth of obligately anaerobic rumen bacteria.

Isolates of deer rumen bacteria capable of utilizing specific substrates were made using the starch medium of Hamlin and Hungate (1956), the casein agar of Fulghum and Moore (1962) and the cellulose agar of Hungate (1950). Organisms taken from these

[1]Pesticide formulations used in testing were all of 90-99 percent purity with the exceptions of Mema RM (11.4 percent) and Black Leaf-40 (40 percent).

enrichment media were inoculated into enrichment broth containing similar substrates and the tested concentrations of pesticides and incubated for 48 hours. At the end of the incubation period, organisms from the broth enrichment were again inoculated into roll tubes of the three types of solid media, and the characteristic colonies formed were counted.

The *in vitro* decomposition of cellulose in the presence of pesticides was measured by inoculating a suspension of rumen organisms into cellulose enrichment broth (Bryant and Burkey, 1952) containing pesticides and weighted amounts of ground filter paper cellulose. After a 48-hour digestion period, pH of each culture was determined and the medium was vacuum-filtered on GFA grade Whatman glass filter paper. The residue was dried at 100° C for 6 hours and weighed to determine percentage digestion.

In vitro production of VFA was measured using the medium and method suggested by Doetsch *et al.* (1953) for anaerobic manometry with rumen bacteria. The medium was modified to contain a mixed substrate consisting of glucose, maltose, lactose, and cellobiose in 0.3 percent concentrations, propionate and succinate at 0.1 percent levels and the tested concentrations of pesticide. After 18 hour's incubation with deer rumen organisms, samples of the fermentation medium were prepared for gas chromatography by the method of Erwin *et al.* (1961) using an Aeograph 1740 instrument with a flame ionization detector, a 10-foot ⅛-inch column of 20 percent Tween 80 and 2 percent H_3PO_4 on 60-80 mesh Chromasorb W. Column temperature was 140° C, and nitrogen carrier gas flow was 40 ml/minute.

The statistical design used for analysis of data was a 5 (level) x 18 (treatment) factorial for counts and cellulose liquefaction and a 2 (level) x 18 (treatment) factorial for VFA production. Mean values for cellulose decomposition percentages represent values from four replicate tubes, those for counts are also means of four tubes. Actual residue weight values were used in analysis of cellulose decomposition data, then converted to percentages for discussion. Values for VFA molar percentages and total m mole/liter represent means of determination made on triplicate cultures. In all cases below in which inhibition is stated to have occurred, the decrease in growth, cellulose digestion or VFA production referred to is significant at the 5 percent level ($p < 0.05$) according to Duncan's New Multiple Range Test.

RESULTS

Total Number of Cultivable Organisms

In liquid media, concentrations of 1000 ppm of Mema RM, Black

Leaf-40, 2, 4-D, bordeaux mixture, dieldrin, toxaphene, Ceresan M, Ceresan L, and Agrox caused significant decreases in numbers of rumen bacteria cultivable from mixed broth cultures. At 100 ppm Mema RM, Black Leaf-40, 2, 4-D, bordeaux mixture, Ceresan M, and Agrox remained inhibitory. When concentrations of pesticide were decreased to 10 ppm only Mema RM, 2, 4-D, and bordeaux mixture still inhibited rumen bacteria. At 1 ppm none of the compounds affected mixed culture total counts. The cause of the large decrease in countable organisms observed as concentrations of some pesticides were raised from 10 to 100 ppm is unknown. As 100 ppm levels are reached a non-specific action appears to be exerted rather than the specific antibacterial activity of certain compounds being responsible for inhibition.

Pure cultures of rumen bacteria proved more sensitive to inhibition by pesticides than did mixed cultures. Isolates of *R. albus* were inhibited by 10 ppm or higher concentrations of Mema RM, Black Leaf-40, Mobam, Ceresan L, Ceresan M, and Actidione. Concentrations of 1 ppm of 2, 4-D, Mema RM, bordeaux mixture, and Actidione were also effective in decreasing growth of this species. Strains of *B. succinogenes* tested were sensitive to Mema RM, 2, 4-D, Sevin, DDT, Ceresan L and Ceresan M at 100 ppm. Mema RM, 2, 4-D, and aldrin caused significant count inhibition at 1 ppm. Isolates of *S. bovis* proved the most resistant to pesticides of the rumen bacteria tested. This organism was not susceptible to any of the tested compounds at 10 ppm or 1 ppm levels and at 100 and 1000 ppm concentrations only 2, 4-D, Mema RM, and bordeaux mixture were effective in decreasing bacterial growth. *Butyrivibrio fibrisolvens* proved to be the most sensitive organism tested, being inhibited at 10 ppm of all the compounds tested except for parathion, malathion EPN, Baygon, and Zectran; pesticide concentrations of 1 ppm in media were inhibitory in the case of Mema RM, 2, 4-D, bordeaux mixture, Actidione and Ceresan L.

Metabolic Isolates

Proteolytic organisms isolated from casein-containing solid media were sensitive to the majority of tested compounds at levels of 100 ppm. At this concentration and at 1000 ppm all compounds used in the experiments except EPN, malathion, parathion, Baygon, and Zectran decreased the numbers of typical casein-digesting colonies significantly, as did Mema RM, Black Leaf-40, 2, 4-D, and bordeaux mixture at 1 ppm. Colonies of starch-digesting organisms, surrounded by clear areas of starch hydrolysis, were decreased in number by

Mema RM, bordeaux mixture, Sevin, Mobam, 2, 4-D, and Ceresan M at 10 ppm, and by none of the tested compounds at 1 ppm. Most amylolytics isolated appeared to be strains of *S. bovis*.

Cellulolytic isolates were inhibited by all of the pesticides at 10 ppm or greater concentrations. In most cases inhibitors increased the time required for organisms to cause visible turbidity in broth media, rather than inhibiting growth for as long as incubation was continued. Thus, liquid cellulose-containing media with pesticides often appeared clear for 48 hours after incubation, but turbidity frequently appeared after 24 to 36 hours of additional incubation. Such initial inhibition was reflected by decreased numbers of organisms in roll tubes made after 48 hours incubation of liquid media.

Celluloytic Activity

Cellulolysis by mixed cultures of mule deer rumen bacteria proved the most sensitive parameter of rumen bacterial function examined (Table 1). As was the case with cellulolytic isolates in cellulose-

TABLE 1. INFLUENCE OF SELECTED PESTICIDES ON PERCENTAGE* CELLULOSE DECOMPOSITION *IN VITRO*

Pesticide	Pesticide Concentration (ppm)			
	1	10	100	1000
Mema RM	96.2	81.1b	53.9c	19.1e
Black Leaf-40	89.0a	62.6c	44.1c,d	31.6d
Sevin	99.3	72.6b	64.3b,c	47.1c
DDT	94.4	76.4b	49.5c	34.8d
2,4-D	79.2b	57.2c	19.3d	16.1e
Bordeaux Mix	87.8a	75.1b	35.5d	21.4d
EPN	63.1c	51.9c	39.1d	25.4d
Dieldrin	90.1a	76.1b	48.0c	31.4d
Ceresan L	91.9	73.1b	41.1d	34.1d
Ceresan M	96.2	78.2b	67.8b	44.6c
Toxaphene	97.3	78.1b	51.3c	39.0d
Agrox	93.8	75.5b	50.2c	24.6d
Malathion	83.1a	63.4c	25.3d	12.6e

* Digestion in treatment tubes expressed as percent of digestion in controls.
a, b, c, d—Any means sharing common subscripts or with no subscripts among the 5 levels of pesticide or within each level are not significantly different ($p < 0.05$) by Duncan's New Multiple Range Test.

containing broth, inhibition was often evidenced as a lag in growth rather than a bactericidal effect. At 10 ppm all pesticides except Baygon, Zectran, parathion, aldrin, and Actidione were significantly inhibitory and at 1 ppm, 7 of the compounds decreased digestion. Inhibition at these levels was in many cases reversed to some extent if incubation was for 72 instead of 48 hours. In the case of the organophosphates tested, which are susceptible to rumen hydrolysis (Cook, 1957), inhibition of cellulose digestion was completely reversed after 72 hours.

VFA Production

Volatile fatty acid production in a broth medium containing a mixed carbohydrate substrate was affected adversely by a number of the pesticides tested (Table 2). At pesticide levels of 100 ppm, 13 of

TABLE 2. EFFECT OF PESTICIDES INHIBITORY AT 10 PPM ON VFA PRODUCTION *IN VITRO*

Treatment	Molar Percent VFA			Total VFA (M Moles/Liter)
	Acetic	Propionic & Isobutyric	Butyric	
No Pesticide	46.2	42.3	11.5	33.4
Mema RM	55.0a	37.1b	7.9a	20.6b
Black Leaf-40	57.2a	52.5a	.3c	23.1a
Sevin	55.1a	37.6b	7.3a	26.0a
DDT	51.7a	45.8	2.5c	27.6a
2,4-D	84.5b	13.9c	1.6c	6.1c
Bordeaux Mix	51.3c	48.1a	1.6c	28.5a
EPN	72.3b	26.0b	.7c	15.3b
Dieldrin	64.6a	22.6b	12.8	23.4a
Ceresan L	61.1a	38.8a	1.1c	14.1b
Ceresan M	88.1b	10.8c	1.1c	12.7b
Toxaphene	74.4b	23.8c	1.8c	16.3b
Agrox	98.7c	1.3c	0	11.4b
Malathion	52.1a	43.0	4.9a,b	26.4a

a, b, c, d—Two means with common subscripts or with no subscripts in each vertical column are not significantly different ($p < 0.05$) according to Duncan's New Multiple Range Test.

the added compounds reduced total concentrations of VFA and altered the molar percentages of the VFA produced. Little inhibitory activity was noted at 1 and 10 ppm of any pesticide with the exception of 2, 4-D and Bordeaux Mixture. At 100 ppm all of the tested compounds became effective inhibitors.

At 100 ppm Mema RM, Black Leaf-40, Sevin, DDT, 2, 4-D, bordeaux mixture, EPN, dieldrin, Ceresan L, Ceresan M, toxaphene, Agrox, and malathion caused significant decreases in VFA levels present in liquid cultures. With 2, 4-D the total VFA produced equaled approximately 20 percent of control levels, and Agrox and Ceresan M decreased production to less than 40 percent of the values for controls. The most obvious effect of pesticides on the molar percentages of VFA was the increase of acetic acid production at the expense of propionic, isobutyric and butyric acid. In the case of a number of tested compounds, increases of greater than 50 percent in acetic acid levels were noted. Agrox almost completely eliminated the production of propionic, isobutyric, and butyric acid.

DISCUSSION

Examination of data gathered during the course of the study shows that only three of the compounds tested were consistently inhibitory toward the parameters of bacterial growth examined. Two of these, Mema RM and bordeaux mixture, contain metallic elements known to

be antibacterial in nature, the third, 2, 4-D, is a herbicide. Organophosphates, DDT, and the other neurotoxicants were usually inhibitory only at very high concentrations. Longer term studies of inhibition by compounds found to decrease rumen bacterial growth or function were precluded by the limited time available for our experiments and determination of whether compounds tested destroyed the ability of bacteria to multiply, or merely exerted a static effect was not undertaken.

The indicators of rumen bacterial growth and function examined during the study showed a wide range of sensitivity to pesticides. Modes of action cannot be suggested in the cases of most of the inhibitory compounds. There is certainly no basis for the assumption that toxicants affect bacteria in a manner similar to that by which higher organisms are affected. In addition, persistence or mammalian toxicity appears little related to antimicrobial activity. Pure cultures and cellulolytics responded to nearly all of the chemicals once certain concentrations were reached indicating that a general inhibitory mechanism might have been active regardless of specific pesticides used. Organophosphates as a rule proved slightly less active as inhibitors than chlorinated organic compounds, perhaps due to the former being hydrolyzed in rumen fluid broth.

Mixed cultures were less senstive to pesticides than pure cultures and isolates of starch, cellulose, or protein digesters, and their growth was decreased principally at the higher levels of toxicants. Since total numbers of viable organisms are indicated with mixed culture total counts, the possibility exists that resistant opportunist organisms may mask inhibition of sensitive strains by increasing in number to fill the vacant niches. Such replacement may result in unaltered total counts despite the fact that inhibition has occurred. Alteration of the rumen microflora composition in this manner, occurring *in vivo,* could result in temporary dominance by organisms of decreased value to the ruminant.

With fewer opportunist-type bacteria to be selected by inhibitory pressure, inhibition is more likely to be evident with pure cultures and metabolic isolates. If these are affected adversely, reduced counts should result. Pure cultures, metabolic isolates, gas production, and VFA production all proved more pesticide-sensitive than did mixed cultures. Since more than one species or strain of organism may be included in metabolic isolates, these would be expected to be of sensitivity intermediate between mixed and pure cultures as was actually the case. Compounds decreasing total VFA levels almost invariably increased the production of acetic acid. Such a change

might result from selective pesticide pressure against propionate producers, and, in the long run, might adversely affect the rumen fermentation. The cellulolytic reaction *in vitro* is sensitive to slight changes in composition of medium, redox potential, temperature, and pH and proved particularly sensitive to the influence of pesticides.

Results obtained in these experiments seem to indicate that unrealistically high levels of field pesticide application would probably be necessary to affect *in vivo* rumen function. Indeed, in some cases a rumen inhibitory dose, as indicated from our *in vitro* work, exceeds an acute toxic dose for the animal. Conclusions as to the effect of pesticides *in vivo* on rumen function cannot be rushed. Sensitivity of pure cultures and metabolic isolates indicates that essential organisms may be affected at relatively low pesticide levels. Decreased VFA production may be a particular cause for concern.

This study shows that many commonly used pesticides possess the potential for *in vivo* inhibition of the mule deer rumen fermentation.

A single dose of an inhibitor pesticide would probably have little consequence due to the rapid movement of ingesta in the deer rumen and consequent flushing out of the toxicant. Chronic-type exposure to a persistent inhibitor widely applied to forage plants would, on the other hand, allow a longer period of time for alteration of the rumen microflora. Selection of resistant species of bacteria, should it occur *in vivo,* may decrease rumen function and adversely affect deer ingesting treated forage. This information would seem to provide an adequate basis on which to begin *in vivo* work with penned pesticide-fed deer, and following that, attempts to obtain some measure of correlation between field application levels of pesticides and levels of the toxicants within the rumen of animals ingesting treated forage. Such data, once gathered, will represent a significant increase in our ability to protect wild ruminants from potentially toxic compounds applied to their forage plants.

ACKNOWLEDGMENTS

This study was supported by a research grant from the Bureau of Sport Fisheries and Wildlife in cooperation with the Denver Wildlife Research Center. The financial aid provided through the grant and the generous assistance given by personnel at the Research Center are sincerely appreciated.

LITERATURE CITED

Bitman, J., H. C. Cecil, S. J. Harris and G. F. Fries.
1968. Estrogenic activity of o, p' DDT in the mammalian uterus and avian oviduct. Science 162(3851):371-372.

Bollen, W. B.
1961. Interactions between pesticides and soil microorganisms. Ann. Rev. Microbiol. 15:69-92.
Bryant, M. P. and L. A. Burkey.
1952. Cultural methods and some characteristics of the more numerous groups of bacteria in the bovine rumen. J. Dairy Sci. 36(2):205-217.
Bryant, M. P. and I. M. Robinson.
1961. An improved nonselective culture medium for ruminal bacteria and its use in determining diurnal variation in numbers of bacteria in the rumen. J. Dairy Sci. 44(8):1446-1456.
Cook, J. W.
1957. *In vitro* destruction of some organophosphate pesticides by bovine rumen fluid. J. Agr. Food Chem. 5(11):859-863.
Doetsch, R. N., R. O. Robinson, R. E. Brown and J. C. Shaw.
1953. Catabolic reactions of mixed suspensions of bovine rumen bacteria. J. Dairy Sci. 36(8):825-831.
Erwin, E. S., G. J. Marco and E. M. Emery.
1961. Volatile fatty analysis of blood and rumen fluid by gas chromatography. J. Dairy Sci. 44(9):1768-1771.
Fulghum, R. S. and W. E. C. Moore.
1962. Isolation, enumeration and characteristics of proteolytic ruminal bacteria. J. Bacteriol. 85(4):808-815.
Hamlin, L. J. and R. E. Hungate.
1956. Culture and physiology of a starch-digesting bacterium, (*Bacteroides amylophilus* n. sp.) from the bovine rumen. J. Bacteriol. 72(4):548-554.
Howes, A. D., and I. A. Dyer.
1968. 2,2-dichlorovinyl dimethyl phosphate on rumen VFA and gas production. Proc. W. Sec. Amer. Soc. Animal Sci. 18:19-24.
Hungate, R. E.
1950. The anaerobic mesophilic cellulolytic bacteria. Bact. Rev. 14:1-63.
Kutches, A. J., D. C. Church, and F. L. Duryee.
1970. Toxicological effects of pesticides on rumen function *in vitro*. J. Agr. Food Chem. 18(3):430-433.
Porter, R. D. and S. N. Wiemeyer.
1969. Dieldrin and DDT: Effects on sparrow hawk eggshells and reproduction. Science 165(3889):199-200.
Tucker, R. K. and D. G. Crabtree.
1970. Handbook of toxicities of pesticides to wildlife. U.S.D.I. Fish and Wildlife Serv. Res. Pub. No. 84.

DISCUSSION

CHAIRMAN KEITH: Thank you for a stimulating consideration of the kinds of effects that we must ultimately come to grips with in our research on pesticides.

One point that wasn't quite clear: I believe you said that it did not appear that the persistence of the pesticide had much to do with its effects, and then you mentioned that hydrolysis of organophosphates may have been a reason for the lesser effect of the phosphates in contrast to some of the more persistent materials.

I wonder if you could clarify that point and also if in your work you found that there was any common denominator running through the compounds that did have certain kinds of effects; or was it more of a haphazard reaction of the chemical regardless of chemical configuration or some other characteristic of these various pesticides?

MR. BARBER: Haphazard is a fairly good description of what we saw in many cases. To answer your last question first, other than the fact that the mercurial Mema as well as 2, 4-D were pretty widely inhibitory, a sort of broad spectrum, you might even say, we didn't find any other compounds that were consistently inhibitory.

In many cases, as you reached a concentration of pesticides in vitro in this culture medium perhaps 100 parts per million all or almost all of the compounds became inhibitory. This sort of response you might expect to occur if there was a nonspecific sort of response. In other words, at the point where you get a certain amount of pesticide micelles or molecules in the medium nonspecific inhibition occurred.

If I have your first question right, organophosphates were, in general, less inhibitory, less dangerous inhibitors of the rumen bacteria than chlorinated organics. Some workers in the field have found that rumen fluid has the ability to

rather detoxify—at least as far as insects or mammals might be concerned—organophosphates, due to a basic hydrolysis of the compounds; what I was doing was speculating that perhaps this occurred in our medium which contains rumen fluid.

MR. KEITH: Again, what does 100 parts per million in rumen fluid mean? Is it equal to 100 parts per million in diet directly, or are there other considerations in determining this level at which you worked and the reality of exposure of animals to it?

MR. BARBER: A hundred parts per million in medium is somewhat arbitrary on our part. We merely put in enough pesticide to give a 100 per million in a weight-to-volume relationship and in media. In other words, I would dilute into our medium enough pesticide on a grams-per-milliliter basis so that we'd have a 1 part per million, or 1,000 parts per million or so on.

Now, in the rumen it would be very difficult to say what concentration you'd have from a given dosage. Because of the animal drinking water, because of dilution by food of pesticide that's previously there it would be very difficult to track this.

MR. KEITH: For those unfamiliar with the role of bacteria in rumen digestion and in digestion by other species, are there animals other than the ungulates, other than deer or elk, that might come under some influence because of the kinds of effects you've been measuring here?

MR. BARBER: If pesticides applied in the field in the *in vivo* situation—that is, in the animal in the wild—were inhibitory towards the deer's rumen microflora, we might expect that we would see something similar with other ruminate animals, such as cattle, bison and so on, that rely on a bacterial fermentation for their energy from rough foods—the horse, which uses caecum fermentation; sage grouse, which have extensive fermentation in their caecal tubes. We might look for something like this there—but *in vivo* work is a very desirable thing to do along these lines. The way I feel, no one can really say at present whether pesticides that we tested are less or more likely to cause inhibition in the deer rumen or that they might cause inhibition which does not show up in our test.

DISCUSSION LEADER KEITH: Tom, thank you again for opening our eyes to another consideration.

CHAIRMAN KEITH: In the 1950's Canadians prided themselves on not having massive pesticide use programs that were spread by major agencies over large parts of their country. A program has slowly crept up on us in eastern Canada which we're now going to hear about.

SIDE EFFECTS OF FOREST SPRAYING IN NEW BRUNSWICK

P. A. PEARCE

Canadian Wildlife Service, Department of Fisheries and Forestry, Fredericton, New Brunswick

This paper briefly reviews some effects on wildlife of a prolonged, large-scale chemical spray operation to protect New Brunswick forests against defoliation by the spruce budworm (*Choristoneura fumiferana*). DDT spraying was not acutely toxic to birds but thoroughly contaminated the forest environment with persistent residues. The short-lived organophosphate insecticides phosphamidon and fenitrothion, which replaced DDT, damaged bird populations at the dosages used initially. The hazard was reduced when application rates were lowered. Spraying has been successful in protecting the forest, but the budworm outbreak has continued.

The spruce budworm is an indigenous, defoliating insect distributed throughout the wide range of its host tree species in North America. The concerted pressure of diseases, parasites and predators normally keeps budworm populations at low levels. When natural control mechanisms fail, populations rapidly increase to epidemic proportions. In the spruce-fir forest of eastern Canada several outbreaks have occurred in the last 150 years. Enormous timber losses were consequently sustained in New Brunswick (Macdonald, 1966).

Aerial spraying began in the north of the Province in 1952 to prevent extensive tree mortality threatened by the most recent budworm outbreak. In that year DDT was applied at the rate of 16 ounces per acre. In each of the succeeding six years the dosage was 8 ounces per acre. Populations declined to endemic levels and no control measures were deemed necessary in 1959. An extension of the outbreak in the center of the Province prompted the resumption of spraying in the following year. Until it was completely replaced by organophosphate insecticides, DDT was sprayed annually, usually in two applications of 4 ounces per acre to provide better coverage and to accommodate phenological differences between fir and spruce. Areas treated annually ranged from 1/5 to 5 million acres. By 1970 more than half of the Province had been sprayed one or more times, and about 13 million pounds of DDT and 2 million pounds of organophosphate insecticides had been used.

Kendeigh (1947) found that DDT applied at the rate of 16 ounces per acre produced a negligible observed mortality of forest birds and did not affect the size of the total breeding population or success in

raising young. These were essentially the conclusions of Boyer and Little (1952), who monitored the first spray operation in New Brunswick. Macdonald and Webb (1963) reported that the spray had little effect on breeding bird populations but that some birds apparently moved from sprayed areas after treatment into adjacent ones where budworm populations were higher. Also in New Brunswick, Wilson (1966) was unable to detect any changes in bird distribution and behavior in areas sprayed with up to 8 ounces per acre of DDT.

The most serious direct effect of the spraying was in the aquatic environment, where there were substantial losses of young Atlantic salmon. This has been documented by Elson (1967) and several other investigators and will not be discussed here. The hazard to aquatic fauna was reduced when the flight patterns of spray aircraft were revised to minimize the amount of spray falling directly on streams.

It was not until 1967 that a multidisciplinary study of the dynamic cycling of residues in the forest ecosystem was begun in New Brunswick (Neilson, 1970). This was in an area where the cumulative application of DDT in the previous 11 years was 70 ounces per acre, the highest deposition anywhere in the Province. Transfer of the residue burden from trees to the forest floor will continue for a few more years. Yule (1970) estimated that 11 ounces per acre persists in a virtually unchanged form in the top few inches of the soil. We have found low residue levels in mice, which are herbivores, but substantial concentrations in carnivorous shrews. Hares contained only traces of residues; mustelids and bobcats were significantly more contaminated. Similar biological concentration at higher trophic levels has also been demonstrated in the forest arthropod community: two years after the last spray operation, only traces of residues were found in defoliators such as budworms and aphids but considerably higher levels were detected in predatory ladybeetles, stink bugs and jumping spiders (Yule *et al.,* 1970). Predacious insects are eaten by some species of birds such as sapsuckers to which residues are transferred (Gibbon, 1968).

It is quite apparent that the legacy of the DDT spray era has been a forest environment thoroughly pervaded by persistent residues. We do not know whether the stability of mammal populations was affected. Impairment of reproductive capacity in some birds has been demonstrated: Wright (1965) showed that breeding success of woodcock in the DDT spray zone varied inversely with the amount of DDT used and the area sprayed. The spraying was also shown to adversely affect immature ruffed grouse survival (Neave and Wright, 1969).

There has been little investigation of residue contamination of the meat of game mammals and birds in the Province, in terms of

potential hazard to human health. We found DDT levels ranging from 0.5 to 5.4 ppm, on a fat-weight basis, in the rump muscle of hunter-harvested white-tailed deer. These were mostly yearlings taken from an area with a long spray history, one year after the last treatment. In the breast muscle of 46 woodcock collected in the early fall of 1970, we found DT levels to average 60 ppm and to range from 3 to 771 p.p.m. when expressed on a fat weight basis. The highly contaminated woodcock were from intensively sprayed central parts of the Province; the relatively "clean" birds were taken in unsprayed or lightly sprayed areas. The highest tolerance set by the Canada Department of National Health and Welfare for human food is 7 ppm on a fat-weight basis. The subsequent closure of the woodcock season in the Province denied recreational opportunity to a relatively small but dedicated fraternity of non-resident as well as resident sportsmen.

It was chiefly the damaging impact of DDT spray on aquatic organisms that led to a requirement for a more acceptable insecticide. Among the criteria governing the selection of a candidate were that it should minimize the hazard to fish and other non-target fauna, and that it should break down rapidly so that undesirable residues would not remain to contaminate the environment. Phosphamidon, an organophosphate insecticide, appeared to possess those attributes. In New Brunswick it was first used along stream banks to provide a buffer zone against adjacent DDT-sprayed forest. Its introduction marked an important beginning of a gradual move towards greater reliance on short-lived chemicals, and a sharp reduction of the problem of loss of control attendant on the use of highly persistent compounds.

The effects of aqueous solutions of phosphamidon on forest birds in New Brunswick have been reported by Fowle (1965a, 1965b, 1966). Techniques used included pre- and post-spray censuses in treated and control (unsprayed) areas, intensive searches for carcasses, and critical observation of bird behavior for symptoms of acute poisoning. Field observations were supplemented by experimental dosing of captive birds. No absolute measurements of bird population densities were made but indices to species abundance were obtained by counting all birds seen and heard along transects. Contrary to expectation, an application rate of 8 ounces per acre caused substantial bird mortality and incapacitation. The effect became manifest within the first few hours after spraying. Casualties representing 20 species were recovered from treated zones. Wood warblers, which comprised about half of the total number of birds in study areas, were frequent victims. The slow build-up of populations in treated areas may have been due to the recovery of birds temporarily incapacitated by the

spray or to immigration of newcomers from adjacent unsprayed zones. Application rates of 4 ounces per acre produced a less pronounced effect. Some species, whose behavior and feeding habits in the treetops or on the branch tips may have exposed them more to the spray, appeared to be especially vulnerable. It was demonstrated that birds were able to pick up toxic amounts of the poison through the feet by contact with contaminated perches during the first few hours after spraying. In Quebec, McLeod (1967) found that phosphamidon caused a significant reduction in the number of warblers when it was applied at the rate of 4 ounces per acre to jack pine stands.

Preliminary field trials of another organophosphate, fenitrothion,[1] were begun in the Province in 1966. Investigation of the effects on birds of both phosphamidon and fenitrothion has continued in subsequent years (Pearce, 1967, 1968; Pearce and Teeple, 1969). Mortality and reduction of breeding populations could be clearly detected when fenitrothion emulsion was applied at the rate of 8 ounces per acre. Lower treatment levels caused slight population depressions, and a small number of intoxicated birds were found in local areas where an increased concentration may have resulted from overlapping spray swaths or peculiarities of drift. Most of the distressed birds which were captured died in captivity within a few hours. The hazard was reduced when spraying took place during the late evening, when most forest birds are relatively inactive and less likely to come into contact with contaminated twigs and foliage.

When the spray was emitted in finer droplets than in previous years, we noted symptoms of acute poisoning at treatment levels which experience had suggested were fairly safe. It is possible that our apparently inconsistent findings may have been due to that change. We found dead and distressed birds, particularly warblers, in most areas sprayed with fenitrothion at the rate of 6 ounces per acre. Peterson (1969) was unable to demonstrate any major detrimental effects on bird populations in forest areas in Maine treated with fenitrothion at that dosage. We found that fenitrothion dosages of 4 ounces per acre killed some birds.

The organophosphates we have investigated are systemic as well as contact poisons. The systemic mode of action could be more fully exploited. If technically feasible, spraying could start at the time of budworm emergence from hibernation early in the spring before the bulk of the bird migrants had returned. That would give an additional measure of foliage protection and avoid unnecessary exposure of many birds to the spray.

[1]Trade names include Sumithion, Accothion, Novathion and Folithion.

Because our investigations in New Brunswick have been conducted in the context of an operational spray program many questions remain unanswered. Threshold application rates at which harmful effects become manifest have nevertheless been established. The conclusion that phosphamidon is more toxic to birds than fenitrothion seems justified. As phosphamidon dosages that are marginally tolerated by birds have not achieved an acceptable degree of budworm control, greater operational reliance has recently been placed on fenitrothion at rates producing minimal observable effects on birds. In both the 1969 and 1970 spray programs fenitrothion was the chief insecticide used, in double applications of 2 ounces per acre or in one treatment at 3 ounces per acre.

Other chemicals may eventually replace fenitrothion. It is important that we understand their effect on the environment before they come into operational use. A field evaluation of the effectiveness in budworm control of three promising candidate insecticides, all carbamates, was recently made in New Brunswick. The trials were made with standard operational equipment, with strict adherence to experimental design, and under optimum spraying conditions. Zectran, Lannate, and Matacil were sprayed in two applications at the rates of 1.0, 0.8, and 1.25 ounces per acre respectively. We found that censuses, searches for casualties, and the behavior of captives exposed to the spray all failed to indicate that birds were adversely affected. Further trials are planned at substantially lower dosages.

The release of broad-spectrum insecticides over large tracts of forest for almost two decades has not controlled the budworm epidemic though it has been successful in protecting foliage, the declared objective of the program. By preserving its food supply and suppressing some of the natural control agents, the spraying has at the same time favored the budworm. In that sense the operation may be self-perpetuating. It is one reason why research into several alternative, more ecologically sophisticated control techniques is proceeding on a broad front. The use of viral and bacterial preparations, sex attractants, juvenile hormone, and introduced parasites are examples of such methods. Though some show promise, unfortunately none is ready for general use. Reliance on the brute force of insecticide spraying will therefore continue in 1971, when the operation is expected to be as large or larger than any of its predecessors.

The employment of more intensive forest management techniques may ultimately provide the best solution to the budworm problem. Meanwhile, entomologists are attempting to identify the attributes of epicenters from which populations spread. It is to be hoped that they are successful, and that incipient outbreaks can in future be sup-

pressed by measures in which toxic chemicals play only a very minor role.

LITERATURE CITED

Boyer, G. F. and S. W. Little.
1952. Effect of aerial DDT spraying during the Upsalquitch Project, 1952. Rep. on file with Can. Wildlife Serv., Ottawa.

Elson, P. F.
1967. Effects on wild young salmon of spraying DDT over New Brunswick forests. J. Fish. Res. Board Can. 24:731-767.

Fowle, C. D.
1965a. A preliminary report on the effects of phosphamidon on bird populations in central New Brunwick. Can. Wildlife Serv. Occ. Pap. 7. 54 p.

———.
1965b. Summary statement on the effects of phosphamidon on birds, 1965. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 2. 15 p. + 10 tables.

———.
1966. Effects of phosphamidon and experimental insecticides on birds. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 3. 19 p. + 6 tables.

Gibbon, R. S.
1968. Residual DDT in relation to a population of yellow-bellied sapsuckers, *Sphyrapicus varius*, in New Brunswick. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 9. 26 p.

Kendeigh, S. C.
1947. Bird population studies in the coniferous forest biome during a spruce budworm outbreak. Ontario Dept. Lands and Forests, Div. of Research, Biol. Bull. 1. 100 p.

Macdonald, D. R.
1966. Forest protection against spruce budworm in New Brunswick. Background paper (B17-12-1) for National Conference on Pollution and our Environment. Montreal. 1966. 20 p.

Macdonald, D. R. and F. E. Webb.
1963. Insecticides and the spruce budworm. *In* The dynamics of epidemic spruce budworm populations. *Edited by* R. F. Morris. Mem. Entomol. Soc. Can. 31:288-310.

McLeod, J. M.
1967. The effects of phosphamidon on bird populations in jack pine stands in Quebec. Can. Field-Natur. 81:102-106.

Neave, D. J. and B. S. Wright.
1969. The effects of weather and DDT spraying on a ruffed grouse population. J. Wildlife Manage. 33:1015-1020.

Neilson, M. M.
1970. Studies of DDT residues in a forest ecosystem. Forest Research Laboratory, Fredericton, N. B. Intern. Rep. M-55. 32 p.

Pearce, P. A.
1967. Summary statement on the effects on bird populations of Novathion, Sumithion and Sumithion-phosphamidon mixtures, New Brunswick, 1967. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 7. 39 p.

———.
1968. Effects on bird populations of phosphamidon and Sumithion used for spruce budworm control in New Brunswick and hemlock looper control in Newfoundland in 1968: a summary statement. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 14. 56 p.

Pearce, P. A. and S. M. Teeple.
1969. Effects of forest spraying of Sumithion on birds and amphibians in New Brunswick. Can. Wildlife Serv., Pestic. Sect. MS. Rep. 19. 7 p.

Peterson, J. W.
1969. The effects of Sumithion on birds. *In* A cooperative pilot study of the insecticide Sumithion. USDA Forest Serv.; USDI Bur. Sport Fish. Wildlife; Maine State Forestry Serv. 41 p.

Wilson, W. G.
1966. Effects of forest spray pesticides on New Brunswick birds: effects of DDT on birds. Can. Wildlife Serv., MS. Rep. 4. 9 p. + 4 tables.

Wright, B. S.
1965. Some effects of heptachlor and DDT on New Brunswick woodcocks. J. Wildlife Manage. 29:172-185.

Yule, W. N.
1970. DDT residues in forest soils. Bull. Environ. Contam. Toxicol. 5:139-144.

Yule, W. N., E. G. Kettela and I. W. Varty.
1970. The current status of DDT residues in New Brunswick's forests

Paper presented at Annual Meet. Acadian Entomol. Soc., Fredericton, N. B. (September, 1970).

DISCUSSION

MR. JAMES O. KEITH: Peter, at the beginning of your paper you stress the damage caused by the budworm and as you ended your paper you mentioned that they were trying to protect foliage. What is the damage caused by spruce budworm?

MR. PEARCE: This is a very good question. I think, initially, when the spray program commenced, the objective was to attempt to eradicate the budworm, and it was quickly realized that this was not possible and the term "control" was introduced. The current phraseology is to protect forests. You don't necessarily have to kill a lot of budworms—in fact, you don't. The essential objective is to prevent widespread mortality of spruce and fir. To do this, you have to preserve some foliage and to do that you have to kill some budworm, but the prime objective is not to kill all the budworm in sight, which is impossible in any case.

DR. ALEX CRINGAN (Colorado): I'd like to ask Dr. Pearce about residues of DDT in New Brunswick. He mentioned residues in the soil and in various faunal components; and I'd like to know if they examined the fatty components of vegetation and looked for residues there?

MR. PEARCE: Yes, this interdisciplinary study I mentioned has incorporated quite a lot of analysis of fir and spruce foliage, where there is a considerable residue burden. The figures are available but in unpublished form. Essentially, residues remain unchanged. In other words, they're mostly in the form of parapara DDT and with some orthopara DDT, which is in the original technical material.

DR. CRINGAN: And have you any idea what residues were in the fats of aspen and so on?

MR. PEARCE: No. I've got a few figures. For some mammals total DDT levels on a wet or fresh-weight basis in the livers:

Bobcat, 40 parts per million; mink, 4.5 parts per million; weasel, 3 parts per million; fisher, 2.2 parts per million; fox, .7 parts per million; and beaver, down to .08 parts per million. So you can see the magnification from the herbivorous stage right through to the carnivorous stage.

These levels, I think, are really quite low. They may not have any effect on mammalian population stability at all, but we don't honestly know.

DR. CRINGAN: Fine. Thank you.

DR. CLARENCE COTTAM (Texas): If I understood correctly, you said that there were 11 parts per million of DDT in the topsoil. How long was that after DDT had been applied?

MR. PEARCE: It was 11 ounces per acre of total DDT in the top and humus layers of the soil—11 ounces per acre on an average, in an area over which 70 ounces per acre had been released in the previous 11 years; and these measurements were made the year after the last application. The levels were higher along a stream valley—about 20 ounces per acre.

DR. COTTAM: Thank you. You haven't used any DDT since 2 or 3 years ago?

MR. PEARCE: No. DDT was discontinued completely in 1968, during which year, very little was used. Fenitrothion is the operational insecticide now, and probably will remain so for several years.

DR. COTTAM: Had DDT become ineffective by that time, or did that have any influence on its discontinuance?

MR. PEARCE: The major factor influencing the decision to change from DDT to other compounds was to reduce the hazard to aquatic organisms, but I believe there is some evidence that some budworm populations did develop resistance to DDT, which is rather a rare phenomenon, I suspect, in forest insects, with one generation a year.

DR. COTTAM: I didn't quite catch the effect on the salmon. Is the salmon population up anywhere it used to be when you started—very early in the late 40's, as I remember?

MR. PEARCE: Well, we have the finest Atlantic salmon rivers in the world in New Brunswick.

DR. COTTAM: You still have.

MR. PEARCE: There were substantial losses of under-yearlings and small parr during the DDT era. I'm not really qualified to answer your question. There still seems to be an area of controversy here, but the strongest school of thought seems to be that there are plenty of apparently quite healthy salmon in New Brunswick rivers.

MR. BUCKNER (Canadian Forestry Service): During the examination of insecticide application, was there any indication that the carriers of the insecticide had any toxic effects on birds or mammals?

MR. PEARCE: This coming year, we are going to conduct some trials of different carrying agents with fenitrothion. It's my understanding that some work was completed in the West here, recently with fenitrothion at 1 pound per acre sprayed as an oil solution. Apparently it caused no adverse effects on birds whatsoever.

In New Brunswick, the fenitrothion is sprayed as a water emulsion. I should have mentioned that point and stressed it—9 parts out of 10 of the total mix is water and the rest is a mix of the technical material, a solvent oil and an emulsifying agent. This may be a very critical factor. The hazard may be, in fact, reduced if you apply the chemical as an oil solution. It may be absorbed into the leaves much faster; if you spray it as a water emulsion, it may hang on the leaves longer, and thereby, the hazard will be continued that much longer.

Does that answer the question?

MR. BUCKNER: Yes. What evidence have we that there is a possibility that, particularly mammals, by inhaling some of the carriers, experience some toxic effects?

MR. PEARCE: Before the change to a finer atomization, the spray was applied at a mass median droplet diameter of about 150 microns. This means about half of the spray volume was in particles bigger than that, and half the volume was in particles smaller than that. And now, the mass median droplet diameter is down to around something like 75, which means the droplets are penetrating right down through the forest canopy into the lower levels, and perhaps mammals and birds are inhaling the poison, because the particles are so fine. But we don't really know.

MR. KEITH: I must interrupt to keep us on schedule. Thanks again, Peter, for a very interesting discussion on the forest problems.

CHAIRMAN KEITH: Many people have been concerned about the potential widespread use of Mirex and of those who have done work on Mirex is a group at the Gulf Breeze Laboratory of Environmental Protection Agency; and here to speak on the effects of Mirex on Selected Estuarine Organisms in Jack Lowe.

EFFECTS OF MIREX ON SELECTED ESTUARINE ORGANISMS[1]

J. I. LOWE, P. R. PARRISH, A. J. WILSON, JR., P. D. WILSON AND T. W. DUKE

Pesticides Office, Environmental Protection Agency, Gulf Breeze Laboratory, Sabine Island, Gulf Breeze, Florida

INTRODUCTION

Estuarine organisms were exposed to mirex (dodecachlorooctahydro- 1, 3, 4-metheno-2H-cyclobuta [cd] pentalene) under controlled conditions in the laboratory. This chlorinated hydrocarbon is the insecticide component of a fire ant bait which consists of 84.7 percent corn cob grits, 15.0 percent soybean oil, and 0.3 percent mirex. The bait is used at the rate of 1.4 kilograms per hectare (1.25 pounds per acre) for control of the imported fire ant, *Solenopsis saevissima richteri* (Coon and Fleet, 1970). Mirex is partially soluble in some organic solvents (Frear, 1969) but only slightly soluble in water (Walsh, 1971). The molecule (Figure 1) is extremely stable and has a melting point of 485° C.

Standard screening tests conducted at this laboratory in 1962 did not reveal the toxic properties of mirex to estuarine crustaceans. Tests of longer duration were required to demonstrate clearly the delayed toxic effects of this insecticide to juvenile pink shrimp and juvenile blue crabs.

This paper summarizes the results of several laboratory experiments in which shrimp, blue crabs, fiddler crabs, and pinfish were exposed to mirex in food, in water, or in both. Information concerning the movement of mirex in simple food chains and the persistence of mirex in fire ant bait is presented also.

EXPERIMENTAL PROCEDURES

Bioassay techniques—standing sea water

Juvenile brown shrimp (*Penaeus aztecus*) were reared from postlarvae in the laboratory and exposed to mirex fire ant bait in one-liter glass beakers or in 30.5-centimeter-square plastic boxes at room temperature. Five liters of filtered sea water and 10 juvenile shrimp were added to a box; a liter of water and two juvenile shrimp, to a beaker. The water was aerated and particles of mirex bait were added to the experimental containers; carrier material (particles of corn

[1]Gulf Breeze Contribution No. 124.

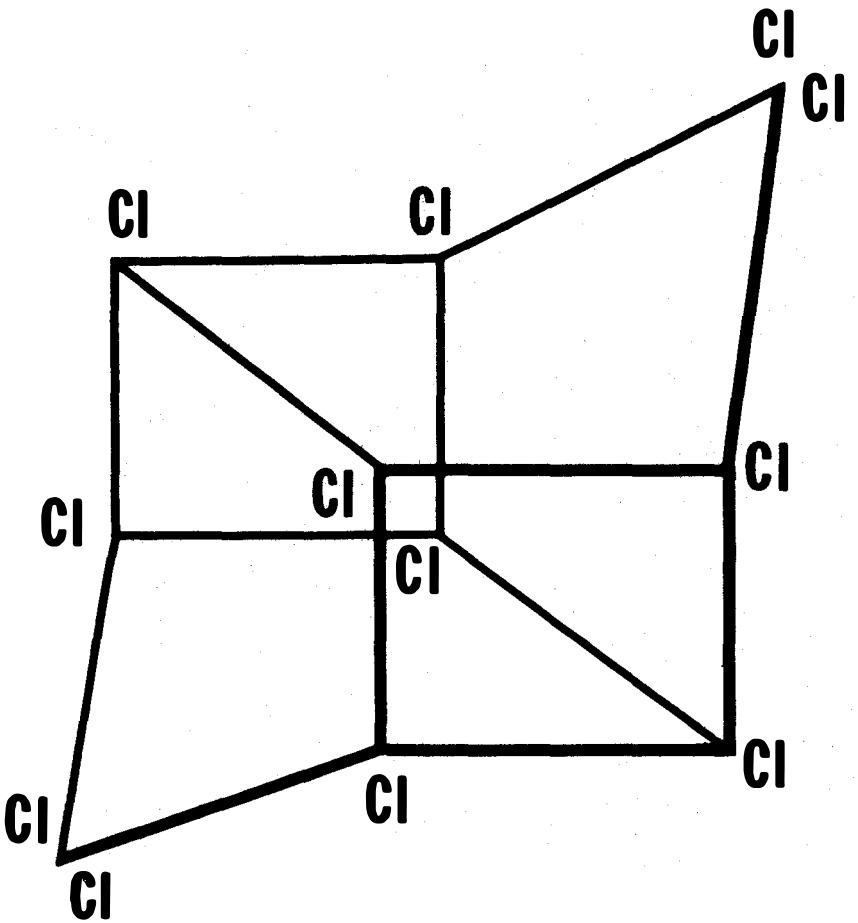


Figure 1.—Mirex (dodecachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd] pentalene), a chlorinated hydrocarbon insecticide (after Frear, 1969).

cobs soaked in soybean oil but without mirex), to the control containers. All containers were covered with nylon screen.

Grass shrimp (*Palaemonetes pugio* and *P. vulgaris*) were captured locally, acclimated to laboratory conditions, and exposed to mirex fire ant bait in one-liter glass beakers. Beakers were filled with filtered sea water and two adult shrimp were placed in each beaker. Particles of bait were added to five beakers; carrier material was added to five control beakers. All beakers were placed in a constant temperature bath and covered with plastic sheeting or nylon screen.

Standing sea water tests were repeated at least three times and the standard error of the mean calculated.

Bioassay techniques—flowing sea water

Juvenile pink shrimp (*Penaeus duorarum*), juvenile blue crabs (*Callinectes sapidus*), fiddler crabs (*Uca pugilator*), and juvenile pinfish (*Lagodon rhomboides*) used in flowing water experiments were captured in local waters, acclimated to laboratory conditions, and exposed to technical mirex or mirex fire ant bait. Bioassays were performed at different seasons of the year when animals were available. The animals were held in compartmented aquaria that contained one shrimp, crab, or fish per compartment (Figure 2). Each aquarium contained twenty-five 10.2-centimeter-square compartments. Calibrated tubes siphoned a continuous flow (usually 400 liters per hour) of unfiltered sea water from a constant-level water supply into each aquaria. Temperature and salinity of the sea water were measured during each exposure but no attempt was made to change these conditions. In feeding experiments, particles of mirex fire ant bait were placed directly into each animal's compartment. In experiments

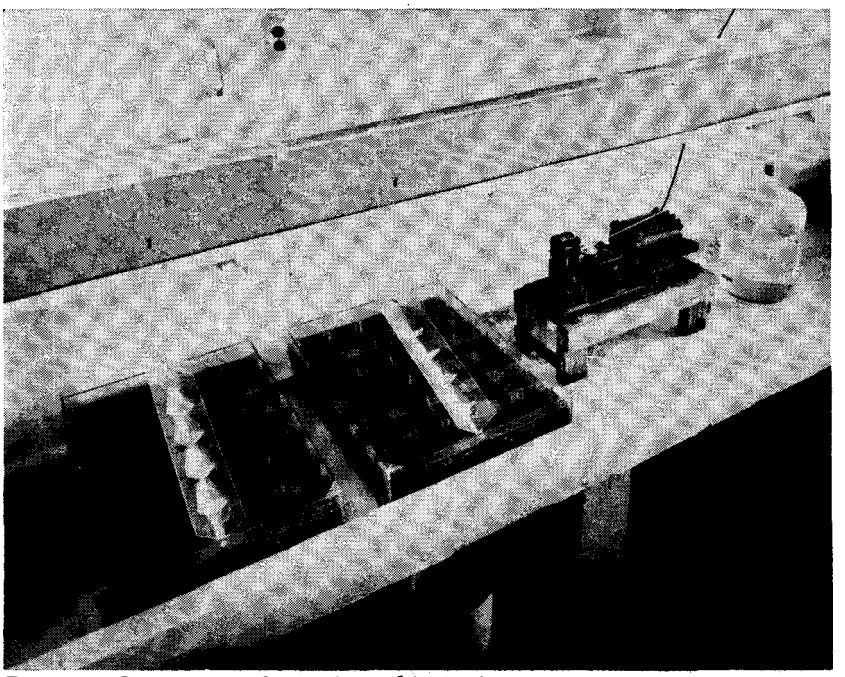


Figure 2.—Compartmental aquaria used in flowing seawater tests.

in which animals were exposed to solutions of mirex, technical grade mirex was dissolved in acetone and added by metering pumps to the sea water siphoned into each experimental aquarium to give the desired test concentration. Control aquaria received the same amount of acetone (1 milliliter/minute) as did experimental aquaria.

Effects of mirex on shrimp and crabs in flowing sea water tests were evaluated statistically by the chi-square test on the premise that all conditions being the same (that is, if mirex did not poison the animals), an equal number of animals in both control and experimental groups would become paralyzed or die. Mortality was considered statistically different at the 0.01 level.

Residue analyses

Samples were prepared for analysis by mixing tissues of shrimp, crabs, or fish with anhydrous sodium sulfate in a blender. The mixture was extracted for 4 hours with petroleum ether in a Soxhlet apparatus. Extracts were concentrated to approximately 10 milliliters and transferred in 3- to 4-milliliter portions to a 400-millimeter by 20-millimeter chromatographic column that contained 76 millimeters of unactivated Florisil. After each portion settled in the column, vacuum was applied to evaporate the solvent. This was repeated after each addition and after three 5-milliliter petroleum ether rinses of the extraction flask. Vacuum was disconnected after all solvent had evaporated and the residue was eluted from the column with 70 milliliters of 9:1 mixture of acetonitrile and distilled water. The eluate was evaporated to dryness and the residue transferred to a Florisil column (Mills, Onley, and Gaither, 1963) with petroleum ether. Mirex was eluted from the column with 6 percent ethyl ether in petroleum ether.

Tissue samples that weighed less than 1 gram were analyzed by a modification of the Enos (1967, personal communication) micro method. Samples were weighed into glass tissue grinders and extracted with three 2.0-milliliter portions of acetonitrile. The three extracts were combined, diluted with 6.0 milliliters of distilled water, and extracted with three 2.0-milliliter portions of hexane. These extracts were combined, concentrated to about 0.5 milliliter, and transferred to chromatograph columns (7-millimeter inside diameter) that contained 1.5 grams of PR grade Florisil (activated at 130° C) topped with 1.5 grams of anhydrous sodium sulfate. Mirex was eluted from the column with 20.0 milliliters of 1 percent ethyl ether in hexane.

Water samples were extracted with petroleum ether. The extracts were dried with sodium sulfate and reduced to an appropriate volume.

The extracts of all substrates were identified and measured by electron-capture gas chromatography. Extract volumes were adjusted to obtain a sensitivity of 0.01 part per million (p.p.m., milligrams/kilogram) for tissue samples and 0.01 part per billion (p.p.b., micrograms/liter) for water samples. Operating conditions of the two 152.4-centimeter by 3.2-millimeter glass columns used were as follows:

Liquid phase	3 percent DC-200	1:1 3 percent DC-200, 5 percent QF-1
Solid support	60/80 Gas Chrom Q	80/100 Gas Chrom Q
Oven temperature, °C	190	185
Injection and detector temperature, °C	210	210
N_2 flow-rate, milliliters/minute	25	25

Laboratory tests indicated recovery rates greater than 85 percent for mirex. Data in this report do not include a correction factor for percentage recovery. All residues reported are on a wet weight basis.

EFFECTS OF MIREX ON ESTUARINE CRUSTACEANS

Shrimp

Juvenile brown shrimp (19 to 29 millimeters rostrum-telson length) died after exposure to mirex fire ant bait (Table 1). In standing sea water, 10 control shrimp and 10 experimental shrimp were in each test. Exposure to one particle of bait per shrimp caused mortality to 60 percent within 96 hours, but mortality was greater and occurred more rapidly when more particles were available to the shrimp. Symptoms exhibited by shrimp prior to death were irritability, uncoordinated movement, loss of equilibrium, and paralysis.

TABLE 1. ACUTE TOXICITY (96 HOURS) OF MIREX FIRE ANT BAIT TO BROWN SHRIMP, *PENAEUS AZTECUS*, IN STANDING SEA WATER. AVERAGE TEMPERATURE WAS 22°C; AVERAGE SALINITY, 21 PARTS PER THOUSAND.

Particles of bait per shrimp	No. of tests	Percentage mortality		
		Mean	Range	Standard error
0 (control)	4	12.5	10–20	2.50
1	4	47.5	40–60	4.79
2	4	67.5	40–100	13.77
5	4	85.0	70–100	6.45

Juvenile pink shrimp are extremely sensitive to mirex dissolved in the sea water in which they are held. Thirty-six pink shrimp (51 to 76 millimeters rostum-telson length) were exposed to 1.0 p.p.b. of

technical mirex in flowing sea water for seven days. Average temperature of the sea water during the experiment was 17° C; average salinity, 29 parts per thousand. Twenty-five percent (9 of 36) of the shrimp became irritated and died during the 7-day exposure. The remaining 27 shrimp died within four days after exposure ended. Each shrimp exhibited the same symptoms of poisoning before death as those observed in brown shrimp given mirex bait. Seventeen percent (6 of 36) of a group of control shrimp died during the 11-day experiment. The difference between control and experimental mortality was statistically significant.

Immediately following the above experiment, a second group of 36 juvenile pink shrimp was exposed to 0.1 p.p.b. of technical mirex in flowing sea water for three weeks. Average temperature of the sea water during this experiment was 14° C; average salinity, 29 parts per thousand. Only 11 percent (4 of 36) of the shrimp died during the 3-week exposure, but several more showed symptoms of mirex poisoning, nine dying during a 2-week post-treatment period while held in mirex-free water. About six percent (2 of 36) control shrimp died during the 5-week experiment. At the end of exposure, 15 live shrimp were removed from the control and experimental aquaria for residue analyses. The livers (hepatopancreases) were removed from 10 mirex-exposed shrimp and residue analyses made of composite samples of the livers and remaining tissues. The livers contained 2.4 p.p.m. of mirex; the remaining tissues, 0.32 p.p.m. A composite sample of five whole shrimp contained 0.26 p.p.m. of mirex. Five control shrimp (whole body) contained no detectable mirex.

Grass shrimp, *Palemonetes pugio,* (17 to 32 millimeters rostrum-telson length) died after exposure to mirex fire ant bait (Table 2). In standing sea water, 10 control shrimp and 10 experimental shrimp were in each test. Exposure to one particle of mirex bait per shrimp caused mortality to 70 percent within 96 hours, but mortality was greater and occurred more rapidly when more particles were available to the shrimp. Five particles per shrimp, for example, caused 100 percent mortality within 48 hours. Chemical analysis of water and

TABLE 2. ACUTE TOXICITY (96 HOURS) OF MIREX FIRE ANT BAIT TO GRASS SHRIMP, *PALAEMONETES PUGIO,* IN STANDING SEA WATER AT 25°C.

Particles of bait per shrimp	No. of tests	Percentage mortality[1]			Salinity parts per thousand	
		Mean	Range	Standard error	Mean	Range
1	4	62.5	50-70	4.79	23	20-26
2	7	75.7	50-100	7.19	19	14-27
5	3	96.7	90-100	3.33	22	18-26

[1] Control mortality never exceeded 10 percent.

whole shrimp carcasses showed higher residues of mirex when more particles of bait were present.

Juvenile blue crabs

Mirex is toxic to juvenile blue crabs, either as a contact-poison or as a stomach-poison. Lowe, Wilson and Davison (1970) of this laboratory reported that juvenile blue crabs and juvenile pink shrimp showed no symptoms of poisoning during a 96-hour exposure to a suspension of 0.1 p.p.m. (milligrams/liter) technical mirex in flowing sea water but became irritated and paralyzed, and then died within 18 days after being placed in mirex-free water. Further observations showed that small crabs held in tanks containing particles of mirex fire ant bait became paralyzed after several days as had the crabs in the suspension of technical mirex. McKenzie (1970) reported that juvenile blue crabs (less than 76 millimeters) are extremely sensitive to the bait. To confirm a suspicion of poisoning by ingestion, several feeding experiments were performed.

Twenty-five juvenile blue crabs were placed in each of three compartmented aquaria (Figure 2). Group A was the control. In group B, each of the 15 crabs in the front compartments was given one particle of mirex fire ant bait. The sea water flowing through these 15 front compartments passed over 10 crabs that received no mirex bait. In group C, each of the 25 crabs received one particle of bait. Several crabs picked up the particle of bait as soon as it settled to the bottom of the compartment and were observed "chewing" with their mandibles. All three groups of crabs were fed pieces of fish after the first three days of the experiment. Crabs were removed from the aquaria when paralyzed or dead, and frozen. The experiment was terminated four weeks after the bait was fed to the crabs, and residue analyses (whole body) were made on individual crabs (Table 3). Nineteen of 25 crabs (84 percent) in group C were paralyzed or dead at the end of the experiment, and 23 (92 percent) contained residues of mirex. About half of the crabs receiving mirex bait in group B were killed or paralyzed. Four (16 percent) of the control crabs in group A died during the experiment. Mortality in control and mirex-treated groups was statistically different. The smaller crabs appeared to be more sensitive to and more quickly affected by the mirex bait. McKenzie (1970) reported that adult and sub-adult (76 to 127 millimeters) blue crabs were not affected by mirex fire ant bait, even in doses equivalent to 10 times the standard application-rate of 1.4 kilograms per hectare. The observation that none of 10 crabs in the back of aquarium B was paralyzed or killed indicates that the

TABLE 3. TOXICITY OF MIREX FIRE ANT BAIT TO JUVENILE BLUE CRABS HELD IN FLOWING SEA WATER. AVERAGE TEMPERATURE WAS 24°C; AVERAGE SALINITY, 29 PARTS PER THOUSAND.

Group (25 crabs each)	Carapace-width, average and range (millimeters)	Mirex treatment	Paralysis or death (percent)		Crabs containing residues of mirex (percent)	Residues of mirex			
						Parts per million		Micrograms	
			2 weeks	4 weeks		Average	Range	Average	Range
A	40 (23–63)	None (controls)	0	16	0	—	—	—	—
B	46 (36–58)	15 crabs—one particle[1] of bait per crab	33	53	73	0.17	0–1.0	1.42	0–6.1
		10 crabs—no mirex	0	0	10[2]	—	—	—	—
C	26 (19–36)	One particle of bait per crab	76	84	92	0.99	0–6.7	1.29	0–4.8

[1] Average amount of mirex per particle of bait ~ 4.4 micrograms.
[2] One crab contained 0.036 part per million of mirex. A particle of bait was probably displaced from a front compartment.

crabs were affected by ingestion of the particle of bait rather than by mirex leached into the water.

Twenty-five crabs (11 to 33 millimeters carapace-width) were placed in each of three compartmented, flowing sea water aquaria to evaluate the toxicity of mirex fire ant bait to smaller blue crabs at higher temperatures and to simulate the possible variability of field application. In one tank, each crab was given one particle of bait. In the second tank, the crabs were given two particles of bait. In the third tank, the crabs, maintained as controls, were given two particles of carrier material. Average temperature of the sea water during the first 96 hours of the experiment was 31° C; average salinity, 30 parts per thousand. Forty percent of the crabs that received two particles of mirex bait and 28 percent of those that received one particle became paralyzed or died within 24 hours after receiving the bait. Eighty-eight percent (22 of 25) and 60 percent (15 of 25) of the crabs in the same groups became paralyzed or died within 96 hours. Ninety-six percent (24 of 25) and 84 percent (21 of 25) of the crabs of the same groups died by the 20th day, when the experiment was terminated. None of 25 controls died. The chi-square test showed a highly significant statistical difference between numbers of affected crabs in control and both experimental groups after 96 hours. McKenzie (1970) found the toxicity of mirex bait to be temperature-dependent: no mortality occurred in mirex-treated crabs held in water of 10° C but survival time and rate decreased as temperature increased from 20 to 27° C.

Fiddler crabs

Fiddler crabs readily pick up and ingest particles of mirex fire ant bait. Paralysis or death may occur within one to several weeks depending upon the amount of bait eaten and the temperature of the experimental environment.

An experiment was performed to evaluate the effects of a simulated field application of mirex fire ant bait on fiddler crabs. The fiddlers were held in tanks that contained wet beach sand at one end and a pool of flowing sea water at the other end. Average temperature of the sea water was 29° C; average salinity, 27 parts per thousand. The mirex bait was sprinkled over the surface of the sand at the rate of 1.4 kilograms per hectare in two treatments one week apart. Seventy-three percent (16 of 22) of a population of fiddlers was paralyzed or killed within two weeks by 50 milligrams (39 small particles) of the bait. Only one control crab died during this period. The digestive tracts of three paralyzed crabs contained 4.0 p.p.m. (3.2 micrograms) of mirex.

Forty fiddler crabs (14 to 20 millimeters carapace-width) were then exposed to mirex fire ant bait to determine levels of mirex accumulation. Average temperature of the sea water was 24° C; average salinity, 30 parts per thousand. The crabs were treated at the equivalent of 1.4 kilograms per hectare (2.6 milligrams of bait per crab) and fed pieces of fish regularly. After four weeks, six control and 16 experimental live crabs were selected randomly for residue analyses. No mirex was detected in the control crabs, but each of the 16 experimentals contained measurable amounts of the chemical. Average concentration per crab was 0.30 p.p.m. (0.51 microgram); the range was 0.12 to 0.66 p.p.m. (0.13 to 1.27 micrograms). At the end of the experiment, approximately 20 percent of both controls and experimentals had died and several more experimental crabs exhibited symptoms of mirex poisoning.

EFFECTS OF MIREX ON PINFISH

Pinfish do not appear to be affected by ingestion of mirex with their food. Large amounts of mirex bait were given pinfish in this experiment to get background information, but the amounts were not related to normal application-rates for field use. Twenty-five juvenile pinfish (80 millimeters mean total length, 7 grams mean weight) lived for five months on a diet that contained approximately 20 p.p.m. of technical mirex. Fresh fire ant bait was also generously applied each week to the bottom of the holding tank. The pinfish exhibited no symptoms of pesticide poisoning during the experiment, but concentrated high residues (30 to 40 p.p.m.) of mirex in body tissues. Fish contained an average of 18 p.p.m. of mirex in their tissues eight weeks after exposure ended, indicating that mirex is not easily metabolized.

A consulting pathologist (Wood, 1971, personal communication) examined five individual fish from control and mirex-treated groups and made the following comparisons:

> No pathologic differences were discernible between the tissues of treated and nontreated specimens. However, the two groups were easily differentiated on the basis of an entirely different parasitic fauna. The non-treated group exhibited a rather high concentration of an unidentified trematode located in the pyloric area of the intestinal tract. This parasite was almost completely absent from the group exposed to mirex, which, in contrast, showed a few encysted or degenerated organisms of similar structure.
>
> Whether this difference is due to the mirex exposure, or to

different environmental conditions (water, feed, time of year, etc.) of the two groups is not known. The degenerated appearance of the encysted parasites in the treated groups suggests, at least, that mirex had a toxic effect on these organisms.

While both groups had a variable concentration of gill parasites, the untreated group in general appeared to be more heavily parasitized, and one specimen of this group demonstrated a striking population of gill protozoans.

The tissues which might be suspected of showing toxic changes from the exposure to mirex, e.g., liver, kidney, pancreas, visceral fat, etc., in fact, were the same in both groups.

Van Valin, Andrews, and Eller (1968) reported no mortality or tissue pathology in bluegills (*Lepomis macrochirus*) exposed to mirex, but the gills and kidneys of mirex-exposed goldfish (*Carassius auratus*) showed reactions 56 days after treatment. The number of goldfish that survived treatment was inversely related to treatment level, and growth of bluegills was reduced at high treatment levels.

MOVEMENT OF MIREX IN SIMPLE FOOD CHAINS

Mirex can be transferred through simple, two-level food chains. Grass shrimp (*Palaemonetes pugio* and *P. vulgaris*) were allowed to feed individually on one particle of mirex fire ant bait in standing sea water. Those which died (more than 50 percent in 96 hours) were frozen and later fed to juvenile blue crabs which were held in compartmented, flowing sea water aquaria. In two separate experiments, 10 crabs (18 to 33 millimeters carapace-width) were fed carcasses of grass shrimp killed by feeding on the bait, while 10 control crabs were fed freshly killed, uncontaminated grass shrimp. All crabs in both experiments died within 14 days after eating mirex-contaminated grass shrimp carcasses. No control crabs died. The number of carcasses eaten by each crab ranged from one to four. A pooled sample of 10 grass shrimp carcasses contained 1.1 p.p.m. (2.5 micrograms) of mirex, and a pooled sample of seven crabs contained 0.16 p.p.m. (1.9 micrograms) of mirex.

Blue crabs also concentrate mirex when fed small fish containing the insecticide. Five juvenile blue crabs (26 millimeters mean carapace-width) were fed one fish that contained 1.0 p.p.m. or 0.4 microgram of mirex (an average of 10 individual residue analyses) each day for five days and uncontaminated fish thereafter. Three of the crabs exhibited symptoms of mirex poisoning and were moribund or dead three weeks after receiving the fifth contaminated fish. These crabs contained 0.13 p.p.m. (0.85 microgram), 0.22 p.p.m. (0.48

microgram), and 0.25 p.p.m. (0.78 microgram) of mirex. The two remaining crabs were alive five weeks after eating the fifth contaminated fish and contained 0.10 p.p.m. (0.37 microgram) and 0.13 p.p.m. (0.57 microgram) of mirex.

Each of five juvenile blue crabs (26 millimeters mean carapace-width) was fed only one juvenile fish containing 1.0 p.p.m. of mirex and uncontaminated fish thereafter. Sixty days later, four of the crabs were still alive and contained 0.045 p.p.m. (0.23 microgram), 0.025 p.p.m. (0.14 microgram), 0.052 p.p.m. (0.19 microgram) and 0.027 p.p.m. (0.11 microgram) of mirex—about half of the total micrograms of mirex ingested with the single contaminated fish.

PERSISTENCE OF MIREX IN FIRE ANT BAIT

Mirex remains in fire ant bait months after the bait is placed in sea water (Table 4). This was determined by placing two-gram samples of bait in 51- by 76-millimeter bags made of 363-micron mesh nylon netting. The bags were hung from a floating board in open sea water. Individual bags were removed at intervals, wrapped in aluminum foil, and frozen. After all bags had been removed, the bait from each bag was placed in a glass vial and dried at 60° C. Control samples of mirex bait kept in glass vials at room temperature were likewise dried. The bait was transferred with acetone into flasks and agitated. Appropriate dilutions were made from this solution for analysis by gas chromatography.

TABLE 4. AMOUNT OF MIREX REMAINING IN DUPLICATE TWO-GRAM SAMPLES OF MIREX FIRE ANT BAIT AFTER SOAKING IN OPEN SEA WATER, AND AMOUNT IN FIVE UNSOAKED (CONTROL) SAMPLES

Time in water[1] (months)	0	3	4	5	6	7	8	9
Milligrams of mirex in bait	6.2 7.3 6.5 6.0 4.1	4.3	4.2	3.4	1.9	1.7	1.7	2.3
		4.7	4.3	3.1	2.3	1.8	2.2	1.8
Average	6.0	4.5	4.3	3.3	2.1	1.8	2.0	2.1
Percentage of mirex remaining in bait	100	75	71	54	52	29	33	34

[1] April 1970 to January 1971. Average temperature was 22.7°C; average salinity, 29 parts per thousand.

Some fouling of bags occurred, particularly those left in sea water for more than four months. However, the surfaces of all bags were sufficiently clean for water to flow freely through the mirex bait. About 34 percent of the mirex remained in the bait after nine months of soaking.

ECOLOGICAL IMPLICATIONS

Both laboratory and field experiments must be performed in order to evaluate the impact of mirex or other chemicals on the estuarine environment. It is difficult, if not impossible, to extrapolate results obtained under controlled conditions in the laboratory to field conditions. For example, the mirex fire ant bait was readily available to test animals in the laboratory, but might not be as available to the biota under natural conditions. Conversely, field tests alone are inadequate to determine the toxicity of mirex. Mass mortalities, where large numbers of animals are affected at the same time, usually indicate toxic effects in the field, but our laboratory studies suggest that mortalities due to mirex would not all occur at the same time. Also, animals in advanced stages of paralysis could be eaten by larger carnivores or swept out of the estuary by tidal action. Thus, the affected animals could be removed from the system without visible evidence of their condition.

For these reasons, we are complementing our laboratory studies by participating in a project with the U.S. Department of Agriculture to study translocation and accumulation of mirex applied to an estuarine test area.

SUMMARY

1. Exposure to mirex under laboratory conditions affects certain estuarine crustaceans by causing irritability, loss of equilibrium, undirected movement, paralysis, and, frequently death. Onset of symptoms depends upon the level of exposure or amount of mirex ingested, temperature, and, in some cases the age or size of the animal being tested.

2. Juvenile brown shrimp (*Penaeus aztecus*) and grass shrimp (*Palaemonetes pugio*) died after exposure to mirex fire ant bait at levels as low as one particle of bait per shrimp in standing sea water.

3. Juvenile pink shrimp (*Penaeus duorarum*) died after exposure to technical mirex dissolved in flowing sea water. Although only 25 percent of a population of pink shrimp died during a 7-day exposure to 1.0 p.p.b. of mirex, all remaining shrimp died within four days after being placed in mirex-free sea water. This phenomenon of delayed toxicity was the first encountered in several years of pesticide research at this laboratory.

4. Mirex was toxic to juvenile blue crabs (*Callinectes sapidus*), either as a contact- or as a stomach-poison. Exposure to one particle of bait per crab caused significant mortality. Fiddler crabs (*Uca pugilator*) were also susceptible to poisoning by mirex. Exposure to

levels of mirex bait equivalent to a field application (1.4 kilograms per hectare) caused 73 percent mortality.

5. Mirex was apparently not toxic to pinfish (*Lagodon rhomboides*). Juvenile pinfish concentrated high residues of mirex, but no differences in mortality or pathology were discernible between control and experimental fishes.

6. Mirex can be transferred through simple food chains in laboratory experiments. Juvenile blue crabs exhibited symptoms of mirex poisoning and died after eating grass shrimp that had been killed by exposure to one particle of mirex fire ant bait. Ingestion of mirex-contaminated fish also caused symptoms of poisoning and death in juvenile blue crabs.

7. The insecticide mirex remained in fire ant bait months after the bait was placed in open sea water. About 34 percent of the mirex in samples of bait was still present after nine months of soaking in sea water.

ACKNOWLEDGMENTS

We thank Jerrold Forester, Johnnie Knight, and James Patrick for technical assistance, Mary Ruth McCracken for illustrations, and Robbin Blackman for photographic assistance. Samples of technical mirex and mirex fire ant bait were supplied by Allied Chemical Corporation. The National Marine Fisheries Service Biological Laboratory, Galveston, Texas, provided postlarval shrimp for use in experiments.

LITERATURE CITED

Coon, D. W. and R. R. Fleet.
1970. The ant war. Environment 12(10):28-38.

Enos, H. F.
1967. Personal communication. Perrine Primate Laboratory, Pesticides Office, Environmental Protection Agency, P.O. Box 490, Perrine, Florida 33157.

Frear, D. E. H.
1969. Pesticide Index, 4th Ed. College Science Publishers, State College, Pennsylvania 16801, 399 pp.

Lowe, J. I., P. D. Wilson, and R. B. Davison.
1970. Effects of mirex on crabs, shrimp, and fish. *In* Progress Report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla., Fiscal Year 1969. U.S. Dept. of Interior Circular 335, pp. 22-23.

McKenzie, M. D.
1970. Fluctuations in abundance of the blue crab and factors affecting mortalities. South Carolina Wildlife Resources Department, Marine Resources Division, Technical Report 1, 45 pp.

Mills, P. A., J. F. Onley, and R. A. Gaither.
1963. Rapid method for chlorinated pesticide residues in non-fatty foods. J. Assoc. Agr. Chem 46(2):186-191.

Van Valin, C. C., A. K. Andrews, and L. L. Eller.
1968. Some effects of mirex on two warm-water fishes. Trans. Amer. Fish. Soc. 97(2):185-196.

Walsh, G. E.
1971. Lack of effect of Mirex® and PCB (Aroclor® 1254) upon evolution of oxygen by unicellular estuarine algae. *In* Progress Report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden

Research, Pesticide Field Station, Gulf Breeze, Fla., Fiscal Year 1970. U.S. Dept. of Interior Circular (In Press).

Wood, E. M. 1971. Personal communication. Tacoma Mall Office Building, Tacoma, Washington 98402.

DISCUSSION

MR. ELI JIMENEZ (Portland): Can you identify the location of the insecticide in the tissue of the blue crab or the shrimp, or any of the other species that you studied? Did you find a particular location in the tissue of the animal?

MR. LOWE: We've done very little of this. In some of the shrimp experiments, we dissected out the hepatopancreas and there were quite high levels of mirex in some, more than in the whole body. But we haven't done this on the blue crab. It was whole body residues in most experiments.

MR. JIMENEZ: Were you able to identify the reason for the delayed effect of the insecticide? This is rather interesting and as you said, apparently has not been noticed before.

MR. LOWE: No. We didn't determine why it's delayed, and at higher temperatures, it's not nearly as delayed as we originally thought. In initial exposure at normal temperatures, you don't seem to get any effect at all; but when you do hold them, they die a few at a time. Of course, this is why mirex is so effective in fire ant control and exactly the way it kills the fire ants. The ants take it down into the colony, pass it around, and gradually are killed off. But as to the delayed effect, I really don't know what causes it.

MR. JIMENEZ: Has your information caused any effect on the fire ant program at present? Has your information been transmitted to the agency using it and are they doing anything about this?

MR. LOWE: I believe they are talking about that this week in Washington.

MR. BOB GOLDWIN (Clatsop College): On cycling, you say that you put them in the fresh water right after you subject them to this change. Now, do you think that this effect of subjecting them to the clean water without a progressive change has any effect?

MR. LOWE: No, I don't believe so. In many experiments, we just put them in other tanks of the same type, same water, same temperature; in some cases, they just stayed in the same tank. I don't believe that there was much of a stress factor involved.

DR. EUGENE DUSTMAN (Patuxent Wildlife Research Center): Jack, I merely want to correct something that I think should be corrected. I don't think you would want to say that this is being applied at the rate of a pound and a quarter per acre.

MR. LOWE: I should have made that clear. You're right. Yes, that's a pound and a quarter of bait, which figures out only to about 1.7 grams of actual mirex.

DR. DUSTMAN: I think it important that people realize that. To put you on the spot, if I may—this is a persistent chemical. It has toxic qualities and the capacity to concentrate in food chain organisms, and to persist for a very long while, we think. Under these conditions, how would you treat this chemical so far as using it on an extensive scale, or if the proposal was being made to use it on an extensive scale?

MR. LOWE: Well, in the case of mirex, the people applying it agreed not to put it into the marshes or into the aquatic areas. So I think this is a point in our favor.

DR. DUSTMAN: Do these chemicals stay where they are put?

MR. LOWE: I don't know. Mirex, from what we know so far, apparently, doesn't all stay where it's put. I am kind of hedging!

DR. DUSTMAN: Yes. You get my concern that it has all the characteristics of a chemical that can become a problem; and in our attempts to use value judgments as to those which should be used and those which should not be used, we must be very careful about approving the use of this kind of a chemical if it is on other

than a strictly experimental basis. And I think you are perhaps fully exonerated in this case, inasmuch as it is on an experimental basis. But even so, the rather extensive use to be made of the chemical is a little bothersome, I think—perhaps 6 million acres is a little bit much to be fussing with on an experimental basis.

MR. LOWE: Right.

MR. PEARCE: May I just comment on Dr. Dustman's comment, which illustrates this problem of loss of control attendant on the use of these very persistent materials? We have in fact found small amounts of mirex in some of the New Brunswick woodcock.

MR. LOWE: I might add, in our study in South Carolina, the Bureau of Sport Fisheries and Wildlife is also involved, and they are sampling birds and raccoons in that area.

DR. CLARENCE COTTAM: This is an area in which I have done some work in years past myself; and if you get a 6-foot tide, there is a lot of water above that dotted line and if they cover that, you know a lot of that mirex will get out into the estuary.

MR. DENZEL FERGUSON (Portland State University): Mine is a comment more than a question, but I'd like to point out that some workers at Mississippi State University have recently shown that a single granule is lethal to juvenile crayfish. I think we need not restrict our interest just to crabs.

MR. LOWE: Right. I'm glad you brought that out.

DISCUSSION LEADER KEITH: Thanks again, Jack, for your interesting comments on mirex and the fire ant program.

Gentlemen, on your behalf, I will thank the speakers; and also, we should thank those of you who stayed with us for 3 hours. I personally think that 3 hours is a long period to be bombarded with this kind of data.

And after such a sober and somber afternoon, I understand on good authority that the liquid and solid refreshment available around here is quite uncontaminated, so let's go.

TECHNICAL SESSION

Tuesday Morning—March 9

Chairman: PHILIP A. DOUGLAS
Assistant to the Executive Director, National Wildlife Federation, Washington, D.C.

Discussion Leader: RICHARD K. YANCEY
Assistant Director, Louisiana Wildlife and Fisheries Commission, New Orleans

OIL, FISH, AND WILDLIFE

REMARKS OF THE CHAIRMAN

PHILIP A. DOUGLAS

Oil has been in our waters for many years, for perhaps centuries, as a natural seep. But recently, this has caused the concern of man mainly because of his recognition of oil as a pollutant to both our fish and wildlife. Our energy requirements are ever on the increase, calling for more and more of this fuel; and, of course, accidents do happen.

The Commander of the Port of Miami, a personal friend of mine, feels that he is sitting on a powder keg, especially when so much oil from Venezuela passes through that port on the way to other East Coast refineries. Further, we have already had serious accidents in Tampa Bay, the Gulf of Mexico, San Francisco Bay and, of course, the Santa Barbara Channel. The maximum delivery of oil at Valdez in Alaska, some two million barrels per day of crude, will be coming down our and Canada's coast to the West Coast refineries, at least should plans be concluded as they are now proposed.

Further, there is much unknown about the direct effect of oil on fish and wildlife or even indirect effects or the effects of oil several months, even years after being accidentally introduced into marine waters, particularly in more northerly latitudes.

We hope that some knowledge may be forthcoming from this morning's session.

THE IMPACTS OF OIL ON THE EAST COAST

DONALD J. ZINN
Department of Zoology, University of Rhode Island, Kingston

I would like to tell you about the impacts of one of our most important fuels, oil, on the biota of one of the largest concentrations of coastal population in this hemisphere, the East Coast of the United States. It is a subject of considerable complexity, intimately involved with the politics, economics, sociology, industry and armed forces logistics of a relatively sophisticated, affluent, burgeoning population, that is becoming increasingly concerned about the dwindling supply of its sources of food. Indeed, one of the major concerns of both coastal and inland man worldwide is the possibility that the earth will not be able to nourish its expanding population; an anxiety increased by the inroads of a growing variety of sources of pollution on all environment fronts.

A particularly controversial issue is the question of how much food can ultimately be obtained from the sea. It is argued on the one hand that, on the basis of area, the oceans receive more than twice as much solar energy—the prime source of all biological productivity—as the land. This suggests that the oceans' potential productivity should greatly exceed that of the land. On the other hand, most of the sea is biologically a desert. Its fertile areas are found where runoff from the land or the upwelling of nutrient-rich deep water fertilizes the surface water and stimulates the growth of marine plants, the photosynthetic organisms on which all other marine life depends. For this reason, the topographic area that is concerned basically with this discussion encompasses the coastal zone, including its component estuaries. It will be seen that the coastal zone provides one of the critical tests of whether man is going to be able to clean up his own pollution of the environment, and more specifically, whether he is willing to make the personal, financial and political sacrifices, and the necessary governmental adjustments, to accomplish viable results.

THE COASTAL ZONE

The coastal zone of which the estuary is perhaps the most important biological and sociological element or unit is more than just the edge of the continent. It is a national asset. The significance of the coastal zone can be described in the words of Mr. Edward Wenk, Jr., executive secretary of the National Council on Marine Resources Engineering Development, as quoted in the *Congressional Record* of March 27, 1969:

What do we mean by the coastal zone? Much of our nation's history and indeed much of its future has derived from the narrow, irregular band of shallow ocean and coastal land that comprise some 17,000 miles of our country's boundary. The 30 coastal and Great Lakes states contain more than 75% of our population. A preponderance of this country's investment by heavy industry is located there. The proximity of land and ocean makes this zone a gateway to a maritime trade of 500 million tons annually, valued at $40 billion; a staging area for harvesting $500 million of fish and crustaceans; a locus for shipbuilding, a base for our naval strength and for our seaward thrust for off-shore oil and gas that today involve over six thousand wells producing fuel values at over a billion dollars.

The concentration of population along the coast translates to a growing concentration of markets and of labor. These in turn attract other nonmaritime industries, and in turn, more people. All the megalopoli projected for the year 2000 lie in this band. And with the increasing utilization pressure on the coastal zone and its natural form, we also seek to modify it to suit new purposes: off-shore airports, off-shore oil terminals, off-shore nuclear power generation plants.

And to this I would add the filling in of estuarine shores to provide additional land area for people and industry.

Studies made in recent months indicate that in the past 15 years, almost one-third of the prime coastal marshlands bordering the estuaries of the United States have been so abused by man, by oil spills and by other depredations, that they no longer can fully serve their important natural functions.

The truly disturbing fact is that these marshlands are a part of an estuarine environment which probably is the most valuable—and certainly the most vulnerable—of all the varied types of natural environment that have been described by ecologists.

In the Southern Atlantic States, for example, estuaries are included in what is often called tidewater country, a complex environment made up of salt, brackish and fresh waters, together with salt and fresh water marshes that are regularly or infrequently flooded.

There was a time not so long ago, when this watery area—particularly the reedy marshes—was considered to be of little economic importance. We know better now. As Dr. Eugene P. Odum, an authority on the comparative biological productivity of various environments, recently said, "The estuaries are the most naturally fertile areas on earth."

Based on research done in Georgia, Odum concluded that the estuarine marshes there—and they are very like those found in all coastal states—produce approximately 10 tons of dry organic material per acre a year. (Most of it, of course, usable by man, the remainder involved in the life cycles of local flora and recreationally or commercially valuable fauna.) This is almost twice the productivity of the best farm land, seven times the productivity of ocean waters along the continental shelf, and 20 times the productivity of the open ocean.

The estuaries provide the source of most of our shellfish—oysters, clams, crabs, lobsters, shrimp and bay scallops, for example. The estuarine waters and their creek-laced marshes are the residence or the nursery for most of the important food and sport fish found on our coasts. For example, in 1965 commercial fishermen in North Carolina sold 226 million pounds of fishery products. Of that total, 97 percent by weight was made up of species which were, one way and another, dependent on the estuarine environment for their survival.

The 5,000 or so commercial fishermen of North Carolina are utterly dependent on the continued productivity of the estuaries. In 1965, this environment produced a catch valued at dockside at $9.5 million. Processed and sold to the ultimate consumer, the 1965 catch is estimated to have been worth $66 million.

There are also the 400,000 or so Carolina sports fishermen who, by the most conservative estimates, spent $32 million last year to catch species whose abundance is determined by the productivity of the estuaries. Most of the waterfowl which come to this state each winter also are dependent on the continued health of the estuarine waters and marshlands. The income to the state from hunting and fishing licenses contributed extensively to the coffers of resort owners, businessmen and the state tax department.

The clapper rail and other residents of South Carolina salt water marshes contribute another, albeit much smaller, source of income for guides in certain coastal counties.

And trapping—raccoon, mink, otter and muskrat—is still another source of coastal income ($422,773 in 1965-66) that is dependent on the continued existence of the estuarine marshes.

These, then, are just a very few examples of the values of this natural resource which are being destroyed along our eastern coast with increasing lack of concern.

In my judgment, the estuarine element part of the coastal zone is the part of our environment in which we will confront probably the most difficult problems of resource management. Probably the best present solution is to provide state controlled coastal zonation, it is

certainly an excellent way to provide environmentally responsible planning for future oil refinery sites, but it is a tactic presently patently unacceptable to local city and town governments, politically oriented bodies that are unrealistically chauvinistic in outlook, that put political survival above the well-being of their citizens, and to whom the credo, *E Pluribus Unum*, is just a meaningless phrase in a dead language.

The oil that pollutes coastal waters and soils of the East Coast shores gets there by drifting in on tidal waters or under the influence of onshore winds: it may have been spilled at sea purposely or inadvertently, it may have been released from a sunken ship, it may be there as the result of an accident, or it may have resulted from dockside carelessness at oil refinery or storage tanks farm. According to a statement attributed to Thomas Pross of the Maritime Administration of The U. S. Department of Commerce at an international conference in Rome in 1970 on marine pollution, between 4 million and 10 million metric tons or more of oil are spilled into the sea each year. There are more than 10,000 so-called pollution "incidents" in U. S. waters alone. These figures illustrate the magnitude of the problem. However, from three well-publicized cases in three different parts of the world, the obvious has received scientific documentation, and it is now generally accepted that a little oil is a dangerous thing with regard to most marine invertebrates and many higher organisms. The Santa Barbara oil spill in California, the *Torrey Canyon* accident off The Coast of England in 1966, and the moderately large oil spill that occurred off the shores of West Falmouth, Massachusetts, in September 1969, have claimed the attention of biologists, chemists and engineers representing research institutions, oceanographers, biologists, the oil industry and government. The damage to marine organisms in such situations may be little short of catastrophic. Chronic exposure to oil and petrochemicals that may occur near major oil refineries usually causes a reduction of the biota over a wide area (NAS-NAE, 1970)

DAMAGE TO BIOTA

Dr. Max Blumer and Dr. Howard Sanders, part of a team of biologists and chemists of the Woods Hole Oceanographic Institution who examined the damage to marine organisms by oil pollution resulting from the West Falmouth oil spill, indicated that pollution along the sea bottom was still spreading, ten months after it happened, and that it now covered at least 5,000 acres offshore and 500 acres of marshes and tidal rivers. They noted that oil from the accident in which a fuel barge struck submerged rocks off West

Falmouth had been incorporated into the subtidal sediments of these areas and into the offshore sediments down to 42 feet, the greatest water depth in that area.

According to Dr. Blumer, "the No. 2 fuel oil involved in the spill is a relatively volatile oil product. In spite of this, volatilization has been minimal and the oil remains in the marshes, exposed to air, and, in the offshore areas, pollution has been spreading on the sea bottom and now covers an area much larger than that affected immediately after the accident.

"Bacterial degradation of the oil is slow, degradation is still negligible in the most heavily polluted areas, and the more rapid degradation in outlying, less affected areas has been reversed by the influx of less degraded oil from the more polluted regions.

"The kill of bottom plants and animals has reduced the stability of marshland and sea bottom; increased erosion results and may be responsible for the spread of the pollution along the sea bottom.

"Where oil can be detected in the sediments there has been a kill of animal life; in the most polluted areas the kill has been almost total, while in control stations outside the area there are normal, healthy bottom fauna.

"A massive, immediate kill occurred offshore during the first few days after the accident, affected a wide range of fish, shellfish, worms, crabs and other crustaceans. Bottom-living fishes and lobsters were killed and washed up on the beaches. Trawls in 10 feet of water showed 95 per cent of the animals dead and many still dying. The bottom sediments contained many dead clams, crustaceans and snails.

"Fish, crabs, shellfish and many other animals were killed in the tidal wild harbor river, and in the most heavily polluted parts of the river almost no animals have survived. Moreover, mussels that survived the spill as juveniles have developed almost no eggs and sperm.

"Oil from the spill was incorporated into oysters, scallops, soft-shell clams and quahaugs. As a result, the area had to be closed to the taking of shellfisfih. The 1970 shellfish crop is as heavily contaminated as was last year's. Closure will have to be maintained at least through this second year and will have to be extended to areas more distant from the spill than last year.

"Oysters that were removed from the polluted area and that we maintained in clean water for as long as six months, retained the oil without change in composition or quantity, indicating that, once contaminated, shellfifish cannot cleanse themselves of oil pollution.

"From laboratory studies on oil and oil products, and on many marine animals, we have determined that all crude oils and all oil products—excepting some highly purified substances—are poisons for

all marine organisms. In addition to direct killing, the destruction of sensitive juvenile forms and the depletion of food resources, oils act on marine life in more subtle ways. The incorporation of sublethal amounts of oil leads to reduced resistance to stress and may result in a failure to reproduce.

"Research prompted by a high incidence of skin cancer in some refinery personnel has traced the cause to prolonged skin contact with petroleum and refinery products. Safeguards in plant operations protect the public from this hazard. But when oil is spilled into the environment, we lose control over it, and we should again be concerned about the possible public health hazard from cancer-causing chemicals in the oil."

Finally, Blumer and his colleagues have shown that marine organisms ingest and retain hydrocarbons to which they are exposed. These are transferred to and retained by predators. In this way, even animals that were not directly exposed to a spill can become polluted by eating contaminated animals. This, and the presence of cancer-causing chemicals in oil pollution, implies that the marketing and eating of fish and shellfish from polluted areas may constitute a public health hazard.

IMPACTS ON EAST COAST STATES

Along the East Coast, the various states have taken different actions in trying to solve the oil pollution problem. In several instances, leadership has come from citizens organizations working with professional biologists and engineers from institutions of higher education rather than from state governments and from industry. Random examples of these activities have been included to illustrate what is being accomplished.

Consideration of how oil could fit into the economy of Maine centered around the possibility of establishing a modern oil refinery at Machiasport, a deepwater port in Washington County. The Natural Resources Council of Maine, a citizen's group composed of many organizations, voted to oppose the oil complex until factual information resolved the questions of risk and benefit.

According to Bernard Corson, director of the Fish and Game Department of New Hampshire, in spite of the fact that the State has adopted stringent measures to deal with oil spills, they still occur, one of the most serious occurring in May of 1969, when an oil barge struck a bridge abutment and lost 200,000 gallons of #2 fuel oil into the Piscataqua River. In Corson's words (personal communication):

"Although reasonable estimates of losses of some of the marine organisms will eventually be possible, perhaps the most serious

repercussion from the oil spill, the loss of productivity of the estuary in terms of shellfish and fin fish, will be impossible to determine accurately. Already, shellfish license holders have been denied the opportunity of pursuing their sport in this area. Although a Health Department closure, resulting from the spill, has recently been lifted from the area, the clams remain contaminated to the point of taste rejection. It remains to be determined what effect the loss of productivity will have on the sport fishery for striped bass, flounder, pollack, Coho salmon and other fin fishes in the area."

In my view, Massachusetts has some of the most progressive legislation in the country on oil pollution; reference is made here to an explanation of the regulations by Thomas C. McMahon, director, Division Water Pollution Control (1969). My chief criticism of these regulations is that the penalties are not sufficiently strong.

According to Director McMahon, Massachusetts has recently been receiving complaints of oil pollution at a rate of about one every other day (roughly 180 per year). About two-thirds of these (120 per year) represent spillage in harbors and coastal waters; the balance originate in inland waters. Although some spills undoubtedly escape detection, prompt reporting of spills has increased markedly in the past two years as a result of more stringent laws, greater public awareness and a generally responsive stance by the petroleum industry.

Where spills occurring in harbors or inland waters are reported promptly, detection of the source is usually possible. In those cases, effort is made to have the responsible party clean up the spillage; total expenses incurred by such parties for oil spill clean-up are estimated to be running at an annual rate of several million dollars in Massachusetts. The cases where the source can not be identified or the responsible party fails to take adequate action, the Division undertakes clean-up in order to minimize damage. Costs incurred by the Division have averaged about $100,000 per year, representing about ten cases annually; somewhat less than half of the clean-up expenses are recoverable from identified sources.

In Rhode Island, policy with regard to the siting of oil refineries and other oil industry construction as well as fixing responsibility for oil spills is being formulated by a recently appointed Governor's Technical Committee on The Rhode Island Coastal Zone, composed of representatives from interested and concerned organizations, institutions of higher learning, local town government, industry, Advisory Council for Natural Resources, state legislators, and the State Department of Natural Resources. Up to the present, oil spills have been handled by the State Department of Rivers and Harbors, the State Department of Health, and local individuals and institutions, while

the endeavors by various oil companies to establish refineries, natural gas tank farms and storage depots have been met on a crisis basis by citizen's organizations. In nearly all such cases, the shores of Narragansett Bay have been successfully protected from potential oil pollution from these sources. The most recent situation of this kind was the defeat of the attempt by Northeast Petroleum Corporation to establish a refinery and other facilities at Tiverton, R. I., by the concerted efforts of a variety of citizen's organizations under the leadership of a determined group of individuals from Tiverton. It was a classic case in which much of the argument on both sides resembled what had just been presented at Machiasport in Maine.

In examining the situation in Delaware, Norman G. Wilder, assistant to the secretary of the Department of Natural Resources and Environmental Control, was particularly helpful. He pointed out that the Delaware Estuary is one of the major petroleum refining areas in the Eastern United States with seven large refineries. Their combined daily throughput is nearly 900,000 barrels or 3,780 million gallons. All the refineries have access to deep water, and more than 50 percent of the crude is supplied by tankers and barges. Evidently oil pollution of the upper estuary is quite common; out of the 38 river runs completed this year, oil slicks were sighted on 33 runs.

The primary cause of spills is apparently negligence or carelessness in material handling operations. Other causes are bilge pumping, leaky or broken hoses, collisions and lightering.

On tidal and interstate waters, the Water Quality Standards established by Delaware pursuant to the Federal Water Pollution Control Act of 1965 (PL 89-234) prohibits the discharge of oil and other hazardous substances, and failure to clean up can result in legal action if the source of the spill can be traced.

It is quite obvious to anyone flying over the eastern borders of Pennsylvania that most of the difficulties in this state occur in the Philadelphia area. Richard M. Boardman, director of The Division of Water Quality of Pennsylvania indicates that the many refineries in the Philadelphia area produce an inordinate amount of oily waste water as a waste by-product. All companies have waste treatment facilities and have waste discharge permits for the operation of treatment facilities and discharge of treated wastes where these can be handled routinely as part of a water quality management program. Boardman points out further that well-operated refineries do not cause any special oil impact problems, but poorly operated refineries, or those that have waste impoundments filled with oil and oily type material, can be serious potential oil pollution hazards.

In the Philadelphia area, oil spills also occur from the failure of

transmission pipelines, oil trucks overturning, oil tanks failing, a delivery man pumping oil into a pipe that was not connected to a tank, a train running over a hose from an oil tank, or a bulldozer severing an oil pipeline, and other causes. Many of the spills are small but can have an immediate effect on the area where the spills have occurred, by causing fish-kills, property damage, or cause taste and odor problems in water supplies.

In Maryland, control over oil spills and other types of water pollution is shared by two agencies: By a long established administrative agreement, which has legislative sanction, the Department of Water Resources exercises primary responsibility with respect to water pollution resulting from the discharge of industrial waste, and the State Department of Health exercises primary responsibility with respect to water pollution resulting from untreated or inadequately treated sewage. Maryland seems to be particularly vigorous in detecting, publicizing and prosecuting violators, and in pushing corrective measures. One of the biggest spills took place last year in the Inner Harbor of Baltimore, where 1600 barrels of oil overflowed a barge that was being filled.

Dr. Morris L. Brehmer, assistant director of the Virginia Institute of Marine Science, points out that the State of Virginia has two areas which receive contamination from petroleum products and that the oil transportation activities on Chesapeake Bay pose a potential threat of a catastrophic oil spill resulting from a collision or sinking.

Both North and South Carolina are apparently unusually free from the disastrous oil spillage found in other states along the Atlantic Seaboard. During the past year, there were seven spills of record along coastal North Carolina, none of them serious, and all of them cleaned up by those responsible. The impact of pollution from the oil industry seems to have been even less in South Carolina.

Mr. Harmon W. Shields, director of the Division of Marine Resources in Florida, indicates that oil pollution in that state is somewhat the reverse of what has just been reported for the Carolinas. The enactment of Florida's Oil Spill Prevention and Pollution Control Act gave the Department of Natural Resources of that state the powers and responsibilities to deal with the hazards and threats of oil pollution from various sources. There are now more than 975 licensed terminal facilities dealing in the transfer of oil to and from watercraft in the shallow coastal waters of Florida, and greater than 13,000 tanker sailings annually from Florida ports. Since July 1, 1970, over 200 oil spills have been investigated including the highly publicized Navy so-called accident off Key West.

THE OIL INDUSTRY

It is pertinent now to consider what the oil industry and businesses involving the use of oil products have been doing in protecting the East Coast from the impact of oil on its natural resources. Perhaps foremost among those realizing the tremendous ecological importance and the critical nature of the problem is M. A. Wright, chairman of the board of Humble Oil and Refining Company and a member of the Board of Directors of the National Wildlife Federation. He pointed out (1969) that since 1966, business has invested significant amounts in pollution control equipment and research programs, rising from less than a billion dollars in 1966 to over 2¼ billion dollars in 1970.

More specifically, for the three years ending in 1970, the petroleum industry invested over one and one-half billion dollars on construction operations and maintenance of air and water quality improvement projects with more than half on water conservation. Also, the American Petroleum Institute is spending $3 million annually on research, again a significant part of it on water quality control. As further indication of the petroleum industry's efforts, in 1970, more than $322 million was spent for water conservation. This level exceeded the federal appropriations under the construction grant program.

Similar progress has also been made by the oil producers in conserving our offshore environment. The petroleum industry is now operating under tighter regulations in offshore drilling operations and has made considerable progress in the control of oil spills. And in doing so, the industry has gone beyond government requirements. A total of 42 oil companies that own more than 70 percent of the crude oil and fuel oil cargoes that move on the high seas has created an insurance fund for the cleanup of oil spills from tanker operations. It has established harbor cooperatives and set up machinery for international cooperation. Recently, a group of international oil companies joined together to develop a plan called TOVALOP to insure financial capability to remove oil spilled from tankers through accidents. In the transport of oil, more than three-fourths of the world's crude oil tankers now use a relatively new technique called "load on top" to prevent the discharge of oil ballast water during normal operations. A virtually new industry has appeared in response to the demand for control of oil spills and for the clean up of both spilled oil and oil polluted environment, with prototypes of new equipment, original designs and an essentially computerized technology advertised in both the old and the more recently established research and engineering journals specializing in this field. The preservation of environmental quality, a theme too long absent from this kind of publication, is

finally being aired in every issue. All of this, while signifying great progress in an industry heretofore not noted for its interest in anything except to satisfy its stockholders, is certainly a good start, and it must be recognized for exactly that. The point is that complacency cannot become the order of the day: Much remains to be done by the petroleum industry; there are some members who have not yet accepted their responsibility; there are others who must be made aware that society has a legitimate concern with its environment; and all must constantly be reminded that at times there may be more reason for protecting a bay or a group of islands than in building a refinery or installing a tank farm.

FEDERAL GOVERNMENT

The position of government in these matters is of course also of prime importance in establishing enforceable legislation based on both the scientific evidence of oceanographers, biologists, geologists and engineers, and the sociologic and economic needs of the citizens; and on the crowded East Coast, such an approach is especially necessary. Governments at all levels must accept their full responsibilities. Pollution control is competing with other demands being placed on tax revenues. Priorities must be assigned to these demands, and government officials must be prepared to present their case honestly and effectively so that the taxpayer is in a better position to determine what social goals he wants to achieve and the price he is willing to pay. In dealing with these priorities and goals, sufficient thought must be given to the need of expanding our economic base for future progress. In this era of concern for quality over quantity, we should not lose sight of the fact that material goods are still necessary. We must not allow an economic backlash to eliminate future economic progress. We still need refineries, plants, factories, highways and power stations.

In this same vein, government must improve its communication, not only with the general public, but with business, as well as with the various levels of governments involved in the war on oil pollution. In some way, the interested parties must be brought together in a mutual understanding of each others' desires and constraints.

Already in January, 1971, encouraging and hopefully progressive action has been taken. Russell E. Train, chairman of the Council on Environmental Quality and the Federal Government's chief environmental officer, in a speech to the International Council on Pollution said that President Nixon's plan to make the most extensive and

comprehensive attack on pollution in the history of the United States would be taken to the Congress in February or March.

The plan would give the government broad powers to tax industries to clean up their pollution and would ban unrestricted dumping of pollutants into oceans.

He indicated that if business firms were required to pay on the basis of the amount of specific pollutants they added to the environment, they would be inspired to "help harness the normal competitive forces of our economy to work with us rather than against us in achieving our pollution abatement goals." In essence, the new policy would ban the unregulated ocean dumping of all materials and strictly limit ocean disposal of any materials harmful to the environment.

Another government proposal which would cut down dramatically on the amount of oil pollution of the oceans was made even more recently by Secretary of Transportation, John A. Volpe. While speaking at a meeting in Brussels of the North Atlantic Treaty Organization, he proposed that the flushing of oily wastes from ships be prohibited by international agreement. These oily wastes include the seawater ballast with which oil tankers fill their empty tanks when they have discharged their oil in port. This seawater ballast, eventually pumped out again into the sea carrying tons of oil with it, creates about half the oil pollution of the open ocean; the other half appearing through the agency of the more than 44,000 military, passenger, pleasure and cargo ships which flush oily wastes from their bilges into the sea.

Secretary Volpe's plan would decrease this oil pollution a great deal. However, the prohibition of at-sea flushing of oil wastes is estimated to have a price tag of some one to five billion dollars. New ships which would not mix oil with water ballast might cost 18 percent to 25 percent more than the old ships which use the same tanks for both oil and water. Or, if new ships are not built, onshore slop tanks would have to be constructed to separate the oil from the water.

It seems like an expensive proposal. The oil recovered would not pay completely for the cost of its recovery. In this connection, Dr. Max Blumer of the Woods Hole Oceanographic Institution correctly points out that, "The high value of fisheries resources, which exceeds that of the oil recovery from the sea, and the importance of marine proteins for human nutrition demand that cost effectiveness analysis of oil spill countermeasures consider the cost of direct and indirect ecological damage. It is disappointing that existing studies completely neglect to consider these real values. . . ."

RECOMMENDATIONS

To overcome the actual and the even more potentially disastrous impacts of oil on the East Coast of the United States in the Seventies and to keep surface and subsurface oil spills from polluting our waters, it is my judgment that several steps be taken immediately.

1. A constantly increasing amount of protein is needed to supplement the diet of the world's burgeoning populations, and since the high seas (representing 90 percent of the marine environment) and the coastal areas (the remaining 10 percent) is where the rich fisheries are located, it is of prime importance to develop the science of mariculture to its fullest potential. This means maintaining complete control over all phases of an organism's life cycle from marine algae and benthic crustaceans to all species of whales. Here, management for sustained yield has primacy; it must be based on several factors including basic information about the environment and the influences of artifactual pollutants, especially oil. The deficiency of information in this area is abysmal, and a crash research program pointed toward the effects of oil on the lives and life histories of the economically important species harvested, should be pushed strongly.

2. A responsible, vigorous, well-organized program must be activated immediately by competent personnel at several marine stations along The Atlantic Coast to determine the precise effects of commercial grades of oil on the pelagic, benthic and inshore environments and on the visibility and continued commercial values of the organisms inhabiting these areas. This program might well be developed and accomplished under leadership of the Smithsonian Institution and funded by NSF and/or NIH and/or HEW. It is discouraging to note that the results of the three best known (and at this time virtually the only) papers in English on this subject, Blumer's investigations in Woods Hole, Boerch's and Haven's work in Virginia, and Johnston's investigations of the decomposition of crude oil residues in beach sands, are apparently not in agreement.

3. The oil industry should be encouraged by gentle persuasion to magnify its conservation effort still more, and to invest additional significant amounts in oil pollution control equipment and in research programs. Certainly material rewards for successful research should be made to deserving organizations by the government.

4. Investigations should be pushed wherever possible to develop technology to clean up satisfactorily after spills in both calm and rough waters. The recent discovery at Florida State University of the possibility of strengthening the natural oil-consuming characteristics of bacteria collected in Boston Harbor is a case in point. The purpose

is to mass-produce the bacteria like penicillin, then freezedry and store these organisms until needed. At such time, a helicopter or duster plane could easily and quickly spread these bacteria over the offending oil slick.

5. The latest techniques of sensing and monitoring (Hillman, 1970) water pollution by aerial color infra-red aerial photography, by satellite transmission and by other sensing methods presently being developed by NASA, should be adapted to the Atlantic Coast inshore and offshore waters on a routine basis.

6. The possibility of the establishment of effective oil spill pollution control, with the costs borne by the polluter, should be seriously considered. The proposal would be to establish what might be called effluent charges (Freeman, 1970)—a pollution tax based on the amount and kind of oil discharged into salt waters. If effluent charges are properly set, they should provide powerful inventives to polluters to reduce their discharges substantially and quickly.

7. The constant and strict enforcement by the Secretary of the Navy of current regulations against oil spillage by naval craft is of utmost importance. Secretary John Chafee is one of the very few Secretaries of the Navy that has held this office who is sensitive to the dangers and serious consequences of oil pollution; it is hoped that his concern can be passed all the way down the chain of command and translated into anti-oil-pollution action.

8. The addition of a federal program for siting oil refineries, tank farms and other oil industry facilities along the East Coast similar to that proposed for the placing of future hydro-electric fossil and nuclear fuel generating plants seems emminently desirable. Essentially, this program would include mandatory announcement of all the details of the siting of oil facilities ten years in advance of the actual start of construction. Among the advantages of this kind of legislation are: consideration of such matters as fitting the inclusion of oil facilities in a previously agreed plan for coastal zoning of all industrial facilities, the availability of sufficient fresh water, assessment of possible biotic and environmental damage and the aesthetics of both the site and location could be fully considered before construction is started.

9. Although the right to dispose of waste materials in the high seas is a traditional freedom of the seas, the United States should press to recodify the 1958 Geneva Convention on the High Seas in terms of rectifying international law to make it adequate to deal with possible long-term effects of oil spillage and the flushing of oil ballast.

Much of what we must do will of course be tremendously expensive. But as Blumer has emphasized, we must start realizing that with the

current rate of oil spills, we on the East Coast are already paying for the damage to the environment, especially when the damage is as tangible as that of oil pollution to fisheries resources and recreation. "Experience has shown that cleaning up a polluted aquatic environment is much more expensive than it would have been to keep the environment clean from the beginning. In terms of minimizing the environmental damage, spill prevention will produce far greater returns than cleanup—and we believe that this relationship will hold in a realistic analysis of the overall cost effectiveness."

CONCLUSION

The present situation has been summarized adequately by Tarzwell, as follows:

The determination of the required water quality for marine life resources is of outstanding importance because water which is suitable for marine life is suitable for most other uses. The oceans represent our last great undeveloped resource. Let us hope that we will not repeat past mistakes and continue current carelessness in the management of these resources, and that we will not keep on further polluting and degrading our Atlantic coastal areas by indiscriminately dumping oil wastes on open ocean, continental shelf and coastal zone. Short-term gains should no longer be used as a justification for unwise exploitation and the degradation of the resource and the environment. The development and use of these resources and the handling of wastes from operations on shore and along the shore must no longer be based solely on the short term so-called economic feasibility approach. This fast-buck approach without regard to long-term environmental effects has been largely responsible for the deterioration of our environment. We must recognize that the manner of the utilization of our resources and the disposal of oil wastes can have far-reaching environmental effects.

As Resources for the Future has pointed out, those plants along the Eastern Seaboard dependent on oil and gas—whether because of geography, economics, or environmental criteria—are no less handicapped in fuel problems. A great deal of recent attention has focused on the Atlantic coast—particularly on New England, where imported residual fuel oil constitutes the major boiler fuel, and in addition, provides space heating in many commercial and institutional structures. The Eastern Seaboard's reliance on residual fuel oil—over 90 percent in the Caribbean, roughly 10 percent in the Eastern Hemisphere—has risen spectacularly in the past few years, especially in those locations where it is replacing coal in order to conform to

regulations limiting the emission of sulfur oxides and particulates. East Coast utilities' consumption of residual fuel oil increased by 63 percent between 1967 and 1969, and by 44 percent between the first three months of 1968 and 1969. The trend has continued into 1970, though at a reduced pace.

Compared to the number and size of accidents and disasters, present counter-measures along the Atlantic Seaboard are inadequate. A rapidly advancing technology is hopeful of developing techniques that will be effective in dealing even with large spills under severe sea conditions. Yet, while we on the East Coast remain hopeful that the gross esthetic damage from oil spills may be avoided sometime in the future, there is no reason yet to be hopeful that existing or planned countermeasures will reduce the biological impact of oil pollution.

Oil pollution is the almost inevitable consequence of our dependence on an oil-based technology, either through intentional disposal or through inadvertent losses in production, transportation, refining and use.

As Tarzwell (1969) has cogently indicated, "More biological and ecological knowhow must be applied to the planning, development and utilization of our resources and the management of oil spills. The ecologist must take a prominent part in the initial planning of projects, in analyzing and determining the environmental and ecological effects of the ongoing activities. We have ample evidence of what should not be done and of what activities are detrimental to wise use and the protection of the marine environment. The value of history is to show us the mistakes which have been made in the past. Let us live in the present for the future, being guided by the past. Let us not fail in the development of this last great largely unspoiled resource on this planet. Our continued existence and our well-being depends upon our working with nature, not against her."

LITERATURE CITED

Brooks, E. Editor
1970. The life sciences. Report of The Committee on Research in The Life Sciences of The National Academy of Sciences. Washington, D. C. 526 pp.

Freeman, A. M. III
1970. The effluent charge, what and why. Me. Env. Bull. of The Nat. Res. Council of Me. for April, 1970. pp. 1-2.

Hillman, R. E.
1970. Monitoring ecological changes in the marine environment. *In*: Ecological Problems in The Marine Environment. Batelle Mem. Inst. Columbus Laboratories, pp. 33-49.

McMahon, T. C.
1969. Rules for the prevention and control of oil pollution in the waters of the commonwealth. State Division of Water Pollution Control. Publ. 5131. Boston, Mass.

National Academy of Sciences—National Academy of Engineering.
1970. Wastes management concepts for the coastal zone. Printing and Publishing Office NAS-NAE, Washington, D. C., publ. ISBNO-309-01855-2.

Tarzwell, C. M.
1969. The effluent society. Proceedings of The Joint Conference on Pre-

vention and Control of Oil Spills sponsored by the API and the FWPCA. New York, N. Y.

Train, R. E. 1970. Ocean dumping, a national policy—A report to the President prepared by The Council on Environmental Quality. U. S. Gov't. Print. Off., Washington, D. C. 1970 0-404-547.

Wright M. A. 1969. The effluent society. Proceedings of The Joint Conference on Prevention and Control of Oil Spills sponsored by the API and the FWPCA. New York, N. Y.

ADDITIONAL REFERENCES

"Regional Multiagency Oil and Hazardous Materials Pollution Contingency Plan—Inland Waters," by The Federal Water Quality Administration CWT 10-20. Abstract of Proceedings Hazardous Polluting Substances Symposium, Sept. 1970, U. S. Coast Guard and U. S. Department of Transportation (New Orleans, La. 1970).

DISCUSSION

VICE CHAIRMAN YANCEY: Thank you very much, Dr. Zinn, for a most informative presentation.

I think we will all agree that the subject of oil, fish and wildlife has been a controversial issue in recent years and has received very much coverage by the news media. You have reported on the oil spill problems along the eastern seaboard and you have also outlined certain remedial steps that would help solve these problems. At this time, we would like to open the floor to questions. I will ask one question at this point.

I notice that you felt that the best solution to some of the oil-spill problems would be state control zones. This brought to mind how this might be put into effect—by state legislation or whatever you have in mind—and also what effect this would have on oil spills that might drift into your coast line from sea-going vessels and other means of transport on the high seas.

DR. ZINN: I think we have two problems.

One involves spills within state waters and another is a problem of the high seas. I don't think this concerns what I have in mind about coastal contamination.

For example, in Rhode Island and other New England states, coastal zonation is a pretty hot problem. None of the town governments wants to give up its little piece of the pie, especially when they have cheese spread all over it. Therefore, in order to pass such legislation in the state it becomes difficult but unless something of this sort is not done, unless we know where the refineries are going to go, we are behind the eight ball in providing protection.

It seemed to me that zoning was a good way of planning ahead. Everybody would know where these areas are going to be. Further, zoning keeps them free, at least to some extent, from real estate development and from a crisis type of situation in which an oil refinery all of a sudden makes its wishes known.

As we know, all of these types of plants, including nuclear plants and fossil fuel plants, as well as hydro-electric plants, invariably seem to seek the most esthetic areas on the coastal zone in which to settle. Obviously, I expect there would be less opposition if people knew where these were going to go. Further, it would reduce a great deal of the feeling of uncertainty and it would increase oil industry public relations all along the line.

Of course, admittedly this is a difficult thing to accomplish. It involves starting in at the beginning but, at least insofar as I see it, one of the best ways in which this can be accomplished is through zoning, especially if we can push it through.

VICE CHAIRMAN YANCEY: Thank you, Dr. Zinn.

Do we have a question from the floor?

MR. DARRELL EAGLE (Department of Fishery and Forestry, Canada): I was wondering, Dr. Zinn, if some of these coastal problems are not more local than anything else.

You mentioned the high seas problem. We very recently had a serious accident

off our east coast and are still feeling the effects of it. Many of the really serious oil problems have resulted from ship collisions or groundings.

Do you feel that there is a need for traffic control similar to air traffic control, which is so important internationally?

DR. ZINN: Well, this certainly would be a very good way in which to work this out. Of course, on the other hand, this means international agreement on these matters and I am not sanguine about the success of these things. We don't seem to be getting very far with them. However, it is a reasonable way out and, certainly, if it could be managed. I would think this would be tremendously helpful.

MR. NORMAN WILDER (Delaware): In the siting of the refineries under the proposal that you have suggested, would you elaborate as to who would do the siting and what role the local people would play in this matter?

Secondly, I would appreciate your comments on what you think the future of oil refineries in New England?

DR. ZINN: If this were agreed upon in the first place, I suspect there would have to be a Federal Commission with representatives from each of the states involved appointed by the governors, hopefully, with some citizen involvement. In that way one could crank in all of the various interests. Certainly, the oil industry would have to be represented as well.

If this were done along the entire coast, this would not be pointing the finger at one state or another. Competition might be reduced a great deal and I think in this way probably would be fairest. This has to be done way ahead of time. It sounds as though all of these details would be easy to manage. However, there is the matter of finding enough water and so on. All of these details take time to work out and, therefore, I felt that the 10-year plan that I suggested in relation to a fossil fuel plant seemed to have a great deal going for it. In fact, it is an analogous situation to the siting of tank farms and refineries.

It is difficult to conjecture about what is going to happen in the future. Our present troubles, however, are due largely to the fact we have not planned on these refineries and tank farms and that the oil situation is a very complicated one. Further, we must not get overly emotionally involved. Nevertheless, this emotionalism has been brought about just by bad planning; I don't think it was at least fully realized just how much damage spilled oil can do until recent years.

Obviously we have to have refineries in New England and we have to have tank farms, but here we are trying to plan for them in a situation that is so emotionally charged that it is difficult to separate facts from fiction. I hope, certainly, that within the next 10 years these matters can be straightened out to the satisfaction of everyone. I am optimistic in hoping that this will be the case.

I can speak from experience in Rhode Island, where we have worked from crisis to crisis on three different occasions, and I am almost sure that if we had planned for the refineries that we are seeking to come into Rhode Island they would be there now. However, this wasn't previously done in the proper form. I hope we have learned enough now, at least within the last two years, to be able to avoid the difficulties that we were involved with previously and that we are going to benefit from past experience.

Now, as I said, we have to have oil and there is no reason why we cannot have it. We also have to be willing to support what it costs to cut down pollution. I think we are willing to do that. Certainly there is an indication that people are willing to pay for this, especially if done properly and above board. On the other hand, by doing this sort of thing and putting all of our cards on the table, I think that we will be able to accomplish what we are after.

MR. FRED HIRSCH (Oregon College of Education): This, as you stated, involves transportation. Therefore, do you feel it might be wise, in the United States and Canada, to require that oil to go by pipeline rather than ocean transportation?

DR. ZINN: Well, by pipeline are you talking about having refineries or tank farms at certain ports and then working it along the coast from these two or three ports? Is that what you have in mind?

MR. HIRSCH: Either that or a national policy that the oil from the oil fields would go by pipeline rather than using ships.

DR. ZINN: In relation to continental oil, that is possible, but there is a tremendous amount of oil brought in from abroad and I wonder how you would do this. You have the danger of pipeline fractures, et cetera. These all are accidental, of course, but, on the other hand, I still believe we do not have the necessary technology to handle this. I appreciate the possibilities of oil pipelines but I don't think it gets rid of the original problem. I am afraid that we are still going to have this matter of spillage facing us. Perhaps we could use more pipelines than we are at present.

IMPACTS OF OIL ON THE GULF COAST

LYLE S. ST. AMANT

Louisiana Wild Life and Fisheries Commission, New Orleans, Louisiana

Any discussion of the impact of normal operations and accidents associated with the petroleum industry on the Gulf Coast must be centered on activities in the Louisiana area. Coastal and offshore production in the Gulf area is almost totally associated with the wanderings of the active Mississippi River delta and the vast coastal marshes and estuaries lying across the base of Louisiana. For example, of the 1792 offshore structures in the Texas and Louisiana area, 1742 are in Louisiana while offshore production in the remaining states is nil. Oil production in estuaries, marshes and marine nursery areas in the Gulf area is almost exclusively a Louisiana problem where more than 25,000 wells are operated in one of the most productive fish and wildlife areas in the world. Some oil production occurs in the shallow bays of Texas but little or no production has been developed in other states and the vast Everglades of Florida with its multitude of other problems has been spared this one.

Much of the recent public interest in the effects of petroleum production on wildlife, fish, and the ecological parameters which support these natural resources has been centered on oil pollution mainly and in particular on massive pollution of localized areas resulting from spectacular accidents. While such events do occur and in some local areas appear to approach catastrophic proportions, these events do not represent the major ecological problems resulting from petroleum production. Oil pollution, per se, is only one facet of the impact of the petroleum industry on the basic ecology of an area, and from our experience appears to have far less permanent effect on the environment than does a multitude of other activities associated with the petroleum industry. Unfortunately the public arousal and outcry about pollution in general and oil pollution in particular has overshadowed many industrial activities that tend to result in more far-reaching and irreversible damages to the environment than occur

from pollution alone. It is the purpose of this paper to point up the many other problems associated with petroleum exploration and production in marine and estuarine areas and to attempt to place oil as a pollutant into proper perspective with these various other activities as they affect the basic ecology of coastal Louisiana.

LOUISIANA'S COASTAL AREA AND NATURAL RESOURCE PRODUCTION

Louisiana's coastal area, unique in the U.S. and perhaps in the world, has a sustained production of environmentally dependent natural resources that staggers the imagination. In addition to its well-know and valuable production of non-environmentally dependent minerals, including gas, oil, sulfur and salt, this same area produces from 800 million to 1.2 billion pounds of commercial fish annually representing from 20 percent to 23 percent of the total U. S. production. This measured production of protein does not include uncounted millions of pounds of fish taken for recreational purposes; or the poundage destroyed incidental to shrimp trawling and lost through natural attrition. The total amount of protein generated in the area annually probably exceeds two billion pounds. In addition to fishery production, Louisiana's coast serves as a wintering ground for five to seven million waterfowl and produces more fur (muskrat, nutria, mink and otter) than any other state in the Union.

The annual economic value of the commercial fishing and fur harvest of Louisiana is near a hundred and fifty million dollars and this does not include the value of recreational fishing, hunting, boating and tourism.

Nevertheless, if we directly compare the annual economic value of the commercial fishery to that of oil we find it to be only about one-tenth that of petroleum. This may not represent a true-value relationship, however, since the fishery resource is renewable while mineral reserves are depletable. Recent studies on the economic value of various uses of the Gulf Coast on a per-acre basis indicates that the recreational value far exceeds all other values and mineral production ranks third, being little more than twice as valuable as commercial fish. The combined value of enviromentally dependent resources and natural uses of the Gulf area such as commercial fish, recreation and transportation far exceed the value of depletable minerals (Sharp *et al.*, 1970).

TYPES OF ECOLOGICAL DISTURBANCES ASSOCIATED WITH ACTIVITIES OF THE PETROLEUM INDUSTRY

In order to appreciate the full impact of the petroleum industry on the marine and estuarine environment, the many facets of its oper-

ation and associated support activities must be recognized as affecting the basic ecology of an area in far more subtle and complex ways than that of oil pollution alone. Futhermore, the location of such disturbances (*i.e.* deeper offshore waters *vs.* shallow inshore embayments and marshlands) has much to do with the relative seriousness and permanence of the ecological change. The actual effects of the disturbance may be simply mechanical or physical, chemical, biological, hydrological or a combination of these changes. Some of the physical problems may not be ecological in the strictest sense, but actually represent a simple competition for space in the water column and on the sea floor resulting in a disruption of navigation or difficulties in harvesting the living resources of the area.

Some of the more important ecological disturbances and environmental management problems associated with oil exploration and production in Louisiana result from the following:

1. Seismic methods used in oil exploration.
2. Mechanical, physical and navigational problems associated with offshore structures and underwater completions.
3. Direct and indirect mechanical, hydrological and physical effects of inshore shallow water oil production which result in destructive ecological changes and environmental degradation.
4. The physical and ecological effects of oil production activities in unstable marshlands.
5. Various types of oil pollution including inshore and offshore pollution; pollution of marshlands; chronic *vs.* accidental pollution; oil emulsion drilling muds; detergents and dispersants used in spill cleanup; odor and taste problems and the toxicity of oil as a pollutant.

These environmental disturbances resulting from activities of the petroleum industry in the marine and estuarine ecosystems are discussed herein to the extent that publication limitations permit.

Seismic Problems

The effects of seismic activities, including blast effects, on the marine fauna have been observed and studied for nearly twenty-five years in Louisiana. (Gowanloch *et al.,* 1944, 1945, 1947; St. Amant, 1955-57) Most of the studies and experiments were made to determine the effects high explosives (dynamite and nitromon) have on fish life, fishing success and bottom configuration. The mechanical effects of vehicles used in seismic operations on shallow water areas, marshlands, the intertidal zone and the animals living therein have also been examined in some detail. Problems involving conflicts in navigation between fishing fleets and seismic boats in offshore waters as well

as difficulties with floating undetonated charges have been successfully regulated in the Gulf area.

Seismic operators for the most part now disclaim the need for high explosives, contending that gas guns, sparkers, vibrators and other sound-making devices which do not affect fish life are in almost universal use. While this may be statistically true on a worldwide basis, on the Gulf Coast unconsolidated organic areas associated with old deltic formations require high explosives for successful penetration. In any case, the use of such devices does not eliminate the physical effects of vehicular traffic in shallow water or marsh areas nor will it rule out navigational conflicts offshore.

Blast Effects

Fish mortalities from the frequent detonation of high explosives in seismic activities have been the principal concern of the fishing industry and conservation groups, as pointed out by the writer (St. Amant, 1970.) "Numerous studies in this area indicate that fish kills will not normally occur from blast effects more than 150 to 200 feet from charges up to one thousand pounds. Fish kills of significant size rarely occur unless the charge happens to be placed in or near a large school of fish, on or near a reef frequented by fish, or in shallow, semi-enclosed water bottoms densely populated by fish." Practically all significant fish kills are eliminated with the following procedures:

1. In offshore or deep waters all charges must be suspended by flotation bags and fired as near the surface as practical. In no instance should they be fired closer than fifteen feet from the bottom.
2. Charges should never be fired directly on the bottom to avoid trenching and spoil piles which damage otter trawls and other types of towed fishing gear.
3. In shallow waters (ten feet or less) all shooting is done at a depth of 100 to 200 feet in subsurface drilled holes.
4. The smallest charge consistent with acceptable recording should be used.

This type of procedure has never resulted in fish kills large enough to affect fish populations or future production. It has resulted in minor kills in offshore waters that caused problems when a few of the dead and decomposing fish were unknowingly caught and included in shipments of freshly caught fish used for mink food. Later chemical analysis detected excessive decomposition and resulted in rejection of the shipments.

Though no significant changes in fish populations or production have been detected, there are unknown factors associated with blast effects

Oklahoma Cooperative Wildlife Research Unit
404 Life Sciences West
Oklahoma State University
Stillwater, Oklahoma 74074

on fish stocks. It is not known whether frequent blasting has any effects on fishing success. Fish could be driven from the area or caused to sound by concussion and vibrations associated with detonations. The effects of frequent shots on spawning activity and success have not been studied but present shrimp and fish production in Louisiana would tend to indicate little if any disturbance occurs.

Extensive seismic activity in unstable marsh areas with organic substrates results in the release of gases (methane and hydrogen sulfide) that may be harming the local area.

Other Seismic Problems

Numerous other problems take precedence over the blast effects. For example, there is a significant amount of damage to marsh areas, the substrate in shallow nearshore waters and intertidal oyster beds by the vehicular traffic used in seismic operations. Marsh buggies, boat propellors and pushed barges can so damage an area that the local fauna and flora are destroyed or driven away. The extent of such operations in the coastal marshes of Louisiana is hard to realize without aerial inspection.

In offshore operations undetonated floating charges which may drift onto beaches or be accidentally picked up in trawls if they sink to the bottom create a regulatory problem. The consequences of this could be fatal to unsuspecting persons. Furthermore, the offshore area also presents navigational problems between seismic boats and fishing fleets. Serious confrontations can and do develop on the high seas over the right-of-way of one group of vessels over the other, where enforcement of regulations is difficult and because the International Rules of the Road were not designed for such navigational procedures.

PETROLEUM INDUSTRY ACTIVITIES OTHER THAN OIL POLLUTION AFFECTING THE ECOSYSTEM

Studies and experience in the Louisiana area indicate there are many facets of oil operation which can be much more detrimental to the ecosystem than oil spillage or pollution. This is particularly true when oil operations occur in shallow waters (less than 10 feet) and in deltic or marsh areas which are geologically recent and unstable. Offshore operations, including the building of platforms, are an entirely different matter. These differences may be summarized as follows:

Inshore Embayments, Marsh and Shallow Water Areas

1. The dredging and channelization needed for the navigation of

drilling rigs to location result in direct destruction and loss of nursery areas from dredging, silting, leveeing and erosion. Sessile animals and bottom organisms are killed or dislocated while marsh areas may be destroyed, drained and drastically altered.

2. Pipeline construction can be especially destructive and/or result in serious ecological changes. The construction of large and long pipelines requires the dredging of wide and deep flotation canals for the laying equipment. These canals, 40 or more feet in width, traverse and cut through marshlands and embayments without regard for changes in the natural drainage pattern, the disruption of currents in bays or waterflow in marshlands, and the direct loss of animals and plants within the rights-of-way from dredging and silting. Long-range effects involve serious erosion of unstable marshes traversed by such canals.
3. Even in cases when dredging is not a factor, shorelines, intertidal areas, marshes and very shallow waters which make up an important part of the ecosystem can be cut up and destroyed by vehicular traffic such as mudboats, marsh buggies, tugs and equipment barges and other heavy equipment.
4. More widespread and serious ecological damage and disturbance of the ecosystem occur from the indirect and secondary effects of the above activities. The more direct effects are local in nature and are generally in or near the rights-of-way while the indirect effects are more far-reaching and difficult to evaluate. These include:
   a. Changes in water cycling rates and volumes;
   b. Salt and freshwater intrusion;
   c. Indirect silting considerable distances from the site of activity resulting from changes in the direction and velocity of currents;
   d. Partial or total disruption of normal drainage patterns and water movements.

The biological effects of these changes in the ecosystem have never been totally assessed, but many significant and destructive results have been documented and studied. In Louisiana, such petroleum activities have seriously affected the oyster industry.

Much of the degradation has been a result of direct physical damage from dredging, silting, barge and boat traffic to oyster beds. A prime problem is competition for space when extensive oil fields are developed in highly productive oyster areas. Some operations have seriously damaged oysters or shrimp nursery areas some distance from the point of the activity by indirect silting, changes in water

cycling, and/or changes in salinity and the volume of water flow. Serious disturbances in the characteristic ecological zones on the Louisiana coast result in a direct loss in acreage of optimal nursery areas and a corresponding loss in productivity.

One change has been a serious loss of acreage of productive oyster seed grounds from saltwater intrustion. High salinities have increased predation from oyster drills and mortalities from the fungus *Dermacystidium marinum* to a point where the oyster life cycle cannot be completed. Salt intrusion has been gradual over the years and is not solely a result of oil operations. Some of it results from natural geological change, but most of it is hastened by man's activities.

On the other hand, oyster mortalities from fresh-water intrustion are sudden and catastrophic and usually can be traced to an activity that suddenly allows too much fresh water into an area.

The ecological changes which affect oysters may be expected to affect also all sessile and bottom-dwelling fauna in the ecosystem. By contrast, the effect of such changes on motile fish and crustacea is more difficult to assess. Basically, the productivity of such species is a function of the fertility and optimal acceptability of the environment as measured in area. Thus a large number of acres of good fertile nursery area will produce a high density of animals, but if the ecosystem is degraded permanently, this reduces the per-acre productivity and, if carried to the extreme, can reduce it to zero. At this point little change in overall productivity of motile species can be detected. Some ecological zones have shifted positions, increasing optimal nursery grounds for some species and decreasing them for others.

One significant change in shrimp production has occurred coincidental with the rise of the petroleum industry. The comparative population densities of the white shrimp *Penaeus setiferus* and the brown shrimp *Penaeus aztecus* have changed in the past thirty years. Until the late 1940's and the early 1950's, white shrimp made up 95 percent of the annual catch. In more recent years the population of browns has increased to a point where frequently they make up more than 50 percent of the total catch. While the exact cause of this change is not clearly understood, it is thought to be a result of increased salt-water intrustion since the brown shrimp is known to be less tolerant of very low salinities. If this is the case, it may have resulted in part from petroleum activities which hastened an increase in salinities in the estuary as a result of dredging and canaling needed there to meet their requirements.

The effect of industrial activities in marshlands is even more startling than has been described for estuarine water areas. Land

loss from erosion after canals are dredged is serious. Changes in the saline characteristics of marsh areas is reflected by changes in vegetation types. This in turn has drastically reduced fur production as muskrat populations declined. Waterfowl feeding and wintering areas are similarly depreciated as the marsh ecology is subjected to such stress.

Offshore Installations

In offshore deep-water areas the ecosystem is more stable and the placement of physical structures such as platforms appears to have little effect on marine fauna in the area. In fact the numerous offshore platforms have been highly beneficial to recreational and sport fishing on the Louisiana coast. Rig and flare fishing is a new and valuable industry to the state. Myriads of fish congregate under and around offshore structures and fishing success near the rigs is phenomenal. Night fishing in the vicinity of structures where waste gas is burned is excellent. Without doubt the numerous offshore structures serve as the most expensive artificial reefs in the sea and for the small-boat sport fisherman and the charter boat captain the rigs in the Gulf have opened up a new area of relatively safe and highly successful fishing.

By contrast, offshore operations have created several types of problems for commercial fishermen, particularly shrimp trawlers. The principal difficulties for fishing fleets involve navigational problems and seabed obstructions. The producing platforms and other above-water structures are well marked and lighted but when they become extremely numerous, significant fishing area is lost. Occasionally boats collide with structures but, for the most part, with fishing gear down they must stay well clear of the rig in order to avoid possible collision or the entanglement of gear in underwater junk and garbage discarded from the rig. This means that a considerable area around each site cannot be safely fished and significant fishing area may be lost to them.

Offshore pipelines usually do not create a hazard if the construction is regulated to prevent exposed pipes on the seabed. Usually the pipes can be buried beneath the sea floor or will wash into the substrate automatically. New construction can be a navigational hazard to trawlers before the seabottom can return to its normally consolidated state. Occasionally lines will erupt above the waterbottom and become a hazard—this is usually corrected in a short time.

Until recently underwater completions and inactive stubs were a serious problem. These obstructions, if in water greater than eight feet above their highest point, do not have to be marked or buoyed. More than two hundred such structures clutter the sea floor off

Louisiana and this has resulted in the loss of a considerable amount of expensive fishing gear. New rule changes now allow the pipes to be cut off below the mudline and it is expected that most of these hazards will be removed within the next year or two.

POLLUTION FROM OIL

Oil as a pollutant has recently received much public notice and political attention. From the news media and the outcry of "conservationists" the impression is gained that oil is the most toxic and dangerous material contaminating the environment. Many of the statements concerning the effects of oil on the environment are not based on factual evidence. Actually the effects of oil pollution and the problems associated with its cleanup are complex and varied, but labeling oil as grossly and permanently toxic to living things over large segments of the ecosystem because of short-term catastrophic accidents appears to be exaggerated.

In most cases large oil spills such as well blowouts and pipeline breaks in the Gulf area, the Santa Barbara accident and the *Torrey Canyon* and other tanker losses have left few if any permanent effects on the ecosystem. Even short-term and local mortalities to plants and animals are difficult to demonstrate with most losses resulting from physical coating and smothering by oil rather than from chemical toxicity. An exception to this is reported by Blumer *et al.* (1970) with respect to losses of large quantities of No. 2 fuel oil in Falmouth Bay, Massachussets. They report chemical evidence of oil pollution and mortalities of some bottom organisms eight months after the spill over a 5,000-acre area. This episode must be considered short-term and local when compared to conditions that have existed for more than thirty years in some areas of the Gulf where intensive oil production and frequent pollution have occurred without evidence of a serious reduction in the production of living resources.

Though the toxic effect of oil in the ecosystem is not clear, pollution problems from oil are many and varied. They include different effects resulting from chronic and accidental pollution, oil losses in open deep-water (offshore) *vs.* shallow semi-enclosed systems (inshore); and special problems resulting from the use of oil emulsion drilling muds, dispersants and detergents used in cleaning up oil spills and odor and taste problems in filter-feeding animals.

Accidental and Chronic Pollution

Accidental and chronic pollution pose two entirely distinct and separate problems. Accidental pollution can be disastrous, costly,

create great public concern, and cause spectacular short-term local environmental disruption. Accidents are never intended to happen, however, and usually are infrequent when compared to chronic problems. Conclusions that may be drawn concerning the effects of accidental pollution include the following:

1. There is little or no evidence that accidental oil pollution has a gross permanent effect on the ecosystem. Whether minor or accumulative effects occur have not been demonstrated.
2. Rarely are there large fish or animal mortalities resulting from oil spills.
3. Even when loss of animal or plant occurs, in time, recovery of the environment is followed by return of normal populations. In most cases the recovery time is not prolonged.
4. The principal problems resulting from accidental oil spills involve these factors:
   a. Contamination of filter-feeding animals
   b. Heavy fouling of beach or marsh areas; and the coating of birds, animals and plants in local areas
   c. Fouling of private property and the cost of cleanup procedures.
5. These conclusions do not propose that we ignore accidental oil pollution. We should insist that accidents be cleaned up; that the liability insurance of companies involved be adequate to compensate public and private losses and that regulations be developed to prevent or reduce accidents in the future. All of this can be accomplished by adequate regulations and enforcement.

Chronic pollution by contrast, is a more critical and less understood problem. Continuing low-level pollution associated with intensive oil production in shallow inshore embayments and marsh areas is common in Louisiana and has existed for more than thirty years. Production from numerous wellheads, with associated gathering lines, tank batteries, separators and sludge pits all afford opportunity for leaks, spills, and minor breakdown or faulty operation. This coupled with human error, carelessness or total disregard for compliance with pollution regulations can result in continuing chronic introduction of oil into the ecosystem. For example, the Louisiana Wild Life and Fisheries Commission has issued citations for more than one thousand such instances in the past six months even though we have a rather successful pollution control system. There are numerous local areas of intensive petroleum production where chronic oil loss and mechanical obstructions have resulted in a biological

desert or have ruled out other uses of the area. Considerable numbers of these areas were once valuable oyster reefs and shrimping grounds.

Oil Emulsion Muds

One of the most serious and long-lasting types of pollution associated with the petroleum industry occurs when diesel oil is added to the mud system to enhance the drilling of deep wells. If the excess or used mud or cuttings from such an operation is lost overboard, there results a serious oil pollution of the substrate since the oil is adsorbed onto the heavy mud particles and settles to the bottom. Visible oil slicks may not occur and the pollution may go undetected. If oysters or other filter-feeding animals are in the area, they soon filter out and concentrate the oil and develop an unpalatable oily taste. As little as five hundred parts per million of oil in mud will cause serious problems in oysters and even one part per million added to a running-water system will be concentrated by oysters kept in the system for several weeks (St. Amant, 1957).

Detergents, Dispersants and Other Chemicals Used To Clean Up Oil Spills

Usually when oil spills occur, public outcry and concern on the part of the industry to reestablish good public relations result in rapid and costly attempts to clean up the area or to make the visible oil disappear from sight. From our experience with oil emulsion muds, this may be the worst approach possible to the cleanup problem for these reasons:

1. Detergents or dispersant chemicals may cause the oil to adsorb on mud and silt particles which sink to the substrate or float in the water column where they are more available to filter feeders.
2. Adsorbed oil on the bottom particles appears to take longer to degrade.
3. The use of chemicals to disperse the oil involves placing an additional load of foreign and undesirable material in the ecosystem. Many of the dispersants tested proved to be far more toxic than oil.
4. Dispersal of oil does not allow proper mapping or study of polluted areas.
5. Floating oil is probably the least damaging position for oil to occur in the ecosystem. Here it degrades more rapidly—its only effect is at the interface and, except in intertidal areas and marshes, will usually dissipate, degrade and be mechanically dispersed by wave action with little apparent effect on the ecosystem.

Generally we do not permit the use of such chemicals for the cleanup of oil spills unless the area is so badly polluted that nothing is living anyway, or unless the esthetic value and effect on private property outweighs consideration for the local ecology.

CONCLUSION

In summary, the coast of Louisiana is a unique, geologically unstable, highly productive area of both petroleum products and environmentally dependent living resources. The rise in petroleum production coincidentally parallels a rise in fisheries production. Because of the great value of oil and gas reserves, both to the State and Federal Governments, intensive and extensive mineral production has developed. During most of the early production and throughout World War II, there was no regulation of the industry with respect to pollution and environmental management. After 1950, the impact of petroleum industry activities on fishery production, particularly oyster growing, became evident; this led to a pollution control system, the development of a marine research program and the birth of an administrative procedure designed to protect the coastal environment.

An understanding of the effects of extensive petroleum activities on an unstable coast has gradually developed as a result of many years of field investigation, observations and research. Much of this work, however, necessarily dealt with the gross and more immediate effects of industrial activities on coastal ecology and natural resource production. The accumulative results of the introduction of sub-lethal amounts of oil or other pollutants into the environment for long periods of time and the additive effect of apparently innocuous ecological changes are unknown. These two factors may, in the long run, result in disastrous management of the environment if we continue to make decisions based only on the obvious short-term effects of multiple-use programs on ecosystems.

LITERATURE CITED

Blumer, M., J. Sass, G. Souza, H. Sanders, J. Grassle, G. Hampson
1970. The West Falmouth oil spill. Persistence of the pollution eight months after the accident. Wood Hole Oceanographic Institution, Woods Hole, Massachusetts. Reference No. 70-44.

Gowanloch, J. N. et al.
1944. Louisiana experiments pave way in expanded oil research. Louisiana Conservationist, Vol. III: No. 1 December 1944, pp. 3, 6.

Gowanloch, J. N. et al.
1945. Dynamite-oyster experiments provide far-reaching results. Louisiana Conservationist, Vol. III: No. 9 August 1945, pp. 5-8.

St. Amant, Lyle S.
1955. Investigation of effects of seismic operations. Louisiana Wild Life and Fisheries Commission, 6th Biennial Report, 1954-55.

St. Amant, Lyle S.
1957. Investigation of oily taste in oysters caused by oil drilling operations. Louisiana Wild Life and Fisheries Commission, 7th Biennial

Report, 1956-57, pp. 11-75.
St. Amant, Lyle S.
1955-1962. Reports of field investigations of oily taste in oysters with accompanying laboratory analysis of bottom muds. 23 reports. Louisiana Wild Life and Fisheries Commission, New Orleans, Louisiana.
St. Amant, Lyle S.
1970. Biological effects of petroleum exploration and production in coastal Louisiana. Santa Barbara Oil Symposium, University of California at Santa Barbara, Santa Barbara, California. To be published.
Sharp, James M., Dan E. Feray, R. F. Bearden, T. E. Hawkins, Frank L. Keller, Michel, John F., A.E. Weidie, T. W. Bilhorn, J. R. Crump.
1970. A study of economic value of increased ESSA services as related to estuarine dynamics in Gulf Coast estuaries. Gulf Universities Research Corporation, Galveston, Texas. ESSA Contract 9-189-69 (N).

DISCUSSION

VICE CHAIRMAN YANCEY: Thank your very much, Mr. St. Amant. I believe everyone will agree you made a very excellent presentation and covered your subject very clearly.

Some of our principal ecological problems that have arisen as a result of development along the Gulf Coast have been associated with activities such as oil exploration, production, and transportation more than the oil spill problem. And, certainly, those of you that are on the verge of this form of development may profit by taking a look at some of the things that are being done along the Gulf Coast. There are solutions to many of these problems and many can be worked out by negotiation. When you are able to point out a practical solution to an oil company we have found these oil companies responsive.

In other words, if you can make a good suggestion as to how they can go about developing minerals in a given area you will find that they will cooperate with you to the fullest extent.

DR. RICHARD W. VAN DRIEL (Washington State Sportsmen's Council): One of the things that bothers us in the State of Washington is why there cannot be a correlation of these things and a committee of some sort to study and evaluate them to correct these problems?

Everybody seems to be able to see the problems but there doesn't seem to be any correlation. What hinders this?

MR. ST. AMANT: We are making a lot of studies now. The State of Louisiana, for example, spent about three quarters of a million dollars this year and has done the same in past years. I will admit, however, we still have only three to four million dollars to do the job. The Sea Grant program at LSU is working in this area and I know that the oil companies are spending some money on ecological research.

With regard to the oyster problem in the 40's, at least five million dollars was spent by the oil companies in Texas and Louisiana on contractual services. Of course we would all like to progress faster, but on the other hand, before we can adequately tackle some of these problems, we have to first do adequate studies. This is often expensive and time-consuming and can only be done in the normal course of events from existing budgets. Much of Louisiana's information was gained from hindsight and examination of results after the fact. As a matter of fact, in the years before 1940 the state had only one biologist and little or no funding.

Also I have the responsibility of regulating or at least writing letters of no objection concerning engineering permits which govern dredging operations on our coast. It is difficult to object to a single operation since there is little or no evidence that one well site or one short dead-end canal could significantly affect seven million acres of nursery ground. It is only when we see the result of this dredging in aggregate and as a series of interconnecting canals that serious changes can be evaluated. This would tend to indicate that the problem is not a need for controlling individual small operations but rather the need to determine the total amount of activity that will be allowed to occur within a given ecological zone. For example at the present time some oil drilling has occurred in Lake Pontchartrain and our Legislative Committee on Conservation wanted information

concerning the effects of these wells. It was pointed out to them that a few wells would probably not affect the Lake but that some decision should be made concerning the point at which no more operations would be allowed.

At any rate, these are the kinds of decisions, at least in my opinion, that need to be made by government so that, in turn, the various administrators know exactly what to do. We have no real priorities set. We don't know where to start or stop. We don't know what is happening and I don't think it is quite fair to a man that has to manage it to be left in dark. However, if these areas are not well managed, at least in Louisiana, we are going to stop them. Of course, the people involved will not like this and maybe we would have trouble doing it. However, it would be stopped.

OIL POLLUTION AND WILDLIFE AND FISHERIES IN THE SANTA BARBARA CHANNEL

DALE STRAUGHAN

Allan Hancock Foundation, University of Southern California, Los Angeles

Amid the chaos and mess that followed the oil spill from Platform A in the Santa Barbara Channel, January 28, 1969, conservationists, fishermen, sportsmen, and many private citizens expressed concern for the wildlife living in and around the Santa Barbara Channel. They knew that large numbers of birds were killed after the *Torrey Canyon* spill. No one knew if the fish would remain in the Channel. Would the lobsters and abalone that live in relatively shallow intertidal areas survive the spill—after all mortality was reported intertidally on British shores after the *Torrey Canyon?* What about the whales that were due to migrate northwards through and to the west of the Channel in February and March? Then there were the seals—the numbers of these species were depleted by uncontrolled slaughtering in the early years. Now seals again occupy these areas in large numbers. Was man again unwittingly to cause the decimation of these populations?

From the vantage point of two years after the spill I would like to briefly review what we do and do not know about the effects of the Santa Barbara oil spill on fish and wildlife. Hopefully, this will provide a guide to the areas of real concern in the event of similar mishaps. It should also indicate the areas in which we are ignorant and where we cannot afford to remain ignorant. One of the problems following an oil spill is that biologists are usually already committed to other work. The few that are able to examine the problem are then faced with an impossible task. Unless someone is engaged in research in the area immediately prior to the spill, the background data will be

inadequate. Sometimes the investigator may be lucky enough to find an unpolluted area nearby, and similar to the polluted area. He can then make a comparative study to determine pollution effects. However this was an impossible task following the Santa Barbara spill—partly because the area of spill was so large and variable. The area to the north of the Santa Barbara Channel has an exposed coastline while the mainland shores of the Channel are sheltered by the Channel Islands. While the mainland shores south of the Santa Barbara Channel have a similar fauna and are somewhat protected by scattered islands, the area is one of high population density. One suspects a higher rate of pollution from sewage outfalls and industry as well as the effects of more people on the beaches. Finally, beaches in the Santa Barbara Channel have been exposed to natural oil seeps through recorded history. In comparison, very few seeps are located south of the Santa Barbara Channel.

The biota in the Santa Barbara Channel has existed with submarine oil seepage for a long time. The commencement of this seepage has not been accurately dated. However, La Brea Tar Pits date back at least to the Pleistocene (Emery, 1960). The early Chumash Indians of the Santa Ynez region used asphalt material washed up on Coal Oil Point for waterproofing and mending their dug-out canoes (Dibblee, 1966) Ferrelo in 1543 reported that on a windy day, he and his men were able to smell bitumen off the coast in the Santa Barbara area. Since that time explorers and later residents of the area have reported the smell and sight of tar in areas of the Santa Barbara Channel.

BIRDS

Oiled dead and sick sea birds were found on Santa Barbara's shores even before the oil reached mainland shores in any quantity. While heavy pollutions of mainland shores did not commence until February, the first oil-drenched birds arrived at emergency cleaning centers on February 1st. At A. Child's Estate cleaning center alone, 652 birds representing 26 species were cleaned and treated to March 5th (Drinkwater *et al.*, 1971).

The California Department of Fish and Game carried out aerial and beach surveys of the bird population in the Santa Barbara Channel commencing February 5, 1969 (for details of methods and results see First and Second Progress Reports on Wildlife Affected by Santa Barbara Channel Oil Spill, 1969). Aerial surveys between February 5 and March 31, 1969, indicated that bird numbers in the affected area remained relatively stable. Avian population for the 1,075 square miles sample by the aerial transect was estimated to be

12,000 birds. Species groupings in order of their abundance were gulls, shorebirds, waterfowl, loons and grebes, cormorants and pelicans and other waterbirds. Most birds appeared to avoid oil-contaminated areas. They were found either in flight, on the shoreline, or resting in open spaces of water which appeared to be free of oil.

Significant bird population movements were recorded on aerial surveys between April 1 and May 31, 1969. A number of species wintering in the Channel area migrated by the end of May to their breeding grounds farther north. A large influx of pelagic birds, notably sooty and pink-footed shearwater, was noted offshore. Estimated bird population in the Santa Barbara Channel area sampled was 85,000 for this period.

Beach transects were established to derive an estimate of bird loss, because oil-affected birds either in distress or dead could not be readily determined from the air. A daily average of 439 birds were observed along the 5.7 miles of beach transects in February and March 1969—290 of these birds were on the 4.8 miles of oil contaminated beach transects. These were mostly shorebirds and gulls apparently little affected by oil. Seventy dead birds were recorded. This was exclusive of birds picked up by others and either taken to the bird treatment stations or disposed of during the beach cleaning operations. Nine of these dead birds showed no evidence of oil contamination. On this basis of the transect data, which may not be typical of the whole coast, bird losses for the 75.5 miles of beach from Pt. Conception, Santa Barbara County, to the Ventura River mouth at Ventura, California, were estimated to be 1,603 birds. Added to this loss are the 1,388 birds which died after treatment and 175 turned in to the treatment stations dead and another 439 dead birds reported by other sources and from areas not included in the study areas. An estimated loss of 3,600 birds can be attributed to the oil spill up until March 31, 1969. This loss does not include birds which may have perished on the open water and failed to drift ashore.

In April and May an average of 391 birds utilized the 4.8 miles of oil-contaminated beach transects. Nine oil-contaminated birds were turned into the bird treatment station during this period. Birds treated to May 31, 1969 number 1,575. Of these, 1,406 or 89.3 percent died and 169 or 10.7 percent survived and were still being held on June, 1969 or were released. The total loss of birds attributed to the Santa Barbara Channel in January, 1969 was 3,686 at May 31, 1969.

The California Department of Fish and Game reported that loons and grebes were the most abundant dead birds while cormorants and pelicans were the second most abundant corpses. While these species

were not the most abundant living species recorded on beach transects, they were recorded in large numbers on aerial transects.

Species mortality figures on a total of 432 birds are available (Drinkwater *et al.*, 1971; Drinkwater, pers. comm.). This includes a total of 253 loons and grebes—176 of these were western grebes. The remaining dead birds were: 76 waterfowl, 69 cormorants and pelicans, 21 pelagic birds, 9 gulls and terns, 2 water-associated birds and 2 shorebirds.

Bourne (1968, p. 115) discusses the probability of pollution by oil in relation to the behavior of different groups of bird species. "Aerial species are unlikely to plunge into oil deliberately, and indeed comparatively seldom get oiled at sea, and coastal species may paddle over it or squat in it on the shore, with minimal damage. But swimming species are compelled to bathe in it. It has been suggested that they deliberately settle in polluted areas, in search of food or because the water is calm, but there appears to be little evidence for this. My own observations (Bourne, 1968) suggest that they simply do not notice it until they swim into it, when aerial species such as gulls promptly fly away (except when taken by surprise in the dark, as with the Medway disaster), but aquatic species such as the auks try to escape it like any other hazard by diving."

Following the *Torrey Canyon* spill, Bourne, 1968, reported that 7,815 birds were affected by oil; 7,746 of these were auks. Bourne (1968) states that the oil causes the fine element of plumage to adhere together, breaking down the capacity of the feathers to insulate them from cold water. Few auks (included under pelagic species) were recorded from the Santa Barbara Channel at the time of the oil spill and only one auklet was brought into Childs Estate for cleaning (B. Drinkwater *et al.*, 1971).

Swimming species had the highest mortality in the Santa Barbara Channel. Loons are open-water species, seldom seen on land except when breeding. Ruddy ducks are unable to walk on land. Loons and grebes are expert divers. Both frequently swim submerged in water and thrash on the surface of the water on take off. Cormorants swim low in the water like loons but they frequently perch on rocks and stumps. In contrast to this, few gulls, terns or shore species died even though these were abundant groups seen in the area.

Drinkwater *et al.* (1971) repeatedly refer to the difficulty of keeping species of birds that seldom walk on land until they could recuperate. The birds' feet cracked as they dried out; it was difficult to keep the birds warm and dry during a period of heavy rainfall; it was difficult to find the correct food. The disasters as well as the

successes are reviewed in their paper in the hope that the disasters will not be repeated.

MARINE MAMMALS

Each year, gray whales *Eschrichtium glaucus*, migrate along the western coast of the United States of America. The majority of the herd had migrated southwards prior to the blowout. However, the entire northern migration passed through or westward around the Santa Barbara Channel while it was contaminated. The fears that were expressed included one that suggested that the whales would have their baleen clogged with oil while filter-feeding. All available evidence indicates that gray whales do not actively feed during migration (Brownell, 1971).

Various reports gave rise to the fear that an unusually high number of gray whales were stranded after the oil spill. Brownell (1971) reported 6 authentic cases of gray whale strandings in February and March, 1969. Three or four gray whales were recorded as stranding most years in the period from 1960 to 1970, with 5 animals stranding in 1963. The Federal Water Quality Administration autopsied two whales and made tissue analysis in an attempt to detect petroleum. No petroleum was detected in the tissues. This analysis in itself does not negate the possibility of oil being deleterious to the whales. However, the number of strandings does not appear significantly higher than the numbers recorded in other years of the decade. One should also remember that there was an increased number of observers working in the spill area in 1969 over other years so that there was an increased probability of observing distressed or dead whales.

Brownell (1971) also recorded that five crisscross dolphins, one Pacific striped dolphin, a sperm whale, and a pilot whale stranded between February and May, 1967. As with the gray whales, the cause of death is unknown.

Oil washed ashore along about ¾ mile of the beach in the seal colony on the north-west tip of San Miguel Island about March 17, 1969. This was at a stage after most of the elephant seal pups were weaned but prior to the birth of California sea lion pups. Northern fur seals and Steller sea lions also live in this rookery. There are no records of the latter becoming oiled. Some northern fur seal were oiled. However, this oil was apparently shed in the normal moulting process later in the season. Northern fur seals shed the outer layer of epidermis with the fur.

Le Boeuf (1971) visited the island shortly after the spill. He tagged a total of 63 oiled weaned California sea lion pups and

yearlings (oiled means that at least 75 percent of the animal was covered with oil) and at random selected an equal number of animals tagged in the annual tagging program as controls. To June, 1970, 40 percent of the pups in the oiled group were sighted as compared to 25 percent in the control group. Except for one animal in the experimental group whose condition was questionable, all animals in both groups were reported to be in apparent good health. At the time the tags were read, the pellage of all experimental animals except one showed no trace of oil. Control group animals were also clean when sighted. Le Boeuf (1971, p. 285) states "These data support the conclusion that the crude oil which coated many weaned elephant seals at San Miguel in March and April of 1969, had no significant immediate nor long term (1-15 months later) deleterious effect on their health. Had the rookery been contaminated earlier in the season when females were nursing, pups might have ingested the crude oil and more serious consequences might have ensued".

The California sea lions bore their pups after the oil reached San Miguel. Here there is a lack of data on "normal" pup mortalities prior to the spill. However, no available data show that pups died as a result of the oil. Large numbers of healthy pups were present when I visited the island in July, 1969. Federal Water Quality Authority carried out tissue analysis on animals and were unable to detect oil. On the other hand, Le Boeuf and Brownell (1971) have found high quantities of DDT in these animals and indicate that DDT concentrations effect mortality in the California sea lions.

FISHERIES

Fears were expressed that the oil spill would be the end of the fishing industry in the Santa Barbara Channel. On the surface of things, the low catches at Santa Barbara appear to substantiate this fear. However, one must also remember that Santa Barbara Harbor was closed for periods following the spill, boats were fouled with oil, and owners with clean boats were loathe to use their gear and boats in oily water.

Comparison of the total commerical fish catch from the Santa Barbara Channel and Channel Islands for the period February through July 1969 (2,337,931 pounds) with the same six months in 1968 (2,124,820 pounds) shows no decrease in catch for the area. On a monthly basis, there was a decrease in catch for February and March, 1969 compared with previous years.

California Department of Fish and Game (1969) surveyed the Santa Barbara Channel to assess the effect of oil contamination on

pelagic school fishes. They report (1969, p. 36) "All fish appeared healthy, well fed, and failed to show indications of starvation which might imply an impairment of the food chain. The species composition and numbers of fish taken varied from station to station and varied at the same station from cruise to cruise. Nevertheless, a comparison of surveys (with similar ones in previous years) revealed few changes and that species diversity has been maintained."

The Department's pelagic fish surveys (1969, p. 30) "indicate no adverse effects on the anchovy, ***Engraulis mordox***, population as a result of the oil leak. The anchovy population of this area appears to be thriving and in no way harmed by the oil, either at the height of contamination or at present.

"Since 1965, the area had been surveyed twelve times prior to the oil leak in the same manner as the three special surveys since February 1969. The northern anchovy always has been the predominant species with far fewer quantities of jack mackerel, *Trachurus symmetrius*, pacific mackerel, *Scomber japonicus*, and Pacific bonito, *Sarda chiliensis*. When we compare the results of the 3 surveys with the twelve conducted prior to the oil leak, we find only one pre-leak survey detected more schools than those made since February, 1969. School sizes and concentration indicate a greater biomass than ever before. The largest concentration of anchovies in southern California was located during the August cruise only 20 miles from the oil platform" (California Department of Fish and Game Report, 1969, p. 31, 32).

The number of fish taken from partyboats operating out of Santa Barbara declined during the period, February to July 1969, when the reported landings were only 10 percent the size of those in the same months for the previous four years (California Department of Fish and Game, 1969 Table 5). The major portion of this decline can unhesitatingly be attributed to lack of fishing effort. The total number of boat days during the six month period was only 13 percent of the average fishing effort for a comparable period during the previous four years.

Fish spotting data were obtained from the Bureau of Commercial Fisheries at Tiburon. These data are obtained by small aircraft flying over the area. They are considered 95 percent accurate. Due to lack of standardization of flights, these data should be interpreted with care. However, the data do show that fish continued to live in the Santa Barbara Channel after the oil spill. Except for February, 1969, when it was difficult to spot fish because of the presence of oil, numbers of mackerel and northern anchovies were comparable to those present in

the two previous years. Pacific bonito was absent until July, 1969. However, this species is usually absent for three or four months from March or April onwards (Straughan, 1971).

No tainted fish were reported after the oil spill. Likewise, there were no reports of tainted lobsters, crabs, abalone or clams. In fact, people still dug for clams when Hobsons Beach was covered with oil in December, 1969 (N. Nicholson, personal communication). Divers from the California Department of Fish and Game observed lobsters, *Panulius interruptus*, at several subtidal stations. All appeared healthy. However, fishermen found that if lobsters were oiled as the trap was collected, they soon expired.

In conclusion, high mortality was recorded in certain groups of birds living in the Santa Barbara Channel, but few claims of effects of oil can be substantiated on fiish or marine mammals. In the case of the former this is probably in part due to the extremely low solubility of Santa Barbara crude oil. Hence fish did not come into direct contact with the oil. In the case of the marine mammals, there was no mortality comparable to that found in birds. Crude tissue analysis did not reveal oil in the tissues of whales or California sea lions. This is not to say that none of these animals died or became ill as a result of the oil spill. However, here the difficulty is, how does one prove that oil was the cause of death or illness?

We lack data on the normal population dynamics of most of these species so that it is impossible to define "abnormally high" mortality. We also lack data on the tolerance of these species to oil and the manner in which they are affected by oil. Are these effects of a long-term or short-term nature? What are the effects of oil if the animal is already under stress due to unusual weather conditions and/or the presence of another pollutant? These are but a few of the problems that make it impossible at the moment to specifically define or predict the effect of an oil spill on the fauna.

REFERENCES

Bourne, W. R. P.
1968. Oil pollution and bird populations. In: The Biological Effects of Oil Pollution on Littoral Communities. suppl. *Field Studies*, 2: 99-122.

Brownell, R. L.
1971. Whales, dolphins, and oil pollution. In: *Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill*. 1: 255-276. Pub. Allan Hancock Foundation.

Brownell, R. L. and LeBoeuf, B. J.
1971. California sea lions. *Ibid*, 1: 287-306.

The California Department of Fish and Game
1969. Progress report on wildlife affected by the Santa Barbara Channel oil spill. January 31-March 31, 1969.
1969. Second progress report on wildlife affected by the Santa Barbara oil spill. April 1-May 31, 1969.

Drinkwater, B., Leonard M., Black S.
1971. Santa Barbara's oiled birds. In: *Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill*, 1: 313-324. Pub. Allan Hancock Foundation.

Dibblee, T. W., Jr.
1966. Geology of the Central Santa Ynez Mountains, Santa Barbara County, California. Calif. Div. Mines, Bull., 186: 84.
Emery, K. O.
1960. The sea off Southern California. J. Wiley and Sons, New York. 366 pp.
Le Boeuf, B. J.
1971. Oil contamination and elephant seal mortality: A "negative" finding. In: *Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill*, 1: 277-286. Pub. Allan Hancock Foundation.
Straughan, Dale
1971. Oil pollution and fisheries in the Santa Barbara Channel. *Ibid*, 1: 245-254.

DISCUSSION

VICE CHAIRMAN YANCEY: Thank your very much, Dr. Straughan, for a very excellent presentation.

The way I assess your paper was that the primary mortality was associated with bird life and the loss of mammals or fishes was apparently very low. This is what I gathered from your comments.

MR. GARVIN BUCHARA (Redmond High School, Oregon): Judging from the photograph you have of the natural seepage and comparing that with the damage that was apparent from other points of view, there did not appear to be very much seepage occurring naturally. Do you have any information as to the natural seepage in the area of Platform A prior to drilling?

DR. STRAUGHAN: This is very difficult to get accurate data on. First of all, I should correct one thing. There are large areas of natural seepage and at the time I was showing seepage from Platform A there was much less seepage from A than occurred in the rest of the channel. I don't have any volume numbers from Platform A. I don't know what the natural seepage is and I don't know if anyone in the audience does. However, at one stage, there was a maximum of 10 barrels a day but this varies from day to day. If you want some natural seepage figures, Allen from the General Research Corporation has some from October of 1969.

MR. CAMPELL (University of Missouri): Do you have any information about the plankton, particularly phytoplankton?

DR. STRAUGHAN: Yes, one section of the report that I showed deals with plankton productivity. Here again, we have difficulty in that we have no background data. However, the thing that may interest you is that we could not show anything from the fieldwork. There was one rough laboratory experiment in which productivity was run in clean sea water and in oily sea water and there were no significant differences. However these data, I must again confess, were in the rough stage.

MR. ERICKSON (California State Polytechnic College): With regard to the bird population, do you have any information as to how many birds are found oiled in a normal year in the Santa Barbara area?

I know there is a constant dribble of oiled birds coming in all down the California coast. Do you have any data on a normal year's mortality from unrecognized oil spills?

DR. STRAUGHAN: No, I am sorry, I don't. The Sierra Club carries out periodic bird studies. Maybe they would have that type of data.

Somebody as I remember, did try in order to get some idea of how accurate the data is on the ones that come ashore and those lost at sea. And, his experiment fell through completely. However, there was some attempt to obtain this type of data.

DR. DAVID KLEIN (University of Alaska): One concern that I think most of us have is that your studies have shown that there apparently were no very significant short-term effects on the population of marine organisms. Are you following up these studies to try to determine if there were any long-term effects on the species involved? Also since there is an area with natural oil seeps, it seems that this would involve a good background for further studies. This would be a useful area in which to do comparative studies regarding productivity and comparative plankton levels in the channel versus areas that do not have oil seeps or spills.

DR. STRAUGHAN: Of course. that may be the case but, on the other hand, there are other difficulties involved. We are, however, continuing some of our work.

There were, of course, decreases but the problem with the rocky mainland and sandy beach work is how do you separate all of the other things affecting the area—all the people walking along the beach and this type of thing? Some of the background data were 10 years old and some three years old and Sandy Beach had virtually none. Therefore, we are continuing the Sandy Beach work in an attempt to find out just what the practices are in this area. I think this is one of the problems.

Of course, everybody wants to do away with oil spills but you have to do what everybody else is doing at the same time.

In relation to the long-term effects, we are doing some work on the effects on reproduction of the species but there is going to be some comparison of oil-seep and non-seep communities.

However, apart from all of this, the only problem is that of money.

MR. PETER PEARCE (Canadian Wildlife Service, New Brunswick): I believe one of the findings of the *Torrey Canyon* investigation was that some kind of birds seem to be able to avoid the oil. There has been some brief reference this morning to the spill on the eastern coast of Canada last year and this involved the most prominent and most abundant species present. However, they apparently were the least effected. It is quite possible, therefore, that there is some behavioral mechanism involved there whereby these kind of birds do in fact avoid the oil. Does your experience bear this out at all?

DR. STRAUGHAN: Yes. We did find that the gulls tended to be the hardiest but I think you could tie this down fairly well with other species. It was more or less a behavior factor. It seemed that the ones which spent more of their time at sea were more likely to become exposed to the oil and apparently became involved with the oil. However, in connection with the ones spending more of their time walking on the land, you did not get as high a percentage of oil in those and, further, you likewise obtained a higher survival rate.

MRS. LOIS WEISS (British Columbia): I notice that in the figures the quantities were up for 1969 but in two cases they seem to be down the following year. Would this offer any indication of reproduction?

DR. STRAUGHAN: You will see that the figure is actually about the same here as it was in 1968. However, I am not sure that we could tie that to the oil anyway.

MRS. WEISS: Would you think this would be a conclusive indication that there were no adverse effects from oil?

MR. STRAUGHAN: I don't think it would make a conclusive indication in either way.

For example, if you compare one period with another, it is less here but more there. And, in fact, really doesn't allow much difference. I don't think you could say that the oil did or did not have any effect. I think about the only thing you can say from this type of data is that obviously there was no decrease immediately after the oil was spilled. That is about all you can say.

MRS. WEISS: However, you are talking about the short-term effect and not the long-term effect?

DR. STRAUGHAN: That is right.

MRS. WEISS: You mentioned that there is no visible decrease in the plankton in the laboratory. Would you think that marine environment tolerance would have been worked up sufficiently in the area which might not, in turn, necessarily be true, if such oil were put into the British Columbia Coast, where we do not have a natural seepage?

DR. STRAUGHAN: In accordance with our hypothesis, nobody has proven it yet either way. We are doing some work on this but we do not have any conclusive results. In other words, we are doing work to ascertain if animals coming from oiled areas are more tolerant than those from non-oiled areas. However, it is conceivable that in connection with certain species you would have a build-up.

MRS. WEISS: Are these being done in areas of large spills, let us say in relation to kelp?

DR. STRAUGHAN: Well, in kelp, oil sticks on the outside and doesn't cause too many problems. Here, of course, I am talking about crude oil. Other oil may have a different effect. That is one of the problems in connection with the different results that people get from oil spills. A logical conclusion here would appear to be that all oils are not the same—they differ in composition. A lot more emphasis should be placed on this factor.

MRS. WEISS: Then you would agree, for example, that the findings in connection with the Santa Barbara spill are not necessarily similar to findings in other areas where there have been spills?

DR. STRAUGHAN: Yes. I think you would have an extremely difficult time in comparing Santa Barbara to other areas. You have to be extremely careful in evaluating spills.

MRS. WEISS: In connection with the spill at Santa Barbara, that might not necessarily happen in connection with the Alaska tanker route. Would you agree?

DR. STRAUGHAN: Well, that might be a little similarity because oil from Alaska is similar to that off Santa Barbara.

MRS. WEISS: It is not the Santa Barbara Channel that I am thinking about. I am thinking about British Colombia.

VICE CHAIRMAN YANCEY: Thank you very much, Dr. Straughan, for an excellent job.

OIL DEVELOPMENTS IN ALASKA—A PANEL

REMARKS OF THE CHAIRMAN

PHILIP A. DOUGLAS

The next portion of our program involves three gentlemen, Mr. Larminie from the BP Alaska, Inc., Dr. Angus Gavin, Atlantic Richfield Company, and Dr. Robert Weeden of the University of Alaska. I will ask you to refrain from asking any questions immediately following each speaker. We have a section designated for discussion after all these speakers have made their presentations. I will not introduce them individually each time. They will just follow one after the other.

At this time, I will recognize Mr. Larminie.

PROTECTING THE ENVIRONMENT

GEOFFREY LARMINIE[1]
BP Alaska, Inc., Anchorage, Alaska

My topic this morning deals with the Arctic and that sector of the Arctic that belongs to the United States which is synonymous with the State of Alaska. I want to review with you some general ideas about the Arctic.

A lot of people could be excused for believing that the Arctic was discovered in 1968 when Prudhoe Bay was drilled. That is not the case. In fact, the Arctic has developed steadily and there are a number of obvious hallmarks of increase of interest with time.

There were first, for example, the early explorers who were probably looking at the Arctic because it was connected with their ideas for a Northwest Passage and, in turn, this was very largely an exploratory, philosophical interest coupled with scientific investigation.

This was the case at least until the second World War, with the arrival of the Japanese in Alaska. And, then, people suddenly began to realize the strategic importance of the Arctic. In turn, the strategic importance of the Arctic gradually became more apparent to thinking people. This involved, as you may know, the construction of the Distant Early Warning System along the North American Continent, which was just one of the manifestations of this interest. It

[1]Mr. Larminie spoke extemporaneously with the use of projected slides.

also involved the realization that by flying the great circle route, one would shorten distance between North America and Europe. The Trans-Polar Air Route developed from the first flight by SAS in 1957. Japan Air Lines then likewise developed a route over this area to various parts of the world.

The marine trade routes are still another attraction. This, in turn, goes back to the Northwest Passage concept and, once again, tends to shorten the distance to Europe.

The scientific importance of the Arctic has grown steadily as we have improved our ability to collect data. For example, the Polar Weather System and World Meterology System are very significant factors in scientific studies in the present day.

Most people in North America tend to look at the Arctic in terms of a map of the North American Continent—with the Arctic sitting at the top. This is not the way to look at the Arctic. The Arctic should be viewed from the polar projection centered on the North Pole and, in this connection, a number of interesting things come to light, the most significant of which is that the Arctic is, in the truest sense of the word, an ocean entirely surrounded by land, a "mediterranean" with two openings, one in the North Atlantic and one in the Bering Straits. The countries surrounding this ocean comprise Canada, the Soviet Union, Greenland (under the flag of Denmark), the United States, Iceland, Norway, Sweden, and Finland.

It is interesting to look at the percentages of the coast or of the land mass actually impinging on the shores of this ocean. For example, Canada has approximately 37 percent, the Soviet Union has 28 percent; Denmark has 28 percent; the United States has 6 percent and the others make up 1 percent.

The circulation of the waters in this ocean belong strictly to the Atlantic and not to the Pacific. The input of water into the Arctic Ocean comes from the top, circulates around and then goes out down through the Greenland Current. Less than 10 percent of the water circulation in the Arctic comes in through the Bering Straits.

All of these facts have been known for a long time. They are relevant to anybody who is working in the Arctic. We, in particular, at present are working on the shores of the Arctic Ocean.

Arctic Alaska basically comprises the Brooks Range, which runs from east to west, a large mountain mass totally uninhabited by man except for one Eskimo village in a pass which transects the Brooks Range. To the north of this lies the North Slope, which is a plainlike surface that slopes from the northern edge of the Brooks Range into the Arctic Ocean; and on the edge of this is the Arctic coastal plain,

which is characterized by thousands and thousands of lakes. It is a completely water-logged area, which, at certain times of the year, bears quite a considerable resemblance to some of the marshes of Louisiana. It can be up to 90 percent water for seven to eight miles inland following the spring break-up.

This then is what constitutes the working surface insofar as the development of the oil field is concerned. It comprises tundra. All good engineers, of course, are interested in what goes on in their working surface, what happens immediately underneath it, and what happens about it. They are also interested in the conditions that accompany changes in season and, to this extent, we have done a great deal of work on the tundra and this is continuing.

We did not start the work on the tundra. Some of the most notable work was done out of the Naval Arctic Research Laboratory at Point Barrow, and probably the best paper that exists on the tundra of the Arctic slopes and the Arctic coastal plains was written by Max Britton.

However, in 1969 and 1970, the tundra boiome projects of the International-Biological Program began to set up a series of studies on the Arctic coastal plain, and we in industry cooperated closely with them. They have, in turn, done some very valuable work in studying the unstressed and the artificially stressed tundra system and the artificially stress isn't always done by the oil industry. Some is experimental and some of long duration.

We have oil seeps on the Arctic coastal plain that have been in existence for thousands of years, and they have not covered the plains with oil. In fact, some of the vegetation in the tundra has naturally grown back over the oil seep.

In studying the effects of oil, a careful analysis of the oil seeps is important in the design of experiments to study tundra oil spills, just in case that should happen. However, we don't start from the premise that they will occur.

In talking about what is going on, I think it is best if I show you a series of pictures of what is happening and also show some aspects of the development of the oil fields at Prudhoe Bay.

(Slide) This is a photograph of the harbor at Prudhoe Bay. This is last summer and you can see some of the ice. Outside on the horizon are some of the barges that brought in the supplies. These barges originated in Seattle. They came across the Gulf of Alaska, through the Aleutians, up through the Bering Sea, around the corner of Point Barrow and into Prudhoe Bay.

(Slide) Here we have part of the fleet approaching shore and part of a production unit which traveled farthest of all. The unit was

constructed near Houston and loaded on barges. These massive units traveled through the Panama Canal, up the coast of the northern United States and then followed the same route as the rest of the cargo from Seattle, across the Gulf of Alaska.

(Slide) This is Prudhoe Bay with the ice gone, showing an off-loading operation in progress. The only permanent installation is the jetty and gravel pad. The former was built out a thousand feet. It has a core of gravel-filled 50-gallon drums tied together with wire.

(Slide) Here we see a herd of caribou at the end of the runway and a large plane coming in for landing. They are not paying much attention to it. The main bulk of material comes by sea. But, on the other hand, aircraft are our main system of supply year round.

(Slide) Here are some river courses on the slope. The ice is beginning to melt and you can see the little lakes that are forming. Frozen lakes are scattered all over the surface of the tundra. The drilling rig is connected by a gravel road to another site. There are some 14 oil wells in that photograph but you cannot see all of them.

(Slide) I inserted this photograph to give you some idea of the flatness of the terrain and the wide horizons in the area. Here we see several small lakes. We did not dam these lakes. We tried to make sure that all natural water movement is unrestricted. This standard five-foot-thick gravel road is designed to reinforce the effect of the frozen permafrost and prevent unsightly melting and degradation of the surface.

(Slide) Here we have an example of clean-up after the spring ice break-up. Unfortunately, when you have people around they have the awful habit of throwing away pop bottles, cigarette butts, et cetera. When the ice melts in the spring you can see much of this litter. Now, we have Eskimos from Point Barrow to clean up the road system. This is not cheap. It costs us about $50,000 per year to clean just along the roadway. However, it is done every year and it looks pretty tidy after the job is finished.

(Slide) Here we have the edge of one of the lakes with a drilling rig and a pingo alongside. This is one of the topographic features. You can see how flat that is. This is a feature of the coastal Arctic plains all the way through the Arctic.

The wind consistency on the Arctic slope is such that it is almost unidirectional. You can pick up the direction of the wind from the wind-oriented lake, and the wind-oriented lakes all have their axes normal to the direction of the prevailing winds. This information is reinforced by the sand dunes which occur on the deltas, and the long axes between the sand dunes are parallel to the wind. In other words, they intersect the axis of the lake. The lake axis is at 90 degrees and

you simply turn your rig when drilling so that it points away from the wind and the bulk of the wind comes from the back and enables you to operate more efficiently.

(Slide) Here we have an example of the pattern of drilling. We have gone on the Arctic coastal plain to what we call an off-shore concept. Each of these constitutes one section or 640 acres, and in order to drill the wells, we put a single pad in the center. It is not much bigger than each of the individual pads would have to be. We then drill a series of directional wells. This means that we can cover an area of six square miles from a single pad. This, in turn, enables us to cut down the surface road facilities that are required to join up well locations and produces a minimum amount of interference.

(Slide) These are geese molting and they are sitting there quite happily. This is an example also of the surface of the area. Each of those cracks in the ground that you see has a big ice wedge underneath and this, in turn, is a sure indication that you have high ice content, permafrost, and that is something to avoid in operations wherever possible.

(Slide) This is a group of falcons. When I was a field geologist mapping the area in early 1960, these birds were nesting on Franklin Bluff. Now, again last summer I was glad to see, despite the relative intensive activities around the bluffs, that these birds were still nesting there.

(Slide) This is an example of the type of engineering work, the largest bridge in the Arctic. These are 14-foot culverts. Here again, we only had our own experience to go on but we knew what the area was like and we put these in in this manner. Of course, people thought this was a bit excessive.

These are 14-foot culverts because the river breaks up into a series of ribbon lakes and hardly flows at all, but during the break-up the water is up to 10 feet high and it drains on the tundra. This is the type of engineering we have been using to insure that all the natural water flow systems are not interrupted in the least by any of the surface construction work associated with the development.

(Slide) This is polygon country and the ice wedge shows up well with the dusting of the snow. Where you have the polygon you always know you have free ice and high ice-content permafrost underneath.

We can detect the areas where there is free ice from the polygons but the absence of the polygons does not mean there will not be free ice and then, of course, it is necessary in our construction work to make recourse to exploratory borings, which is a standard foundation technique for all engineering work anywhere in the World.

(Slide) Here we have the gathering station within the context of the operation. This is a drilling site with six wells.

There is one thing that has upset a great many people recently. I refer to the misconception that exists regarding the likelihood of oil spills with regard to tanker operation. This results from an error made by Dr. Blumer, which, unfortunately, has been augmented by many others who, like Dr. Blumer, did not go back and check the original data. I refer to Milford Haven, which is a major tanker port in Britain and in 1963 to 1970, Milford Haven spills were .00018 percent of oil handled and not .01 percent as quoted by Dr. Blumer and others. In 1969 and 1970, that had been reduced to .00004 percent and, transmitted in terms of what happened in tanker operations at full production at Valdez, this is a total possible spillage of 12 tons a year and not 30 tons a day as quoted by Blumer and others. This certainly makes a tremendous difference.

* * *

ALASKA—OIL AND THE ENVIRONMENT

ANGUS GAVIN

Atlantic Richfield Company, Fairbanks, Alaska

Alaska the 49th State, which has been described as the last frontier, represents a new challenge to the pioneering instinct in the American people. It contains 365 million acres (570,000 square miles), roughly equal to the combined areas of California, Arizona, Nevada, Washington and Oregon. However, in contrast with the 22 million people in these five western states, Alaska has a population of about 290,000. More than eighty percent of the state's population resides in the Maritime Region which encompasses southeastern and south central Alaska. This area enjoys a climate comparable to the northern temperate regions of the lower 48 states.

From the first commercial discovery on the Kenai Peninsula in 1957 up to the present time, oil industry activity has been a vital factor in the state's unparalleled economic growth. This growth paved the way for Alaska to achieve statehood in 1959, and the state now ranks eighth in the United States oil production. From the first major commercial oil discovery on the Kenai Peninsula, now known as the Swanson River Field, oilmen have worked closely with conservationists to protect the wildlife. The Kenai National Moose Range, where the Swanson River Field is located, protects a natural environment for the famous Alaskan moose and many other forms of wildlife. Because of favorable vegetation, climatic and topographical condi-

tions, large numbers of moose are supported in this area. Oil operations opened forage areas and movement corridors, timber clearance provided them with a new growth of the young vegetation they seek. Today, the moose count at Kenai is greater than it was before the beginning of oil operations in this area. At the start of operations on the Kenai, procedures were established to assure the minimum of disturbance to the natural habitat. Debris was removed, check dams were built to prevent any possible erosion from vehicle tracks, and stream crossings met rigid requirements to prevent any impediment or change in the natural flow. The Range is a popular recreational area for many Alaskans. Unobtrusive assemblies of valves and pipes at the top of producing wells which control the flow of oil are the only reminders of oil's presence. Side roads, built by the oil companies at the request of wildlife officials, provide easy access to lakes and camping areas for recreational pursuits, previously reachable only by air, boat or on foot.

Soon after the Swanson River Field development, commercial quantities of oil and gas were discovered in Cook Inlet. The inlet's swift currents, 30-foot tides and grinding ice flows, which can be six feet thick, posed special problems to the industry. Ultra modern platforms had to be designed and built to withstand the Inlet's tides and ice masses. These are especially designed for safety and prevention of pollution. Platform workers are thoroughly trained in safety and conservation practices. On these offshore platforms all liquids from drilling are collected in skim tanks to prevent pollutants from escaping into inlet waters. All trash is collected for disposal on shore.

Alaska has probably the last major untapped natural resources in the United States. Oil is regarded as the most important of these resources, particularly since the major discovery on the North Slope at Prudhoe Bay. Since this is an area of much concern to conservationists and the oil industry a full description of the region and an assessment of the ecological systems involved would seem timely. The Slope itself, located above the Arctic Circle, is separated from the rest of Alaska by the Brooks Mountain Range. It encompasses an area of some 87,000 square miles, extends some five hundred miles east to west from the Bering Sea to the Yukon Border, and fifty to two hundred miles north to south from the Brooks Range to the Arctic Ocean. At the present time it is broken into three Zones: the Naval Petroleum Reserve covers that portion of the Slope lying west of the Colville River to the Bering Sea and from the Brooks Range to the Arctic Ocean. The Arctic Wildlife Range encompasses all of the area lying east of the Canning River to the Yukon Border. The area in between

these two Zones from the Colville River to the Canning is the portion of the Slope (through lease from the State and Federal Government) now under oil exploration and development and covers approximately 15,000 square miles of coastal plain. The major part of this is comparatively smooth, rising imperceptibly from the Arctic Ocean to a maximum altitude of 500 to 600 feet. Pingos break the flat monotony and produce an undulating skyline. Generally the shore is quite flat—broken only by sand dunes near some of the river deltas—and much of it is only a few feet above the ocean level. The whole area is very poorly drained and consequently marshy. Much of this part of the coastal plain is covered by elongated thaw lakes ranging in size from only a few yards to more than a mile in length. All are quite shallow, varying from a foot to a maximum of ten feet in depth. The entire area is underlain by permafrost which reaches a depth of over 1,000 feet. Ice-wedge polygons cover the entire plain. Several rivers and streams intersect the area, the major ones being the Colville, Canning and the Sagavanirktok. All are heavily abraded and contain large quantities of gravel. Surface vegetation throughout the coastal plain is typical tundra type, with mosses, lichens, grasses and sedges being the most dominant. Along the numerous valleys and river courses there are extensive stands of riparian willow. Since the area is poorly drained, sedge grass marshes are numerous. Vegetative components of these vary considerably but the most dominant plants are various species of *Carex* and grass interspersed with sedge-sphagnum bog-type plants.

While major oil finds in Alaska's north were not discovered until 1968, this was not the first attempt to locate oil in this part of the North. The United States Navy was the first to drill for oil above the Arctic Circle, encouraged by oil seeps reported before the turn of the century. Although none of the Navy's discoveries was of sufficient size to warrant development, they lent encouragement to the belief on the part of the industry that commercial quantities of oil might be found in the area. Starting in 1958 when leases were first opened for commercial exploration, at least ten dry holes were drilled before the Prudhoe Bay find. Drilling in the Arctic is an expensive undertaking—one dry hole cost $4.5 million, dramatizing the high-risk nature of oil exploration.

Although men and machines are comparative newcomers to the Arctic Slope of Alaska there are many species of wildlife that are native to the area. Herds of caribou roam the tundra, fish of several species migrate up the rivers to spawning grounds in the upper reaches, barren-land grizzlies wander over much of the plain and

foothills, Arctic fox and lemming are abundant in cyclic periods, Wolves although scarce at present can be seen at times following the caribou herds, Ptarmigan and ground squirrels are common. In some of the valleys and river courses moose are plentiful and, during the summer months, waterfowl, shorebirds and some of the smaller tundra-nesting species are there in good numbers. Roughleg hawks, golden eagles and peregrine falcons, although not abundant, are seen frequently. The North Slope itself is the summer range of what is generally accepted as two distinct herds of caribou: the Porcupine herd (present population estimated 140,000) centered on the Arctic Wildlife Range, and Arctic herd (population estimated 300,000) using that part of the Arctic plain west of the Colville River.

Although the main portions of the two caribou herds that frequent the North Slope are outside the oil development zone, surveys show that off-shoots of both are to be found within this area. In both 1969 and 1970 some 20,000 animals were counted between the Colville and Canning Rivers. Waterfowl populations on this part of the Slope, although not large in comparison to prairie densities, are significant. Overall they average 2.8 pairs per square mile with densities up to 5.8 pairs per square mile on some of the delta and tundralacustrine types of habitat in the low-lying coastal regions.

Major fish species in the area are Arctic char, whitefish and grayling. These fish run in the rivers during much of the summer season and, although few spawn in the lower reaches, these waterways are important to their migratory cycle. Any blockage or disruption of these fish runs, particularly during the spawning period, could upset the cyclic balance in future years. Extreme care is being exercised by the industry to see that this does not occur.

Climate on the North Slope is typically Arctic, with long winters and short, cool summers. Temperatures during the winter will drop as low as −65°F, with the average for the winter period about −25°F. Summer temperatures will reach +70°F but this is the exception rather than the rule. The average for the months of June, July and August in 1970 was +44°F. There are about 280-290 days in which temperatures fall below freezing during the year and it is not uncommon to get snow in July. Annual precipitation amounts to about six inches with winter snow accounting for about half of this. Daylight during the short summer lasts twenty-four hours a day gradually decreasing until by mid-winter there is no sun and only about three hours of semi-daylight. Breakup of the ice on lakes and rivers occurs towards the end of May, although sea-ice will hold tight until the end of June. Freeze-up can start in August although normally this does not occur until September.

With this basic concept of the type of terrain, seasons, weather and the various ecological systems involved in operating within the Alaskan North Slope, we get a better perspective of the challenge facing the oil industry in the extraction of oil from this area and its eventual transportation to the outside world.

First we must recognize that any comparison between transportation in the Lower Forty-eight and that of the Alaskan North Slope does not exist. There are no-all weather roads to the outside from this area, so the major portion of all equipment, supplies, and materials must either be flown in or transported by barge from Seattle or down the McKenzie River to Prudhoe Bay.

Few people outside the oil industry realize the enormous quantities of supplies and materials needed in the operation and drilling of a well in the Arctic. Apart from the rig itself and all its attendant facilities, upwards of 4,000 gallons of fuel per day and tons of cement and drilling mud are required to keep it in operation.

When you have a number of rigs operating within an area, the amount of supplies and materials reaches enormous proportions and the problems of transportation become difficult. With no roads or airfields in the area during the initial exploration period all supplies and materials had to be flown in to winter landing strips on frozen lakes or transported by cattrain over the frozen tundra. Once the announcement was made that oil had been discovered, more modern facilities had to be constructed to handle the increased volumes of traffic. Today airfields capable of handling large Hercules and jet transports have been built at several locations on the North Slope. Docking facilities for barge unloading and a network of excellent roads have been constructed between the various camps and other facilities. The Atlantic Richfield-Humble permanent camp near Prudhoe Bay capable of housing 200 men has a more modern waste disposal system that most municipalities in the United States.

Fully aware of the environmental damage that could occur to the ecosystems in this harsh yet fragile land many of the oil companies have engaged the services of biologists, ecologists and others versed in Arctic ecological systems and methods of construction to help them keep environmental damage to a minimum.

Of most concern to conservationists and to the oil industry is the tundra itself. This delicate vegetative layer is in so critical a balance with nature that any disruption or break in its surface could leave unhealed scars for years and become a focus for erosion. While some damage was done to the tundra during the early days of exploration, this does not occur now since movement of vehicular traffic across the tundra during the thawed period is not permitted.

Drilling rigs are supported on piles drilled into the permafrost and the whole base covered with four to five feet of gravel to prevent thawing of the tundra below. Around each drilling site, dykes are constructed as a precaution against oil spillage or blowouts. When a well is completed and the rig moved off, the site is completely cleared and leveled to as near its natural state as possible. All that is left are an unobtrusive assembly of valves and pipes necessary to the production of the oil resource.

To minimize disturbance to the natural environment, while conserving the oil resources, usually two or three companies will serve as the operators for a field such as Prudhoe Bay. Under this arrangement fewer wells are drilled. To further avoid unnecessary disturbance to the tundra, five to nine wells will be drilled directionally from each pad, minimizing the number of roads, drilling pads and gathering lines required. Permanent buildings like the Atlantic Richfield operation center at Prudhoe Bay are designed to achieve maximum compatibility with the environment. The main building contains office space, living quarters, recreational and eating facilities and a dispensary. It is connected by a series of covered heated walkways to a garage, repair shop, warehouse, water treatment plant and a biological waste treatment facility. The entire complex, constructed on piling, is insulated from the tundra by gravel and an air space to protect the permafrost.

Rigid operating procedures have been established by the industry for its employees and contractors designed to protect the natural environment. No vehicular traffic is permitted at any time which would cause permanent damage to the surface and the number of roads constructed is kept to a minimum. Further, extreme care is taken to prevent deterioration of existing roads or erosion of nearby soils. To ensure that the roads being constructed are adequate to protect the tundra, Atlantic Richfield Company is conducting research, development and testing of road construction techniques. To adequately study these variables, a prototype roadway was built in sections, containing varying thicknesses of gravel and urethane. Instruments installed at different levels measure the variations in thermal condition. Data have been collected continuously since August, 1969. The studies to date indicate that the protective insulated surface may be superior to conventional all-gravel roads and pads. Although large amounts of gravel have been required to construct the present airfields, drilling pads and roads and the only source for this gravel is the alluvial flats of the streams and rivers that intersect this area, great care has been exercised to ensure that no disturbance to migratory fish or their spawning beds are created. Extensive studies

on fish movements and spawning areas have and still are being carried out within the oil development zone to ensure their protection.

Tundra re-seeding test programs have been undertaken by the industry which now indicates that several varieties of hardy grasses can be used to repair damage to the tundra.

The question being asked today by a great many people is: What effect has all this activity in the North had on the environment and ecological systems? In our opinion the disruption so far has been minor. Caribou which have used this tundra plain for thousands of years still do so. They wander between the rigs and camps and cross roads without the slightest indication of disturbance. They have as a matter of record, been found sleeping on drilling pads during periods of light activity, apparently because the gravel pads are dry and warmer than the open wet tundra. Even during periods when considerable activity is in progress at drilling sites, animals approach quite close and graze unconcerned, moving off only when a closer approach is attempted by humans. Incidentally, firearms are forbidden at most permanent camps on the North Slope even though state laws do not require this regulation. Low-flying aircraft have little effect on these animals. When an aircraft approaches, some caribou take off at a crisp gait, but only for a short distance. Others, if lying down, will remain so, showing little or no concern. During July of 1970 a herd of some 1500-2000 animals entered the base area and had to be driven off the runways in order that planes could land. Waterfowl nest along the roadsides, in the ponds around the buildings and drilling rigs just as they do in areas of civilization on the prairies. Other wildlife that inhabitated the area before the advent of oil activities still continue to prosper.

Commercial oil activities in the Central Plain of the North Slope have resulted in only relatively minor damage to a limited area of the environment, caused by early mistakes. These early mistakes can be corrected and further damage can be avoided by good housekeeping practices which have already been established.

Although much more scientific data will be gained from further study, action already taken and commitments already made by oil companies on the North Slope demonstrate a unique partnership of conservation and petroleum.

OIL AND WILDLIFE: A BIOLOGIST'S VIEW

ROBERT B. WEEDEN
University of Alaska, College, Alaska

In this brief review of oil-wildlife relationships in Alaska, I will discuss three different questions:

—Has contemporary Alaskan petroleum development caused serious wildlife problems?

—Are important future problems likely, that will be directly attributable to the oil and gas industry?

—As oil and gas development catalyzes economic and population growth in Alaska, what consequences to wildlife will result?

Most of the scanty literature on environmental effects of arctic and subarctic oil activities deals with the exploration phase of petroleum development. The North has seen little of production and transportation phases. The varying views of industry, science, and government on the effects of petroleum operations in Alaska and northern Canada can be found in two recent book-length publications: ***Change in Alaska*** (Rogers, ed., 1970), a selection of papers from the August, 1969, Alaska Science Conference, and the Proceedings of the Conference on Productivity and Conservation in Northern Circumpolar Lands held in Edmonton, Alberta, in October, 1969 (Fuller and Kevan, eds., 1970). Weeden and Klein (1971) reviewed the evidence of conflict between oil and wildlife in Alaska; only a few of the items discussed there will be repeated in the present paper. The Environmental Impact Statement of the proposed trans-Alaska pipeline (United States Department of the Interior, 1971) is a valuable reference to problems of northern pipeline construction. Other reports are cited later in this paper.

EVALUATION OF PAST OIL-WILDLIFE CONFLICTS

Alaska's experience with oil and gas development activities has come from two widely separated and ecologically different areas. One hundred miles north of the limit of trees, south and east of Point Barrow, prolonged exploration by the Federal Government and private industry in and around Naval Petroleum Reserve Number 4 culminated in March, 1968, with discovery and subsequent development of the Prudhoe Bay field. About 750 miles south, the Swanson River field was found in 1957 within the Kenai National Moose Range. An adjacent series of oil and gas pools was tapped a few years later under the silty, shallow waters of upper Cook Inlet. Production from the Kenai-Cook Inlet area totaled 317,643,000 bar-

rels of crude oil and 614,284,000 cubic feet of natural gas through the end of 1970. About 1.5 million barrels of crude oil have been produced at Prudhoe Bay for local fuel needs. Reserves at Prudhoe Bay are estimated variously at 10 to 20 billion barrels.

Oil operations to date have caused only one major wildlife disaster that we know of. A large number of lesser problems have occurred whose cumulative impact is hard to estimate.

The exceptional incident was the massive mortality of sea birds east of Kodiak Island in February and March, 1970. A minimum of 10,000 waterfowl, alcids, and other marine birds were killed by oil, and biologists were sure that many more died—perhaps up to 100,000 (United States Department of the Interior, 1970). No major commercial fishery activities were present in the area at the time. The pollution probably resulted from the deliberate discharge of slop oil or oily ballast from tankers.

Ruptured underwater oil pipelines and carelessness and accidents on offshore drilling platforms, tankers, and shore facilities have caused many small- to moderate-sized oil spills in Cook Inlet over the past 12 years. Kinney *et al.* (1969) estimated that approximately 0.3 percent of all oil handled in Cook Inlet is spilled. Their studies showed that oil slicks disappeared from surface waters in two days, that bacteria feeding on Cook Inlet crude oil could consume nearly all of a sample in a few months, and that tides and winds flushed oil from the Inlet rapidly (90 percent in ten months). Acute problems from spills have been moderate to date (with the exception noted above). Chronic effects, if any, are completely unknown.

Evans (1969) gives a more thorough documentation of biological problems stemming from Cook Inlet oil operations.

Onshore, on the Kenai Peninsula and in upper Cook Inlet marshes, the impact of oil development has been more complex. Spilled oil has been a very minor problem in comparison with the ecologic and especially the recreational and esthetic effects of oil-related activities.

The Kenai National Moose Range, created by executive order in 1941, has been a somewhat reluctant host to the oil industry for over 13 years. Petroleum operations have been under relatively intensive regulation and surveillance on the Range. This work has paid dividends, as a comparison of seismic and drilling practices in and adjacent to the Moose Range clearly demonstrates. The policing effort also has taken its toll of the limited staff and budget of the Range, diverting energies from research, habitat manipulation, and recreation programs.

The Kenai account shows a mixture of credits and debits. The

presence of the oilfield on the Kenai National Moose Range seems to have caused no noticeable sustained changes in wildlife numbers. The 3000 miles of seismic trails cut through the part of the Range open to oil exploration are esthetically displeasing to many people, but have become access roads for fishermen, hunters, and snowmobile enthusiasts. Where open to public travel, roads built to drilling pads and other facilities have become arterials for recreationists. These gravel roads were built to high standards of landscaping and construction. Fire hazards have increased. Fires, always costly in an economic sense, may be "good" or "bad" ecologically, depending on individual viewpoints and the characteristics of specific burns. Infrequently, carelessness by seismic or other field crews driving heavy equipment has caused severe siltation of streams and excessive vegetation damage. Lastly, the paraphernalia and activities of petroleum development (helicopters, bulldozers, drill rigs, pipelines, gas flaring, seismic shots, etc.) are intrusive factors that diminish the enjoyment of the Range for people sensitive to those sorts of disturbances.

Alaska's North Slope (the land area north of the crest of the Brooks Range) has experienced extensive seismic exploration for three decades. Part of this huge area has been subjected to exploratory drilling. A still smaller area in and around Prudhoe Bay is under more intensive oil operations, including intensive seismic exploration, development drilling, and construction of permanent roads, airfields, camps, and storage areas.

Almost nothing is known about the effects of this activity on wildlife populations. The main difficulty lies in not knowing what was there before oil operations began. The general oilfield area at present seems to have a similar fauna to adjacent lightly-explored areas. However, it is reasonable to expect delayed effects which may show up only after several years of increasingly intensive and widening oilfield activities. Severe losses to wildlife certainly could occur (for example, see Bartonek, 1969, for comments on the vulnerability of arctic waterfowl to oil spills in coastal lagoons).

The large carnivores of the North Slope, at least grizzly bears and wolves, appear not to be faring well. Wolf numbers are much lower than a few years ago. Although there is little quantitative data to go on, some biologists believe that grizzly bears are scarce and declining in the eastern half of the North Slope, where human activity has been relatively intense. Proposals now being considered by the regulation-setting Board of Fish and Game would eliminate all legal hunting of grizzlies in this area. The oil industry itself is not solely responsible for the apparent declines in grizzlies and wolves. Government con-

tractors, military station personnel, field parties of scientists, a handful of unethical guides, and legal and illegal hunters all have taken their toll through hunting, harassment from vehicles and helicopters, and destruction of "nuisance" animals around poorly planned campsites.

FUTURE DIRECT THREATS TO WILDLIFE

Even without new petroleum developments in Alaska there are risks of worse damage from existing operations than have occurred so far. For example, an oil spill of moderate size (on the order of 1000-2000 barrels, the amount lost in a tanker mishap in Cook Inlet early in 1968), pushed by a south wind and an incoming tide, could wreak havoc in the marshes of upper Cook Inlet at peak waterfowl migration times. Quantifying the risks of such catastrophes is extremely difficult because certain risk-inducing factors will increase with time (intensified development activity at Prudhoe Bay, for example) whereas others should decrease (such as technologic and operational weaknesses).

Schofield and Hamilton (1970) pointed out the potential severe damage to lichen populations in and around high-latitude oilfields from chronic sulfur dioxide pollution. Using an estimate of 0.7 percent sulfur for North Slope crude oil (this being a world average, as no specific analysis was available for Prudhoe crude), they calculated that potentially damaging concentrations of SO_2 could accumulate during a four-day period of stable air at Prudhoe Bay from normal fuel burning and flaring. Recently (Anon., 1969) an analysis of crude oil from this field showed a 1.12 percent sulfur content. This is considerably above the average for US crude (0.75 percent) but lower than Venezuelan crude and that from some other foreign fields. Lichens are critical in the diet of caribou in the region. Widespread damage or destruction to the pollution-sensitive fruticose lichens would cause the loss of some existing range and might result in caribou population losses.

Recognizing that petroleum reserves (other than oil shales) in the conterminous United States are at least half consumed (Hubbert, 1969) and knowing that close to 20 percent of Alaska's land area and very large segments of adjacent offshore areas are underlain by geologically promising sedimentary basins, Alaskan biologists are deeply concerned about environmental effects of expanding oil and gas exploration and development in the near future. Just to list a few of the sources of an ecologist's anxiety, I will mention (1) the extraordinarily enticing oil prospects in the Chukchi Sea adjacent to

Alaska's northwest coast, where oil spills could cause heavy mortality in migrating whale, seal, walrus, and polar bear populations; (2) the present industry interest offshore from Prudhoe Bay in the ice-and-water environment of the Beaufort Sea; and (3) the long-standing explorations along the Bristol Bay coast of the Alaska Peninsula, where discovery of a commercial oil reserve could lead to serious economic losses to the area's world famous salmon fishery.

It is hard to know how to approach these problems most effectively. There seems to be very little middle ground between crying wolf and playing ostrich. Before-the-crisis research has never had much attraction to budget review committees in government, and industry has moved so quickly from semi-secret exploration to billion-dollar developmental investments that science always seems to be putting on its trousers when the fire starts. A good example is the lack of meaningful information about Prince William Sound, terminus of the proposed trans-Alaska pipeline. It would take at least two years and $500,000 to provide thorough baseline data on the physico-chemical environment, biota, and pollution problems of that body of water. At this point there is time but no money; later, there may be neither.

In recent years nearly all private oil companies in Alaska have been very responsive to wildlife and general environmental problems their operations might be influencing. Policies at the top have been exemplary. Companies have gone to considerable expense to alleviate problems stemming from poor waste disposal, improper use of tracked vehicles, illegal shooting, and so on. Performance in the field is—as engineers are fond of saying—"orders of magnitude" better than during the disgraceful seismic operations by the Federal Government 10 to 20 years ago. Nevertheless, human error and a degree of environmental ignorance will accompany oil and gas activities into new parts of Alaska. Occasional catastrophes and the cumulative attrition of local harassment and habitat loss will diminish—temporarily or otherwise—some wildlife populations, especially the large carnivores, waterfowl, and other vulnerable groups.

OIL: A STIMULUS FOR ECONOMIC GROWTH

Present or foreseeable effects of petroleum development on animals, vegetation, soil, or water, though important, pale when compared with the eventual secondary effects of economic and population growth stimulated by petroleum extraction. The ecological problems accompanying oil operations can be tackled with science and technology, our society's strong points. The other problems are rooted in economic

myth, frontier attitudes, and life styles, none of which respond well to logic.

The drive for economic security has long dominated the Alaska political scene (Morehouse and Harrison, 1970). This in itself is not a uniquely Alaskan phenomenon, but in no other state in the last half century has popular sentiment tied economic progress so closely with geographic expansionism and natural resource extraction. In the conventional wisdom of the North, roads, new settlements, mining and homesteading are synonymous with progress. This frontier notion thrives despite the near impossibility of commercial agriculture in all but a tiny fraction of the state, despite the fact that metallic mineral production has not equalled the value of sand and gravel for years, despite the fact that government payrolls and construction contracts have been the lifeblood of the Alaskan economy for three decades, and despite the increasing urbanization of the Alaskan populace.

Vast areas of the state still are virtually uninhabited. Fur and gold spread people to the hinterland of Alaska, but neither survived as a significant employer of people or source of revenue beyond World War II. In the span of the generation you and I represent, the important economic happenings have been urban ones: the growth of military bases, the birth of a pulp mill industry in southeast Alaska, modernized transportation, the building of educational facilities, and the growth of government as prime employer.

Now oil has "arrived" and a latter-day Klondike is in the making. The petroleum industry will go where there is promise of oil. For them there are no far corners of the earth, only greater or lesser cost distances from Houston or London. The North Slope experience sets the pattern. Early in 1968 there were only a few wildcat wells being drilled north of the Brooks Range; the wells drilled during exploration of Naval Petroleum Reserve No. 4 were plugged and abandoned. In spring Atlantic-Richfield and British Petroleum found oil. The next year witnessed the largest peace-time airlift in history, as tons of freight were flown to Prudhoe Bay. Two years later we seem on the verge of building the continent's biggest pipeline across Alaska and extending the present continental road network 365 miles to the Arctic Ocean. As I mentioned earlier, this sequence could be repeated in the remotest parts of Alaska, given three or four discoveries in other sedimentary basins. (Alaska's Governor Egan recently announced projections showing that the State will be operating with a serious deficit by 1980, even with North Slope oil produced at 2-3 million barrels per day. His conclusion: another rich oil strike is needed.)

Thus, oil development can play leapfrog with geography, wiping out with extraordinary speed the protection that distance and inaccessibility give to wildlife populations. If new and more costly forms of protection are not provided by management and enforcement programs, ensuing harvests and disturbances can threaten vulnerable fish and game species. (It can be argued that access is a benefit, which it can be. The key is control—and we have a very spotty history of control in Alaska.)

The oil industry itself is capital-intensive and highly mechanized; probably more dollars are produced by fewer people than in any other private endeavor except counterfeiting. During an initial phase of intensive exploration and developmental drilling, oilfields require more manpower than after production starts. The men are usually housed in work camps in remote fields like Prudhoe Bay where they work for periods of a few weeks, interspersed with rest trips to distant regional headquarters cities such as Anchorage. If semi-permanent oilfield settlements do develop they are likely to be small freight-handling and service centers with few or no family facilities. The greatest direct population effect of petroleum development, therefore, is in existing communities selected as administrative and service headquarters. With development and discovery of the Cook Inlet and Swanson River fields, for example, Kenai, Soldotna, and other communities nearby grew from a combined population of 6100 in 1960 to over 13,500 by 1969 (Rogers, 1970).

The most important economic effect of oil and gas production is to channel very large sums of money directly into the treasuries of landowners. In Alaska the present major oilfield proprietor is the State by virtue of offshore grants and upland selection grants provided at statehood. State oil revenues stem from bonus bids on competitively leased lands, lease rentals, royalties on production, and severance taxes. Bonus revenues occur only during bidding for leases. They can be extremely important—witness the $912 million bid on September 10, 1969, when Prudhoe Bay leases were offered—but in the long run are outweighed by production taxes. Royalty and severance taxes now total about 16 percent of wellhead prices of oil and gas in the Cook Inlet fields. The effective rate will be closer to 20 percent in Prudhoe Bay due to increasing scale of taxation on highly productive wells. This may amount to an annual income from North Slope crude of about $200-300 million at a production rate of 1 to 2 million barrels per day, or roughly 50 percent of the State's income at projected 1976 levels.

The full effect of this revenue in a state with a frontiersman's

goals is difficult for a non-resident to appreciate. There will be a tremendous pressure for state investments in roads to "open up" lands alleged to contain vast deposits of metallic ores and other politically less glamorous natural resources. Whether the resources actually exist is not important, as Alaskans generally accept the idea of speculative transportation investments. The Alaska Department of Highways has publicly announced a plan for new roads to be built by 1990,, which includes highways to the Arctic Ocean, Seward Peninsula, Bristol Bay, the Southwest Interior, and other areas, amounting to a doubling of the present non-urban road mileage of the state. Other public works investments will be important, too, in encouraging the growth of a large local construction industry that will make its demands for annual encores. The shape of things to come was visible in the ways the State proposed to spend the first of its bonus bid windfall from the Prudhoe sale of 1969. For example, the 1969 budget included only $1.6 million for capital improvements. In 1970 the Legislature authorized $50.6 million, most of the increase being for an expanded marine ferry system.

Any wildlife biologist could predict the impact of this apparently inevitable spread of settlement, transportation, and economic activity into the bush, if the game is played according to traditional rules. Funds for research and resource protection will lag far behind needs. Fishing pressures on slow-growing subarctic and arctic freshwater fish populations will exceed sustained-yield levels. Grizzlies, wolverines, wolves, and some raptorial birds will disappear from land near highways and other activity centers. Presently liberal hunting seasons and bag limits on most big game species will be reduced progressively.

It would be overly pessimistic, perhaps, to predict the disappearance or the widespread reduction of populations of most wild animals. This has not occurred around present communities and road systems, despite the pressures of 300,000 people. I am confident of the fundamentally conservative attitude of Alaskans toward wildlife resources, and of the ability of Alaskan fish and game biologists to point the way to successful sustained-yield management.

But if most problems of *quantity* can be averted or alleviated, the problems of *quality* remain: poorly defined, neglected, and almost completely overshadowed by the urgencies of daily management crises. To me, maintenance of that complex interaction of scenic beauty, faunal diversity, uninhabited countryside, solitude, and sense of personal adventure that we call the Alaskan experience, is the foremost challenge to wildlife biologists in the North today. And when

I wake in the night darkness, listening to the sibilant drone of another load of drilling mud on its way to the North Slope, I have a desperate feeling we are not going to meet it.

In conclusion, the petroleum industry, like the little girl of nursery-rhyme fame with the curl in the middle of her forehead, is of mixed character. On one hand, the large companies working in the North are willing and able to absorb extra costs to provide needed protection when ecological problems are perceived. Secondly, the industry is highly automated and will in itself bring relatively few people to the North. Furthermore, the petroleum industry pays well for the right to extract and ship oil and gas, making funds available for intensified natural resource protection and management.

But the potential for environmental mischief also is great. Oil and gas could occur in Alaska in more than a dozen large sedimentary basins beneath tundra, boreal forest, deltas, tidelands, open ocean, or marine ice. In many places the industry would be operating at the fringe of ecologic and technical knowledge, where familiar problems are magnified and new risks loom unexpectedly. Despite all efforts to prevent them, damaging oil spills are still a statistical certainty in large and prolonged petroleum activities. Finally, the petroleum industry is a massive political force that historically has held the upper hand whenever its interests were challenged.

In looking beyond the first-order effects of oil and gas exploitation I expressed forebodings that the economic spark of oil discovery has set off a chain of roadbuilding, settlement, mining, urbanization, and human population increase that would have a more profound environmental impact. This assumes the continued ascendancy of the frontier mythology in Alaskan government. There are developmental strategies that could delay or in some areas prevent the overrunning of Alaska by commerce. (As an example applying to the petroleum industry, Alaska could set an upper limit to daily North Slope oil and gas production, calculated to be within the capacity of one transportation route chosen as a least-cost route from an environmental standpoint. In addition to this policy's many land management and environmental benefits, it could also help prevent the State from stepping onto the wrong budgetary escalator.) It is also possible that new environmental perceptions could make themselves felt politically —as seems to be happening occasionally today—and could lead to significant shifts in economic and social policies. Along with many other groups of concerned natural and social scientists, wildlife biologists must help provide a sound factual basis for these heightened environmental interests and to make all Alaskans aware of the implications of their daily economic and political decisions.

LITERATURE CITED

Anon.
1969. Analysis of North Slope crude oil. Oil and Gas Journal, 67(40): 91.

Evans, C. D.
1969. Environmental effects of petroleum development in the Cook Inlet area. Proc. Twentieth Alaska Science Conf. (E. C. Viereck, ed.), Alaska Division American Ass'n. for the Advancement of Science. pp. 213-221.

Fuller, W. A., and P. Kevan (eds.).
1970. Proceedings of the Conference on Productivity and Conservation in Northern Circumpolar Lands. International Union for the Conservation of Nature and Natural Resources, New Series no. 16. Morges, Switzerland. 344 pp.

Hubbert, M. K.
1969. Energy resources. pp. 157-242 in *Resources and Man.* National Academy of Sciences, National Research Council. W. H. Freeman Co., San Francisco. 259 pp.

Kinney, P. J., D. K. Button, and D. M. Schell
1969. Kinetics of dissipation and biodegradation of crude oil in Alaska's Cook Inlet. (Contro. No. 61, Institute of Marine Science, University of Alaska, College.) Joint Conf. on Prevention and Control of Oil Spills, New York. pp. 333-340.

Morehouse, T., and G. Harrison
1970. State government and economic development in Alaska. Part I. State Government, 43(4): 194-202.

Rogers, G. W.
1970. Alaska's economy in the 1960's. Alaska Review of Business and Economic Conditions, VII(6): 28 p. Institute of Social, Economic, and Government Research, Univ. of Alaska, College.

Rogers, G. W. (ed.).
1970. Change in Alaska: People, petroleum, and politics. Univ. of Alaska Press, College. 213 pp.

Schofield, E., and W. Hamilton
1970. Probable damage to tundra biota through sulfur dioxide destruction of lichens. Biological Conservation, 2(4): 278-280.

United States Department of the Interior
1970. Summary report, Kodiak oil pollution incident, February-March 1970. 28 pp. mimeo.
———. Environmental impact statement, trans-Alaska pipeline. Draft, January 13, 1971. 196 pp. plus attachments (60 pp.). mimeo.
1971.

Weeden, R. B., and D. R. Klein
1971. Wildlife and oil: a survey of critical issues in Alaska. Polar Record (in press).

PANEL DISCUSSION

VICE CHAIRMAN YANCEY: Thank you, gentlemen, for these excellent presentations.

We will now open our discussion period. And, if it is agreeable, we would first like to ask if any of the members of the panel would like to pose questions to other members of the panel. I would first like to call upon Mr. Gavin and see if he may have some questions for other members of the panel.

MR. GAVIN: The only thing I have to say is that during 1969 and 1970 I had the opportunity to survey parts of the Alaska North Slope by helicopter and I covered the area pretty well. While we did not go out of the way to count every bear we saw, we did keep a log on them. In 1969 we counted 10; in 1970 we counted barely one.

VICE CHAIRMAN YANCEY: Of course, you may further elaborate, if you will, relative to the data concerning birds, mammal and fish population in this area. You might discuss the purpose of gathering that information and how you are going about it and why you are monitoring the levels of the population.

We would like to bring out as much information about this issue as we can while we have all of these divergent views available.

MR. GAVIN: During 1969 and 1970 I worked for the Atlantic Richfield Company in order to find out what there is on the slope insofar as wildlife was concerned. In the past two years I have taken an inventory of all wildlife on the slope, in fact, a very complete inventory of waterfowl. In the last two years we have found out more about the North Slope than probably has been found out in many years. In this connection, I have a report which will be available soon and it covers everything in this area.

VICE CHAIRMAN YANCEY: Thank you. Now, Mr. Larminie, do you have a question or additional comments to make?

MR. LARMINIE: One interesting point that Mr. Weeden brought out has to do with the areas of exploration in Alaska, and this, of course, has to do with the particular water area that he mentioned. You know, it is one of the facts of life that this area was brought to our attention by a survey carried out by the U.S. Geological Survey.

MR. DAVID LATTIMER (University of British Colombia): I am interested as a student ecologist in exploring the subject of employment with industry and Mr. Gavin has answered part of the question. However, I would like to press on with it and I would like to use as a basis for my comments some non-scientific literature if I might.

The latest Alaskan magazine includes an ad. I think this conveys the message pretty completely and, further, it bothers me to some extent. I do not wish in any way to question your personal dedication and sincerity but I do want to examine your relationship with your company and, therefore, that leads to these questions.

First of all, are your important findings, in the event you make any, going to be dispensed in the same way all scientific findings are dispensed—in other words, in appropriate journals and subject to scrutiny and criticism of other people in the field?

Secondly, would you be reluctant to present any facts or information which your company clearly would not like? In other words, is this information to be classified in relation to only the company or are you in the position where you hold a tremendous influence in the decision-making processes of the company or, on the other hand, are you just a public relations expert?

MR. GAVIN: Well, first, to answer your last question, I am not tied to anything in connection with the Atlantic Richfield Company in relation to holding anything back. I am up there to find out what it is all about and tell them how we are going to do it and not how they want to do it.

Further, the information that I have gathered will be published in different journals and, further, this paper that I have presented will also be in the hands and can be put into the hands of anybody who wishes it within the next few days.

MR. LARMINIE: I would like to also add an additional word in response to the last question. Now, I don't know whether the fact that he has ignored me indicates that my credentials are beyond hope. (Laughter)

I wish that I could say, however, that I am not without influence in my organization and, of course, Mr. Gavin is in the same capacity insofar as his organization is concerned.

In the coordination of the operations in this area there exists in the development of the Prudhoe Bay field a unit which I think is unique. For example, under the state laws we are required to unitize oil fields and produce a single unit. This, in effect, obviates the possibility of modification of facilities.

In pursuit of this objective, we possess an environmental sub-committee of the unit which is charged with reviewing all production operations, engineering plans and the like and insuring that they are in complete conformity with what we know or what we can find out from other factors about the circumstances pertaining to the north slope.

In our efforts to enlarge our information, there are two ways that we can go about it. First of all, we can hire all the ecologists that we can lay our hands on and send them forth in great numbers to find out all about everything. However, when they finish that work, they would have to direct somewhere else. In order to achieve the results of getting information from a wide variety of disciplines within the total eco-system concept, we have gone to the tundra biome of the International Biological Program. We cooperate closely with the two directors of this organization and its scientists. We have test sites associated with the IBP program on an experimental basis within the area. We have some input into the design of the experiments of the IBP program. We have access, immediate access, to results of their work.

In this way, as we start out and suddenly go from nothing to something very quickly, we have achieved a very considerable body of knowledge.

On the other hand, this is not enough. Therefore, please do not get the idea that we are complacent about this. The learning process, at least in my estimation, is a continuum. Nobody has any right at any time to claim that he knows everything about everything.

MISS SUSAN SCHWARTZ (Seattle Times): I would like to call attention to a paper which Schofield and Hamilton presented in 1970, which pointed out the potential severe damage to life population in and around high latitudes from sulfur dioxide pollution. Could either of the two gentlemen from the industry comment in relation to that and whether normal fuel burning could be reduced or has been reduced?

MR. LARMINIE: If I understand your question, let me say very quickly that we are operating under certain federal rules which cover the way we will develop the Prudhoe Bay oil field, including regulations set up by the State of Alaska. This includes regulatory provisions and the design of production facilities in Prudhoe Bay, wherein we are presently engaged, fully in accordance with the various requirements.

We have not yet completed the feasibility studies for methods of gas disposition but it is our intent to dispose of gas—in accordance with the standards prescribed.

MR. KEITH HAY (American Petroleum Institute): One of the major concerns of conservationists in Alaska concerning wildlife and the pipeline is that of the inhibiting effects of the pipeline on caribou migrations. Therefore, this question is directed to Mr. Gavin. I know he has followed the caribou migrations for at least two years and I know of nobody more qualified to answer.

MR. GAVIN: For the last two years we have followed migrations of the Arctic caribou and possibly mostly those coming in from the South Brooks Range to the North Slope. We have some 20,000 animals coming in from that area.

Now, the animals from the North Slope come in through the valley and this, in turn, is nowhere near the pipeline and judging from the information facilities we have, the caribou have no problem there at all.

MR. DAVID BROWER (Friends of the Earth): I appreciate very much that this is the most important conservation meeting held in the United States every year. I also think that the Alaska situation is probably the most important conservation problem we have, dealing with the largest and last great wilderness belonging to the United States and also the finest wildlife range that was ever set up in our history.

I am wondering why we cannot have time in a meeting of this importance and on subjects of this importance to discuss what I think is the item of greatest importance. And, that is,—what are the alternatives to this kind of development of our Alaska wilderness and what can the industry and scientists do to alleviate the pressures that are brought about by such prescipitive and unplanned attacks upon this wilderness as epitomized in one or two reports which, in my 20 years in working with government reports is the least competent that I have ever seen?

I would like to hear the three panelists on alternatives—on their own evaluation of what they think of the 102 report and whether they think that represents what the industry wants and what science wants. This report on environmental quality has been said, by the Corps of Engineers, to probably strike at the heart of the Environmental Quality Act. I think this is a very important factor and likewise one which has been completely skirted.

MR. LARMINIE: I would not like to tackle it in the time available because I am completely at a loss as to what I can say about the alternatives.

I work in the oil industry and my job is exploration and production and to find and produce oil.

Now, if you have reference to alternative routes or schedules, well, the alternative routes are perhaps governed by the precipitious nature of development. When the United States through the Office of Naval Research and the Director of

Naval Operations went into the Arctic in 1944 to name a petroleum reserve, it did what every exploration organization will do. It had no communications, was in a remote location, was searching for an economic substance which only had an evaluation when transported to market. And, so, as a part of the exploration they did a study on pipeline routes and those exist and are in the archives and are known to us.

When we started exploration in the Arctic in 1959, we used that data. We commissioned and completed our first pipeline study in 1962 and evaluated a variety of routes. We updated this in 1963, 1964 and in 1968, on the basis of this data, we carried on and refined and further evaluated our plans. Now, of course, there has been considerable talk about the Canadian Route. I am not sure whether this really concerns itself with the Canadian Route as an alternative or the hope that if you send it through Canada that the problem will some how go away. However, it will not. There is as much permafrost, for example, on the Canadian Route as there is in the transect of the North Slope.

There are two routes out of the North Slope. One is across the Arctic National Wildlife Refuge into Canada. Are you proposing that we should take that route? I was on it just before Christmas. I had been invited to participate in an international study group with the objective of extending the wildlife range into Canada and setting up facilities for expanding the wildlife ranges. This, in turn, involves double the distance of the protected wildlife area, if it came into being, across which you would have to carry pipeline.

Now, if you do not go that way, then you have to follow the existing route across the Arctic Slope through the Brooks Range and to north of Yukon. At that point, you turn left and you go up into Edmonton.

I believe that we have fully and carefully evaluated all of the alternatives and as responsible engineers we have made our decision and we shall have to stand on that decision.

MR. GARVIN BUCHARA (Oregon): I don't know to what degree the Eskimo has been involved in your planning. From my experience with the Eskimos, and I worked with them during the summer of 1968, I find that these people have a tremendous ability. Therefore, I wonder if the Eskimos in the area have perhaps been surveyed and consulted as to te behavioral trends of the caribou. Some prior studies indicate, for example, that presumably some interference with the leaders might well cause a change in migration patterns. Have these folks been carefully consulted or considered? I think that they should be.

MR. GAVIN: Yes, I think the natives down at the pass have been consulted. In all my years in wildlife, and I have spent some 20 years in it and talk the Eskimo language fluently, I have talked to the natives there on many occasions when I have been there and I find that they are quite happy with things at the present time because, after all, there is no other development within that area.

MR. BUCHARA: However, your development does not preclude the chance, for example, that the pipeline might pass through Anaktuvuk Pass?

MR. GAVIN: At the present time, there is no indication that the pipeline will be anywhere near this pass.

MR. BUCHARA: Well, in this connection, I would hope that at least one Eskimo village will be somewhat preserved if it is possible to do so at this late date.

MR. GAVIN: I would assume that it will be, simply because there is nothing there to disturb it at the present time. Also, in the future we likewise see nothing there that will disturb it.

MR. BUCHARA: However, there is "us."

MR. GAVIN: Well, there is "us" in every part of the world and if you don't want to move into it, then you will have a wilderness. Of course, immediately that man goes into it, it no longer is a wilderness.

MR. BUCHARA: I think that the Eskimos and the wilderness have in the past been compatible.

MR. GAVIN: Well, to a certain extent but, on the other hand, they have to also keep alive.

MR. LARMINIE: Just to set your mind at rest about Anaktuvuk Pass, let me say that this was one of the alternative possibilities within our route selection and was also a possibility within the Navy's routing selection. We evaluated that route by drilling and we discovered that it had an unacceptable ice content within the permafrost. Therefore, we abandoned it and went to a more difficult and shorter route across the Dietrich Pass and we have further refined that and there is no danger of the pipeline going through the area you mentioned.

MR. BUCHARA: I have one other brief comment. You know, very often studies are carried out by professionals and this information is, in turn, made available to higher authorities and this eventually comes to a point where it is gathered together in a report and decisions are made. Now, the weak point in this is that in fact many of the higher-ups making final decisions have not been trained in scientific methods and, in fact, are political personalities. Therein lies our weakness. Perhaps some of these high level positions should be made available to professionals who are not, I might add, biased by industry, government relationship with individuals, et cetera.

MR. ST. AMANT: I have a question of Mr. Gavin.

How do you handle your waste drilling material and do you have a salt water bleed problem? Further, how are you handling any excess brine and are you drilling deep enough to use oil emulsion mud? In other words, how do you dispose of these excess wastes?

MR. GAVIN: The technique of disposing of drilling mud is to put them into pits. That is about all I can say.

MR. STEVE BLACK (Wildlife Society of Arizona): My remarks are directed to Mr. Larminie.

Now, you communicated in your presentation that the average spill per year would be 12 tons. Could you give us an idea about how much surface area would be affected by this average spill per year and also how soon the environment would be able to respond from this spillage?

MR. LARMINIE: No, I could not, because they weren't always spilled at the same time, if spilled at all.

I was considering, and I did say that the possible spillage applies to a situation at Milford Haven, where you are handling ballast and other factors. These operations cannot be carried out at Valdez. The actual acceptable level of ballast treatment has been assessed at Valdez at 10 parts per million. This is at the present time about the limit of instrumental resolution equipment.

I would like to point out as an analogy with regard to introducing this type of oil in the water, that it is like the one between radioactivity and whiskey. In other words, you can drink 10 glasses of whisky, one day, and you will not be drunk on the 10th day. However, you can obtain identical dosages of radiation and on the 10th day you will have a cumulative affect.

In the case of oil at this concentration, it has a half-life loss of volatiles and complex chemical relations of only a few moments. Insofar as I know, no one has been able to detect its effect on wildlife.

MR. STEWART BRANDBORG (Wilderness Society): I believe that this excellent panel has illustrated the breadth and full dimension of some of the unanswered questions which we face as we consider the pipeline proposal in Alaska and the network of roads and supporting pipelines that will be required to accommodate it, as well as the long-range need for plans to develop Alaska and to preserve some of the unique values that we have in that wonderful state.

It has been pointed out that this is perhaps the biggest public lands issue that we face in this country and have faced since the Louisiana Purchase. It is an issue which should involve Americans in the lower 48 because the lands that we are speaking of are lands that are largely publicly owned. We face the critical issue of native claims. We face the long-range opportunities that we see in developing a plan and a program for Alaska that will avoid all of the tragic mistakes that we have made in connection with our environment in the lower 48.

My question is this—does the panel see any reason why we should not ask the

Congress of the United States to require, within a 5-year period, the development of a comprehensive land-use program for Alaska which will permit us to then take into account all of the resources that we have there—the opportunities for extraction of commodities, the preservation of this vast wilderness, the protection of the wildlife herds and populations? Have we not time in this point in history to develop the plans that will avoid the tragedies that we see in the lower 48?

Can we ask the Congress to reconsider the various public land proposals that now apply to Alaska and to call for a major review of what we face here and to assure that we do not make irrevocable mistakes in relation to such specific proposals as the pipelines?

I wonder if Dr. Weeden would like to answer that question.

DR. WEEDEN: In other words, you asked whether the panel thought we should ask Congress?

I think we should.

MR. LARMINIE: Not only that, but unless I have my ideas of the Constitution of the United States in relative position of the states comprising the federation wrong, they ought to also ask the Alaskans about this.

MRS. LOIS WEISS (British Colombia): We have been involved in our country in what we consider ecological blackmail, whereby large industry puts in a great investment before suitable permits and authorizations are received from the appropriate boards. I should like to hear from both of the industrial men as to what assurances we have been given by your companies that you would be allowed to build a pipeline through Alaska before such huge investments and big equipment and material are made there.

VICE CHAIRMAN YANCEY: I will call on Mr. Larminie to answer this question for the panel.

MR. LARMINIE: Well, in answer to your question, in a strict sense, none.

In other words, we purchased oil and gas leases from the State of Alaska entirely legally and included in the legal rights pertaining to those particular leases was the right to develop those leases. Having developed a lease, it is then up to the operator to use either existing methods of transporting the oil from that lease to market or to devise new ones.

Now, the standard process, where possible, in relation to the oil business, is to use pipelines. It is the safest, best and most economical method of transporting commodity to market, and to the extent we assume inherent in the right to produce the lease was the right to dispose of it at the market place and not sell in buckets at the wellhead, in this connection we determined we would build a pipeline.

That is your answer. In other words, it is not the practice in this country, before you go on to a lease in Texas, to get permission to build a pipeline to Chicago, if you build a pipeline. Here we have gone on the historical record in relation to the way the operation is conducted. We have done this in a series of steps and that is, look for oil, find oil and get to the market and, of course, our responsibility is to get the oil to market and, further, since it is our livelihood, we don't want to lose any of it on the way.

MISS PATRICIA CARPIO (Society for Human Abortion); According to the information I have, there is a 25-foot right-of-way on each side of the proposed pipeline. And yet I find, in the Wilderness Society Bulletin, that the oil companies are seeking to persuade the Federal Government to ignore that Act of Congress, the 1920 Mineral Leasing Act, which limits pipeline rights to 50 feet plus the diameter of the pipeline. Instead, they want to slice 100 feet off the pipeline, plus a 200 foot right-of-way through a proposed road, all of which is in violation of the law now in existence. Do any of the gentlemen representing the oil industry have anyting to say with regard to this particular accusation?

MR. LARMINIE: No, I do not. I am in favor of the details I have indicated.

VICE CHAIRMAN YANCEY: Is there anybody here from the Alaska Fish and Game Department that would like to bring any additional factual information forward?

MR. DARWIN S. BRADIN (Alaska): May I say that I am a 12-year resident of

Alaska and formerly employed by the Fish and Game Commission for about six and a half years.

I would like to say that there have been a lot of misstatements and misleading information published in connection with this pipeline. There have been national news articles and advertisements which, in my opinion, have been deliberately staged by certain individuals which cannot, in the final analysis, stand very close scrutiny.

Further, it has been indicated by the various companies, and they have made it public that they have spent some five million man hours in environmental research on this project alone. Further, there are certain questions not answered at this particular point.

Now, insofar as the land classification schemes in Alaska go, let me say that I was formerly with the State Division of Land as the Land Classification Officer and was instrumental in drafting the regulations that industry currently operates under on the North Slope, and conversely, throughout any state lands in Alaska. These regulations are unique in that there are no other states in the Union or any other Canadian provines that have land use regulations of this nature at this time.

There is one Canadian province, for example, which I see by the papers the other day, which is advocating adoption of these types of rules. And, I hope that they will.

You know, this is a rather unique situation. Alaska has the strongest land use policies available to it today of any state in the nation.

MR. BUD BODDY (Alaska): I represent the Alaska Wildlife Federation. I have been a member of the BLM Land Advisory Borad for quite a number of years.

In my connection with this Board, we have had the opportunity of working very closely in connection with the various problems that have been presented as a result of the development of the North Slope, as well as the proposed pipeline and highway route.

I believe that we have, as has been mentioned here by the previous gentleman, some of the stiffest stipulations that have been developed for any type of highway or pipeline anywhere in the world.

On the other hand, I think they are misunderstood. In fact, I wonder how many people have really read the stipulations. Now, I would also like to indicate, in relation to the gentlemen on the panel, that they have done an excellent job here this morning in helping to alleviate some of the misunderstanding and to answer some of the questions that people are entitled to have answers to.

This has been one of our problems—the problem of communications. However, these gentlemen have done a fine job in analyzing the present situation and also towards looking toward the future.

I would like to go back for just a moment to the territorial days. Many of us were there and many of us in the audience will remember when we were pleading with the Federal Government for adequate funds to carry out what we thought was much needed information in relation to many, many areas, not only in land areas but also water areas. As we all know, the record will show we received very little in the way of results and now we are in a state where we have problems of responsibility of conducting ourselves in a manner which is directed, what has been said many times, prevention of the many mistakes that have been made in the past.

We have the intentions but, on the other hand, we had, until recently, been led to believe we would have money to implement these plans and carry out our responsibilities.

However, we are now in a position of again questioning whether or not this is going to be true and at the present time, of course, we have the delay in relation to the pipeline. But, more importantly, we have the land freeze and the Native Land Claim question which has tied up the state almost to the point where we can't do anything.

This question in relation to Native Land Claims is one of the biggest questions that faces Alaska and one that must be resolved or we cannot go ahead.

We cannot implement our land use plans, we cannot carry out our responsibilities in connection with our total responsibilities not only in relation to economics but in relation to future planning, until this question is resolved. Therefore, I hope you will give consideration to this matter and I hope we will all work together to solve this Native Land Claim question and that we can also work to see that not only the state carries out its responsibilities from a funding level, but also that the Federal Government does likewise.

MR. GORDON WATSON: I am an instructor in resource economics at the Alaska Community College. I also happen to be Alaska Area Director for the Bureau of Sport Fisheries and Wildlife.

Now, I would point out that I have never been shy as an Alaskan about letting my representatives in Congress know how I feel about the Grand Canyon, jet airports in the Everglades, et cetera. Therefore, I would only say that in my 18 years of experience in Alaska, that the American flag always flies above the Alaskan flag.

VICE CHAIRMAN YANCEY: We will now hear from anyone from the Interior Department who may wish to comment.

FROM THE FLOOR: I am a commissioner with the Alaska Departmnet of Fish and Game. Let me say that we have examined the project thoroughly from top to bottom and do feel that the thing is built properly. That is all I have to say.

MR. BRANDBORG: I think that view is shared by many of us who wish to see the State of Alaska and the Federal Government do the best possible job in regard to development opportunities in Alaska. Now, you call for an Interior Department representative. I think the fact that no one stood up to offer an observation is indicative of the phenomenon which we frequently see in the American scene today the phenomenon involving suppression of information on the one hand and the hearings and the statements made in Alaska some two weeks ago. I think that we have all become aware, through this knowledge, that the provisions of the National Environmental Policy Act and the purposes of this fine act have been ignored. Therefore, it is encouraging to also note that the people in Washington have called for a careful, deliberate approach to a re-evaluation of these statements and all of the opportunities that they encompass. Again, I think we must be of one mind in pursuing the utmost of effort to get detailed research and then carefully draw comprehensive plans for development. This will require the involvement of Congress and Congress likewise should know about views in this matter.

VICE CHAIRMAN YANCEY: Thank you for those comments. We appreciate the participation of all of you.

TECHNICAL SESSION

Tuesday Morning—March 9

Chairman: GLENN D. CHAMBERS
Research Biologist, Department of Conservation, Columbia, Missouri

Discussion Leader: GORDON W. GULLION
Research Biologist, University of Minnesota, Cloquet

FIELD AND FOREST

REMARKS OF THE CHAIRMAN

GLENN D. CHAMBERS

We're fortunate this year in that we had over 25 papers submitted for the particular session which you are about to enjoy. The quality of our papers was very good.

Because of the desirability for wide geographical distribution and variety of interest, we selected papers on that basis. For that reason, some very good papers have been rejected. To those of you who submitted papers that were not accepted, I apologize, because it was really quite a job to screen them. On the other hand, there are other good outlets for publication that you may want to pursue.

I would like to take this opportunity to say "thank you" to our participants because they have done an excellent job in preparing their papers and keeping on schedule with the type of schedule that we had to meet, to come up with the discussion and presentation here this morning. So to each of those who so diligently worked to make this session a success, a "thank you."

I would like to introduce our discussion leader, Dr. Gordon Gullion. Gordon is with the University of Minnesota, the Cloquet Research Center, and to those of you who are familiar with ruffed grouse and some other species, Gordon is no stranger.

Because of the recent focus of attention upon our environmental

problems, it is most fitting that we, at this very session, address ourselves to the relationship between these problems and some of our wildlife species. With this in mind, a series of papers has been prepared which will help us see the impact that man and his works have had on the environment. This impact is reflected, of course, to different degrees by many species of wildlife. And that is what we're going to be talking about.

But before we look at what some of these wildlife indicators are trying to tell us, I think it is most fitting that we look at what the problem really is. Describe it any way you want, look at it from any angle that you like, and it all boils down to a people problem.

Our first speaker is a native Californian who is very interested in this subject. He graduated from the University of California at Berkeley in 1939, with a B.S. in Zoology. He received his Ph.D. in vertebrate ecology at the University of Michigan in 1947. He served in World War II and joined the University of California at Davis in '47, where is currently professor of Wildlife Biology and Vertebrate Ecology.

He has an impressive publication list with over 150 publications. He has traveled widely, in New Zealand, Australia, Europe and Mexico. So he knows the problem.

MAN'S POPULATION—ENVIRONMENT CRISIS

WALTER E. HOWARD

Department of Animal Physiology, University of California, Davis, California

Since space is finite and limited, it is an indisputable fact that birth rates and death rates must be balanced someday at some level. Most of the world's problems—social, political, economic—are both symptoms of the disease of overpopulation and a consequence of pollution produced by our technological advances. The picture looks grim, the treatment grimmer, and the prognosis almost hopeless. Already the rich are devouring the poor—the survival of the fittest.

A monstrous problem is created by current control of premature death through improved sanitation, vaccination, modern public-health practices, and other means that keep more babies alive. The problem is not one of inadequate food production or improper distribution of resources, but, rather, the failure by mankind to recognize that no population can continue to grow indefinitely. The population of the world is growing by about two percent per year. At this seemingly low rate of growth, a mere dozen people a thousand years ago could

have produced the present world population, and in another thousand years each one of us could have 300,000,000 living descendants. Obviously, this cannot be—something else must occur. The choice is ours. Either the world birth rate must be significantly curtailed, or the death rate will be drastically increased through war, famine, or pestilence—probably by all three working in grim partnership, with pestilence taking the greatest toll.

Man can no longer be indifferent to this basic population problem. Its severity requires that all of us must act now. Hunger and overpopulation will not go away if we do not discuss them, and the bringing of too many babies into this world is not just someone else's problem; it is everyone's concern. All of the world's dearest desires—ample food, permanent peace, good health, and high-quality living—are unattainable for all human beings, both now and in the foreseeable future, for one obvious reason: there are too many people. A soaring population means a shrinking of man's space on this earth.

Our mode of life, our habits, our standard of living and technology have all reached a new high. Yet isn't it ironic that both the population and pollution problems stem from technical advances brought about by the knowledge explosion, especially over the last 100 years? As our technology advances, each person requires greater amounts of our resources—but the supply is not endless.

Most people are not aware of just how much faster the population is growing today than before. The following example will indicate how the rate of growth of the population of the world has changed with time. During the entire 8 million years prior to the Neolithic age, the increase in our knuckle-walking ancestors averaged only slightly more than one individual per year, whereas during the next 10,000 years, to the time of Christ, it was 29,000 per year. In 1969 it grew by 72 million.

Because of this rapid growth in recent times, one of every 20 to 25 individuals of our species who have ever been born is alive today. This is really fantastic! No other species has ever done this. Just visualize the world today if 1/25 of all the rats that have ever been born were scampering about, or if 1/25 of all the trees that have ever been produced were still growing today.

POPULATION DYNAMICS

The basic cause of the overpopulation problem is man's success in creating a low death rate. People are not having more babies; simply, more of them survive to reproduce themselves. It should be obvious that a low death rate can be maintained only by also achieving a low

birth rate. It would be catastrophic in nature if any other wild species achieved the same low-death-rate culture which man has now acquired in the developed countries. If deer mice (*Peromyscus maniculatus*), which live in North America, had the same low-death-rate culture which man now enjoys in the United States, one pair would have billions of living decendants before they died, instead of only the two they now average.

No population can continue to grow beyond certain limits; eventually, involuntary self-limitation—in the form of premature deaths from starvation, pestilence, and wars — will limit density. Even though the average birth rate in the United States has declined during the past century—from about seven children per family to fewer than three—the population density has been growing much more rapidly than before. The reason is the high population base level; there are now so many more women that their "small" families add a greater number of new people to the population each year than their grandmothers did, even with much larger families.

Our humanism has destroyed the means whereby primitive man achieved population control. Animal species regulate their population density either by territorial spacing, infanticide, neglect of surplus offspring, or the interaction of other social stress factors that limit any further increase in a dense population. Primitive human populations were maintained at some "optimum number" by a variety of means, including taboos against intercourse during lactation, infanticide, compulsory abortion, cannibalism, head hunting, ritual murder, emigrations, human sacrifice, territoriality, and warfare. These voluntary and involuntary density-dependent social regulatory mechanisms prevent populations from growing to where they seriously challenge the normal carrying capacity of the physical environment within which they live.

It has been stated that without prompt action man will breed to oblivion. This, of course, will not happen. Why? It has never happened in the past, and I do not think it is going to happen in the future, because man is like other organisms and ultimately will control his own numbers, even if it is done ruthlessly and violently. The dominants in each country will continue to survive. Man will not, however, check his population growth in time to avoid great additional damage to the environment. In the future, the potential carrying capacity of this earth for people will be far less than it is today.

THE SOCIO-ECONOMIC TRAP

In industrially developed countries, middle-class couples often have fewer children than they would like (if they only had more money,

domestic help, etc.), whereas in underdeveloped countries and ghettos the reverse is too frequently true. High birth rates tend to nullify national efforts to raise average per capita income, since there is less money for savings and developmental investments. Neither families nor a nation can escape when life is held close to the margin of subsistence.

Overpopulation inevitably commits too many people to poverty and despair. With perpetual pregnancies the bonds of welfare become inescapable, for unskilled parents cannot feed a large family from the wages they can earn. No matter how you look at it, families of more than one or two children intensify the problem of national development, and this happens whether the parents are poor, middleclass, or wealthy. A couple has much less a chance of becoming successful dominants in today's societies if they have many children.

The current density of the United States population is not the major problem; it's just that Americans are so rich. The success of capitalism has had or will have disastrous environmental consequences if we continue down the same paths. Our greed and environmental ignorance have led the average American to judge his success by monetary achievements. Will we realize soon enough that the dollar sign is a poor yardstick for measuring the quality of life and the environment? What is needed, of course, is an ecological conscience.

As far as the human species is concerned, there have always been those who have been classified as the have-nots since the beginning of time. They are the unfortunates who have died prematurely. This tendency is likely to continue, although we must do all in our power to provide a good life for all who are born. As overpopulation becomes worse, the percentage of the people in this nonsurviving unfit category must obviously increase, and many will be found in large families. However, none of the people who read this article is likely to starve, though his very existence will indirectly cause the deaths of others who are less well off.

What does it mean for a country today to have a low death rate but a high birth rate? Take Mexico as an example. The amount of time required for the population in Mexico to double was recently thought to be about 18 years. This means that if their current growth rate is continued for 100 years, the population will increase about 44-fold. Obviously, Mexico cannot accommodate a doubling of population in the next 18 years, let alone increasing 44-fold during the next 100 years. The same phenomenon holds true for all countries in the world. As tragic as it may sound, when an underdeveloped country's population density is growing rapidly, both health and agricultural

aid from the United States may not only be wasted but may severely aggravate the already deplorable social and economic situation in that country.

ECONOMIC FACTORS

No nation's population growth rate has ever leveled off without some form of undesirable social or economic pressure. Population stability develops only when conditions are such that parents do not desire many babies. For example, economic, social, and political factors make it unfavorable for large families.

With reference to our affluence, we cannot turn back—if for no other reason than the fact that there are now too many people to permit going back—to a less materialistic existence, without cars, pesticides, diesel exhaust, sewage and garbage disposal, etc. The stork has passed the plow. Food prices in developing nations are rising faster than the purchasing power.

Instead of striving for maximum economic efficiency, we should be striving for environmental stability. We need to develop an unexploitive economy, based on quality and service rather than growth, which means that items such as an automobile will cost much more than now but be made to last longer. The only realistic way of redirecting our technology to actions that are less environment-destroying is to start a steady progressive tax increase to force such changes. All uses of fossil fuel should be taxed more each year.

RESOURCES AND TECHNOLOGY

The world's supply of natural resources is finite—especially in land, crude oil, copper, and other minerals. Thus, if the current rate of utilization of these items continues, the supply will be gone in the foreseeable future except for what can be recycled. If this happens there will, of course, be a complete collapse of our society as we now know it. But, it is likely that total degradation of humanity will occur first in the less fortunate areas of the world. This is the way all species control their own numbers before they have completely destroyed all of the resources that are available. They become their own worst enemy, and thereby ruthlessly prevent their own kind from increasing any further in numbers. Man seems destined to follow the same path.

What is happening in developed countries? Today, six percent of the world's population lives in the United States. That six percent is using up at least ⅓ of the world's mineral output, and an even greater share of the raw-material resources being utilized in the entire

world. Of the 100 most important minerals needed to provide the degree of affluence enjoyed by people in the United States, the United States is self-sufficient in only 12. Man is now living beyond the ecological means of the environment, especially in the United States.

No one anticipated the scope and rapidity of the technological changes that have occurred in Western society. About one-third of the people now consume about two-thirds of the world's food production, while the other two-thirds go undernourished. But, unfortunately, these starving people reproduce at a high rate. As individual aspirations rise and per capita resources fall, the widening gap between the haves and the have-nots could well generate some serious social and political pressures. Harrison Brown has estimated that it would take 60 years' output of all the mines and factories in the world to provide today's population with per capita minerals equivalent to those of the 10 most developed nations. Hence, providing the minerals needed for a growing population would be impossible; we could never catch up.

Insiduous economic pressures seem to prevent any effective management of resources in a manner that would provide for their utilization in perpetuity. Concrete and pavement surely are not the epitome of the human species' fulfillment. An ecological appreciation of resource management is needed, and ecological ethics must replace ecological atrocities.

Man is rapidly depleting the nonreplenishable resources. Half of the energy used by man during the past 2000 years was used in the last century. Man is reported to have mined more in the past 100 years than during all previous time. But, every barrel has a bottom; unbridled technology promises to speed us faster toward that bottom. Our planet's resources diminish faster as society's affluence is increased. Our qualitative sense of appreciation of our environment seems to be replaced by mere quantitative values. Why cannot civilization fulfill its obligation of being a competent steward of all resources?

The environmental crisis today is critical. Our water is becoming a cesspool, and the air a depository for poisons. We have acted as if pure air, pure water, and waste disposal were free. Pollution is largely an economic problem, resulting from technology having ignored the social costs. The affluent society has become an "effluent" society, with six percent of the world's population—the United States—producing 70 percent or more of the world's solid wastes.

The world is now suffering from water pollution, air pollution, oil pollution, thermal pollution, water-proofing of the land's surface, loss of phosphorus, DDT and other pesticide problems, mercury contami-

nation of water, careless throwaways, changes in vital gases in the atmosphere, organic overenrichment of water systems, industrial disease, noise pollution, increases in reflective surfaces such as cites, roadways, and oil slicks in the oceans, lead fallout, and increased exposure to radioactivity. Even today it remains impossible to predict all of the ecological side effects of many of man's activities.

Environmental pollution is, of course, related to population growth, but pollution *per se* is primarily the consequence of our style of technological "progress." Hence, pollution is greatest in the developed countries. In fact, even if the population stopped growing in developed countries, the amount of pollution would continue to increase as long as people want more goods, services, and increased amounts of energy, and continue to be unwilling to pay the technology needed to eliminate the pollution. A massive conservation equalization fund, or tax relief, is needed to enable willing industries to redirect their activities so as to cause less pollution.

Mankind must quickly learn how to obtain maximum recycling and reuse of resources, such as minerals, metals, papers, glass, plastics, and both industrial and domestic wastes. This will help our situation, even if it does not solve the problem. At national, state, and local levels we need environmental zoning based on sound, comprehensive, long-range land-use planning. This is to protect current land types—farms, wildernesses, estuaries, forests, and parks—from urban sprawl, highway encroachment, and industrial desecration.

There are many ways of using taxes to reduce pollution. Items which are nonreturnable or nonbiodegradable might be taxed excessively. Anything which produces adverse environmental effects, solid wastes, etc., could be taxed. But it is difficult not to avoid just shifting the problem when we attempt to cut down on environmental pollution. Too often, one undesirable practice is merely traded for another. No one knows how to control viruses in reclaimed water. There are diminishing returns as attempts are made to purify water further. These costs soon skyrocket, so costs on a per capita basis increase as population grows.

ENERGY DEMANDS

The total impact on the environment in terms of utilization of resources and energy has been estimated as being 20 times as great in the United States as in India, which has a population about 2-½ times that of ours. Thus, on a per capita basis, each of us uses about 50 times as much resources and energy on the average as does someone in India. According to the *United States Statistical Yearbook*, we

account for 37 percent of the energy utilized in the entire world, 27 percent of the petroleum products, 25 percent of the steel, 28 percent of the tin, 33 percent of the synthetic rubber, and so on.

Unfortunately, as our population grows, the per capita demand for nonrenewable resources and electric power also increases. This means that demands for energy grow at a faster rate than the population grows. In addition, because of our growing affluence, every day each of us thinks he needs even more in terms of goods, services, and energy.

As the supply of many kinds of food declines, the amount of energy required to produce the accustomed amounts increases. For example, as fish in the sea become scarcer, the energy required to procure the same tonnage increases. As the supply of such foods decreases, the costs of obtaining them increases.

There are no known technological solutions to an ever-growing population. Some savings might be made, however, if the price of energy and resources were steadily increased, for then there would be more recycling and less mining of new ores.

POPULAR SOLUTIONS AND MISCONCEPTIONS

Is it possible to feed the world's burgeoning population by farming the sea? Of course not. Already we see signs of hungry nations overexploiting these dwindling resources, and the hungrier they get, the greater will be their fishing effort. In addition to man's overfishing, he is polluting the seas so badly with raw sewage, pesticides, oil, and industrial wastes that it is no wonder some fish populations have declined.

The population problem is not underproduction and malnutrition, but uncontrolled fertility. Many people are misled into thinking there are easy solutions to the problems. The popular misconceptions—which I contend will not be able to solve our problems—include producing more food from oceans, developing irrigation, increasing desalinization of sea water, developing synthetic proteins and vitamins, producing food by hydroponics, developing more agricultural research in the tropics, applying more fertilizers, developing the vast unused lands, introducing land reforms and better government regulations, encouraging private enterprise, stimulating a migration of people or redistribution of populations, exploiting outer space, and developing more green revolutions. These may provide some additional food, but even a combination of all of them will not be a panacea, for they can never keep up with the rate at which the world's population is growing.

If we produce more food now without controlling the birth rate, we merely create a much greater problem later on. Science can now save a child's life more readily than it can assure that a child will be fed for life. However, since we are humanitarians, and hence compassionate, we will continue to strive to produce more food and to increase the life expectancy of every baby that is born, regardless of whether or not we are overpopulated. Unfortunately, each of us adds to the need for further meddling with the environment and making it less stable. The increase of monoculture in agriculture that occurs with population growth further weakens the stability of the environment. We should remember the tragedy of the Irish potato blight.

Another tragic case is the Aswan Dam, in Egypt. When it is completed, in 1973, it will have added about one-million irrigated acres to their economy. But the population will have grown by about 10 million and on a per capita basis there will be only about half as much farm land available as before the dam was started. Other problems are ecological classics—salt intrusion into the delta area, loss of the sardine fishery, a silting of the reservoir and the loss of this renewed fertility downstream, and dispersion of schistosome flukes throughout the canals, causing schistosomiasis to be widespread.

POPULATION CONTROL

I think the most effective means of stemming the population growth rate is going to come first as a result of public awareness. The public must become fully aware of the terrific problems, ecologically, economically, and socially, posed by a growing population that is polluting the environment. Once the public becomes informed, I believe a social stigma will then develop against large families or anyone who is damaging the environment. People will be embarrassed to have more than one or two children.

We need to extol the virtues of late marriages and single life, in contrast to the drudgery of early pairing and many children. There will be many social problems in bringing this about. Marriage partners will have to be better friends than now, because, without children, they will have much more time together. Future generations are not going to be able to enjoy the bonds of the family units known today, because family structures will be different.

There is a need for economic pressures on those who have multiple children, and rewards for those who have none, especially by changing taxes and welfare. But the children should not be the ones to suffer for any punitive action taken against irresponsible parents. People must develop much greater voluntary restraint in reproduction—or conception itself may someday come under government

control. Government control of the number of babies one can have is perhaps the only truly equitable means by which this can be accomplished.

Civilization can no longer endure a way of life in which people believe they have the right to have as many children as they can afford. This is hypocritical, for whose who can "afford" luxurious living are already utilizing many times their share of the limited food and other resources, and they also contribute much more pollution to the environment than do the have-nots. Affluent people must be made aware of overpopulation problems, for they often want more children per family than do the poor.

Nature has seen to it that all organisms are obsessed with a breeding urge and provided with the biological capacity to overproduce, thereby ensuring survival of the species. Since man now exercises considerable control over so many of the natural factors which once controlled his population, he must also learn to control his innate trait to reproduce excessively. If a surplus baby does not die at birth, it means that another child or person is going to be unable to live a full life—because of the resources consumed by the surplus baby. Good "human husbandry" implies that we regulate the population density before the natural self-limiting demographic and societal stress factors do it for us. But human motivation will always work against good human husbandry, because, with each individual who has living of good quality, two, three, or more children will seem desirable, and the world can no longer support this number of children.

The average American family has slightly more than three children today. If this were reduced to 2.5, there would still be over 300,000,000 people in the United States by the year 2000, nearly ⅓ more than the present population. If it were reduced to only 1.5 children per family, there would still be 57,000,000 more people by the end of this century. To stabilize the population in the United States, for example, the family size would have to be about 2.1 children on the long-time average. If that were done immediately, however, the population would still increase over the next seven years. To stabilize the population now, each family must have only about 1.2 children for the next couple of decades, then only 2.1 from then on to maintain a stable population with a zero growth rate. What is actually needed, however, is not a zero-population but a minus-population growth rate.

BIRTH CONTROL

One price that society must be willing to pay for sustained world peace is a stringent universal birth-control program. This will require

a revolution in modes of thought about our traditional human rights with regard to family planning. Parenthood must not remain a status achievement. Motherhood can no longer be the principal vocation of women. The increasing disparity between population density and food supply, by itself, justifies effective birth control regardless of the "morality" associated with depriving parents of the right to have as many planned children as they choose.

If babies of the future are to live in this world, there must be fewer of them now, and mankind must stop destroying the environment. A conscientious regulation of fertility is needed, or a calamitous rise in premature mortality rates is inevitable, especially in the developing countries.

Up to now, only death has been of public concern; procreation has remained an individual and highly cherished private matter. But this privilege cannot continue, and regulation of the number of conceptions, or at least births, may have to become a government function.

Most babies are the consequence of passion, not love. But children are loved. Since the greatest enhancement of sexual relations comes from control of conception, it is desirable that sex education in all schools shift the emphasis from procreation to understanding sexual satisfaction. Stop teaching procreativity! It is high time that society acknowledge every individual's right and responsibility to limit his or her reproduction, which means recognition of the significant difference between sexuality and reproduction.

Sexual pleasure must, of course, remain a basic human right, though it cannot include the having of children at will. While intercourse remains an individual and private matter, procreation must become a subject of public concern. Conception should not be a euphemism for sexual relations. It can no longer be a basic human right for a woman to have as many children as she wishes, and men must assume an equal responsibility for procreation and the welfare of children.

All restrictive legislation should be immediately repealed that hinders birth control or the obtaining of abortion and sterilization. Birth-control information, not procreation, should become the emphasis of the human sex-education curriculum of all school systems. Free and easy access to voluntary birth control, including sterilization, abortion, and other services related to sexual expression, should be available to all people regardless of age, sex, or marital or socio-economic status. In today's overpopulated world, these should be considered essential health services of all public and private health-care programs.

Induced abortion is probably both the most controversial form of birth control and the most common form of birth limitation in the world today. Most people do not realize that early abortions done in a hospital are much safer than a tonsillectomy; the new vacuum abortion technique requires but a few minutes and no hospitalization. The pill is much safer than pregnancy, but of course is not as safe as continence. There is no such thing as a 100 percent safe pill, and all future pills will be toxic to a degree—but pregnancy itself has been called a nine-month disease because of its dangers.

The pill is the most effective contraceptive today. Intrauterine devices (IUD) are quite effective with many women, but not all. About 1/5 of couples who use a diaphragm nevertheless have a pregnancy in any one year. Similarly, about a 20 percent failure occurs with those who rely on condoms. But it should be pointed out that all forms of contraception, even though not completely effective, still greatly reduce the need for abortions, the only resort remaining when contraception fails.

The *easiest* method of contraception, at least for the developed countries, is a vasectomy of the male, and this minor incision of the sperm ducts in no way interferes with normal sexual intercourse. Likewise, ligation of the oviducts has no effect on hormones and the menstrual cycle of women.

RELIGION

Are war, famine, disease, inflation, and other types of suffering, God's will? Of course not, and, similarly, it is not God's will to bring surplus children into this world to further magnify these forms of human suffering.

Having too many children can no longer be dismissed as an act of God, for it is now truly the consequence of a complacent society that is unwilling to take any of many steps available for preventing surplus births. Our primitive reproductive instincts cannot be condoned in the face of modern survival rates. The two are no longer in balance.

CONCLUSION

No longer can we consider procreation an individual and private matter. Intercourse, yes, but not unregulated numbers of conceptions, since they affect the welfare of all other individuals living at the time, plus those to be born in the future.

It needs to be said over and over again that the bringing of surplus children into this world, whether from personal desire or from

religious edicts, destines not only some of these children but many others to a premature death. Overproduction actually lowers the maximum density that can be sustained for normal life spans, thereby increasing the number of souls in need of salvation.

Technology and science can and do progress at an ever-increasing rate, but can social, political, and religious views change rapidly enough to cope with this "progress"? The fruits of all our scientific and technological advances will be ephemeral if the world's population continues to explode. Our intelligence is so powerful that it may destroy us because we lack the wisdom and insight to recognize and correct what we are doing to ourselves and, especially, to future generations. We are passing on an enormous population-environmental problem to the next generation.

Nature practices survival of the fittest, but man believes that all who are born should be given every opportunity to live to an old age. If this is to be our objective, and I am sure it will be, then we have only one other alternative: restrict the number of births. Before surplus individuals die, they consume resources and contribute in general to other population stresses, all of which make the environment less suitable, thus lowering its carrying capacity. Man needs space to live, just as do plants and animals. Overpopulation inevitably commits too many people to poverty and despair. A soaring population means a shrinking of man's space on this earth.

As the population density increases, per capita demands on the environment also increase. What is needed is a bold and comprehensive environmental land-use plan to help maintain environmental quality. At present, less than 2 percent of the federal budget is spent on all its environmental programs. One difficulty also is that theoretical solutions to population-environmental problems are often just not workable with existing forms of government and current philosophies. Further, there are no real long-term advantages in solving technological environmental insults if we fail to correct the underlying cause—overpopulation.

The potential carrying capacity of this earth for people is steadily being reduced through man's overexploitation of the soil and nonrenewable resources. This steady reduction of the maximum human population which the earth can support will continue for a long, long time, and possible indefinitely, no matter what science or technology may come up with in the future. To make matters worse, every day each of us wants more in terms of affluence, *i.e.*, goods, services, and energy to run our machines, which further pollute the environment and further reduce the carrying capacity of our spaceship, earth.

Therefore, what is actually needed is not a zero population growth, but a minus population growth (perhaps for centuries), before people in the developing countries of the world can ever expect to have a better life than the substandard levels existing today.

DISCUSSION

DR. GULLION: This problem that Dr. Howard has addressed himself to is a most important problem in the wildlife field; and I think we are a most appropriate group to listen to it, because we have been dealing with population problems. Listening to Dr. Howard reminds me of discussions I have heard at various times at sportsmen's groups when we were trying to convince them that we needed an either-sex hunt in a deer population that was overbrowsing its range. I think all of us in the wildlife profession have long recognized the importance of carrying capacity. We have perhaps failed to recognize that man is also governed by carrying capacities, just as much as many of our other species.

I hope we have some discussion from someone in the audience. This whole matter of population control, of course, is most important to our habitat management efforts in the wildlife field. If we continue to be crowded by increasing populations of people, then we are certainly going to have to give way with our wildlife habitat.

DR. DAVID HATTER (University of British Columbia). I would like to say at the outset that I'm in complete agreement with everything that Dr. Howard has said, and I too am a proponent of zero population growth or less. I am a member of the organization Zero Population Growth. But I am bothered by one aspect, and that is that when I look around among my friends who have really endorsed the idea, and who said, "I'm not going to have any kids or I'm going to have one, or at the optimum, I'm going to have two," I find that many are people who I really wish would have more. Their kids would really be wilderness lovers. They would be out watching the birds and preserving some of the other values that we hold dear.

And believing in natural selection as I do, I can only see a reduction in the long run of the kind of people that I would like to see more of in the population. I wonder if we couldn't better serve our ends by all reproducing at a mad rate, one every 9 months, for the first 50 years or so, and saturate the population with wilderness people and teach others not to have young ones? (Laughter)

DR. HOWARD: I'd like to react to that in several different ways. If the world has problems, if the environment has been damaged, if there are other things that we object to, the fact that the population has been able to grow so fast, whom do we point the finger at? We point the finger at the IQ, at science and technology; the advanced people in the world, the scholars and the rest are the ones who made the mess of the world, not the primitive people, not the under-developed countries, not the others. So it's a matter of where you want to put the responsibility.

In terms of our own country, we often hear that the minority groups—the unfortunate people in ghettos and the lower social economic group are having too many children. They're the ones having large families that should not be. They do need family planning. Most of them are having more children than they would like to have. There's no question about it. But in terms of our population growth in the United States, it comes from people like myself, the middle-class American, that wants 3 to 5 children. And I apologize—I had 3 and would have had more if I could have afforded it.

We so outnumber the minority groups that we're the major ones contributing the population. In terms of genetic change, there is insufficient time. At the present, the world is going through tremendous hybrid vigor because of the great mixing of all of the races that are occurring.

LOIS BOYCE: (British Columbia Environmental Council): We must be all the dubious ones up above the border.

In this matter of population control, it would seem that the enlightened

countries and the more advanced, developed countries, are the ones more receptive to this idea and more readily practice it. Now, to my understanding, Japan is doing quite the opposite and there are taboos and different obstacles to this in some of the underdeveloped countries. It would seem to me that this could be an invitation to revolution. They are bulging at the seams. This seems to be an invitation for takeover.

DR. HOWARD: I agree with you. I think there are great problems along this line. From a personal point of view, I don't really think we need to worry too much at the moment about many of the developing countries of the world. They're going to continue to overpopulate and they are going to continue to die at an early rate. The individuals who live in ghetto conditions in the United States have a higher standard of living in every yardstick you can use except the emotional one, than considerably more than half of the people of the world.

Our problem is that we're utilizing the resources so fast in this country, that unless we set examples for the rest of the world, we can't expect them to follow us. So the greatest abuse to the environment, from my yardstick, is occurring in California today, the greatest damage the world has ever seen, because of the disgusting affluency in suburbia—the amount of land we take for each new individual, the number of roads and freeways that each person requires. So, until we get our own house in order, I don't think we can ask other countries to respond very directly. However, as we attempt to bring our own house in order through public awareness—and once we are aware of the problem, we will want to do something, and we then will vote for laws, taxes, changes and things that will affect us. We won't voluntarily do it, but we'll vote for people who will force us all across the board to do it.

So I think that we do need to get our own house in order first, and that our government is moving at an unexpected rate in this direction; but of course, not fast enough.

DR. JAMES G. TEER (Texas A&M University): I don't want this to sound like a quarrel with your last point, Dr. Howard, but I think that to get our house in order before some of the events that can happen in the under-developed countries of the world, may come too late I don't want to bore you with one liners or other statistics, but the President of the National Academy of Science in India says that inexorably, 20 million people are added every year to that population of over 500 million; and he tells us that we will see the stench of that population overflow the western world, despite anything that we do here. This may be a dire prediction, but I think we should be very much aware of it. Not only Asia, but other parts of the world as well.

DR. HOWARD: Yes. I agree that we are going to see tremendous suffering. If you plot it for two or three year gaps, the trend is all up now.

On that resource point, I would like to follow up with a couple of figures. We're only about 6% of the world's population. The United States is using about 20 times as much energy as India is using. Put on a per capita basis, one of us is taking about what 50 Indians are taking in terms of energy and resources. With 6% of the world's population, as of last year, we were using 37% of the world energy; 27% of the petroleum that was used in the world; 25% of all the steel; 28% of the tin; and 33% of the synthetic rubber—I could go on.

I failed to answer one question the lady asked about types of control that will occur. I predict that there will be a tremendous increase in the rates of abortions. I believe in a very few years, looking at the crystal ball, in the developed countries, you will find contraceptives free and abortions free. Abortions will be used as a back-up for the contraceptive methods. There's no pure contraceptive. There will never be a safe contraceptive, because there is nothing that everybody can drink or eat and take that won't affect some pople. Milk is toxic to some.

So I think this new vacuum abortion technique, which if done early enough is a very effective means for backing up unsuccessful contraception. If religions don't permit it, then be more careful and sleep in twin beds.

MR. ORIN GELDERLOOS (University of Michigan): I would ask Dr. Howard if

he's run across these situations or similar ones. Currently, the birth rate in the United States is on the decline. The fertility rate in the United States is also on the decline. Based on this, many people claim that there is no population problem. In your classes and in discussions how do you answer this? How do you work on this problem?

DR. HOWARD: Thank you for bringing that up. I think that's a good one. The birth rate is going down, but the family size is staying the same. There has been very little change. If you count the number of women who are in the peak reproductive age. 20 to 29, in 1969; and then count the number of women that will be in that age in 1980, in the United States—you see, they're already born, so it's a real easy statistic to count—you will find that in 1980, there will be an increase of 83% of women in that peak reproductive period. This depends on the age classes, so now, we're going back in where the birth rate is going to be picking up through the 70's, and all of the forecasts will support that contention.

Thank you very much.

CHAIRMAN CHAMBERS: We've all felt the effects of human population expansion and explosion. We also have a greater need to relax, to get away from things; and outdoor recreation, particularly hunting and fishing, offer a marvelous way in which we can do it. The sad thing is that the human population explosion has not been accompanied by a similar explosion in wildlife numbers, in most cases.

The hunter and fisherman today is finding it more and more difficult to find that quiet place and to enjoy his sport, as he would really like to. This kind of competition generally does not add positive social values to the outdoor experience; on the contrary, it often brings out greed, selfishness and unsocial behavior.

So resource managers have long faced the problem of distributing the benefits of wildlife among people in a very democratic way; and doing it without endangering the welfare of the species. This is the very basis for the regulatory process whereby seasons and bag limits and the like are set. As humans become more abundant and wildlife in their habitats become less so, more stringent controls are going to be necessary, and our next speaker is going to describe a kind of problem that wildlife managers and administrators will have to face more and more often in the future.

The solution he is going to talk about was drastic and expensive, but it was also effective.

THE CANADA GOOSE TAGGING PROGRAM IN WISCONSIN

GEORGE K. BRAKHAGE

Bureau of Sport Fisheries and Wildlife, Twin Cities, Minnesota;

HENRY M. REEVES

Migratory Bird Populations Station, Laurel, Maryland; and

RICHARD A. HUNT

Department of Natural Resources, Horicon, Wisconsin

INTRODUCTION

Wildlife managers have found that special permits and tags offer a practical means of controlling and evaluating the harvest of game. The number of permits issued can be limited if excessive kill is anticipated, and tags may be used to help enforce bag limits and, in some cases, to distribute hunting pressure. Post-hunting season re-

ports from permittees provide facts about hunting pressure, size and distribution of the harvest, crippling losses and other details of the hunt.

Special permits are most often associated with hunting of big game or trophy species. However, waterfowl managers in Montana, Utah, Wyoming and elsewhere have used permits and tags to limit the seasonal number of geese shot by individual hunters, and in Montana, Nevada and Utah to control the total harvest of whistling swans, *Olor columbianus*. This report describes a permit and tagging program used in Wisconsin to control the harvest of Canada geese, *Branta canadensis*.

An acute harvest management problem developed near Horicon National Wildlife Refuge, Mayville, Wisconsin, when large numbers of Canada geese were attracted to the 21,000-acre sanctuary. Peak numbers have approached or exceeded 100,000 birds annually since 1961. More than 1.5 million persons live within 75 miles of the refuge, thus hunting pressure was very heavy. The planned rate of increase for the population of geese migrating through Wisconsin was interrupted when the total kill became excessive. Much of that kill occurred in Wisconsin.

The history of Canada goose hunting and management in Wisconsin prior to 1967 was described in detail by Hunt, Bell and Jahn (1962) and by Reeves, Dill and Hawkins (1967). The later authors reviewed the development of the Mississippi Valley Population (MVP) of Canada geese, and the background behind the establishment of harvest quotas in 1960. Two points in their paper are worth repeating briefly here. First, most Canada geese found in Wisconsin are members of the Mississippi Valley Population. The movements of these birds are predictable, and this predictability gives managers an excellent opportunity to influence the population's destiny. Secondly, managers tried a number of schemes in the Horicon area to monitor and control the harvest. These included creation of a special harvest zone, a mandatory registration system to monitor the harvest, efforts to slow the rate of kill by feeding shelled corn on the refuge, and, later, efforts to disperse the birds by early-season openings and by intensive hazing on the refuge. Techniques used in an effort to improve the quality of the hunting experience included shooting on alternate days, blind spacing, and reduced shooting hours.

These management programs were not effective in achieving their objectives. The 1966 Canada goose season in the Horicon Zone lasted two and one-half days and the harvest was more than twice the 14,000 bird quota. An almost "carnival-like" atmosphere prevailed as eager

hunters filled the blinds and crowded roads and parking areas. The quality of the hunting experience was considerably below that provided in the past. There was a compelling need for a better way to manage the harvest in the interests of both the resource and the people who enjoy its benefits.

Jahn (1953) was the first to suggest the use of tags in Wisconsin to limit the bag of individual goose hunters. His purpose was to improve the distribution of the harvest among hunters, discourage land leasing for goose hunting, and possibly to eliminate the need for expensive public hunting areas. He did not propose the use of tags to limit the total number of geese taken.

THE 1967 TAGGING PLAN

After the disastrous 1966 season, the Wisconsin Conservation Department (now the Department of Natural Resources) developed a new harvest management plan for 1967. It featured the use of special permits and tags on a statewide basis. To quote Reeves *et al.* (1967), "Although having much merit, the plan met with considerable opposition from landowners near Horicon and enabling legislation was not passed. Since the tagging system could not be implemented under State auspices, the Bureau of Sport Fisheries and Wildlife, acting for the Federal government, executed the Wisconsin plan with slight modifications through a private electronic data processing firm."

It should be emphasized that the tagging program in Wisconsin was conceived by personnel of the Wisconsin Department of Natural Resources. Full credit is due them for developing the original plan. The Bureau was called upon to implement the program only after the State was unsuccessful in its efforts to gain needed support from the legislature. We wish also to emphasize that tagging was considered only after all previous efforts to manage the harvest had failed.

The objectives of the tagging plan were to control the harvest to insure compliance with harvest quotas, distribute hunting opportunity widely among people, extend the season to allow people a reasonable chance to hunt and also to help prevent depredation and encourage southerly migration, and to improve the quality of the hunting experience by allowing leisurely, uncrowded participation.

To achieve these objectives, the plan included the following major points:

1. Canada geese could be hunted only by persons having special free permits and tags. Permits and tags were issued to individuals for either the Horicon Zone or the remainder of the State.

2. A new Horicon Zone was created. (See Figure 1.) It measured about 30 miles wide by 70 miles long, and consisted of the degree latitude-longitude block centered on Horicon Marsh, but modified slightly to highway boundaries. The Wisconsin harvest quota, set by the Bureau with the assistance of the Mississippi Flyway Council, was divided between this Zone and the remainder of the State.
3. Persons who wished to hunt together in the Horicon Zone could

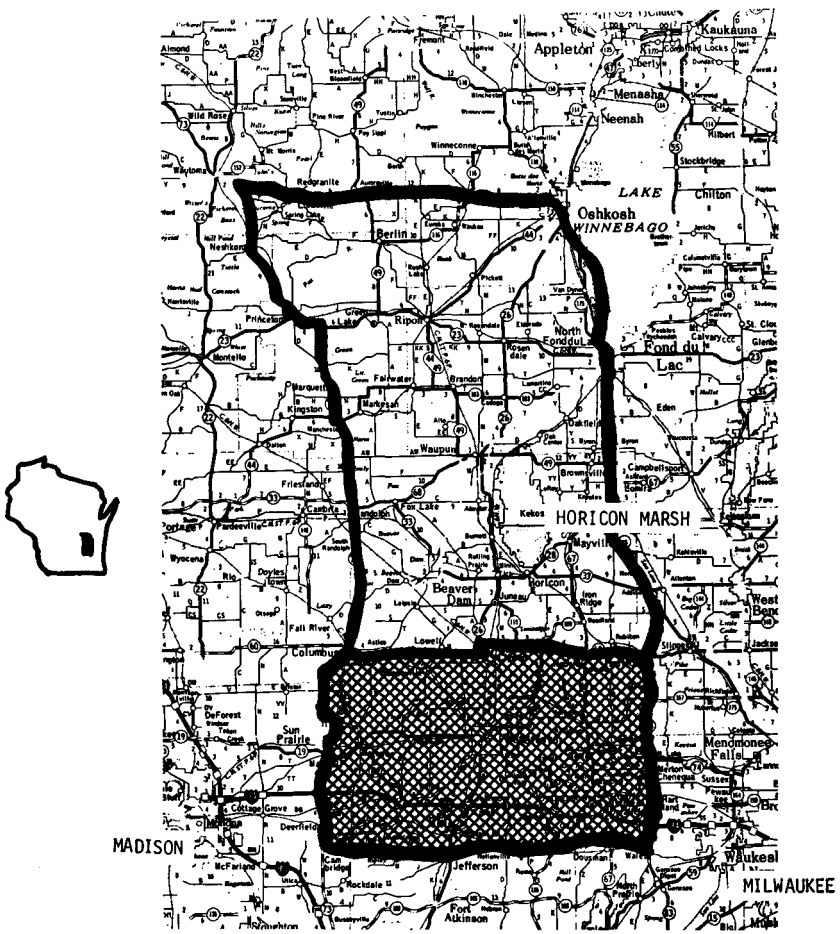


Figure 1.—The Horicon Zone in Wisconsin as defined in 1967 and modified in 1968 by removal of the cross-hatched portion.

apply as a party, with the selection process being the same as for individual applications.

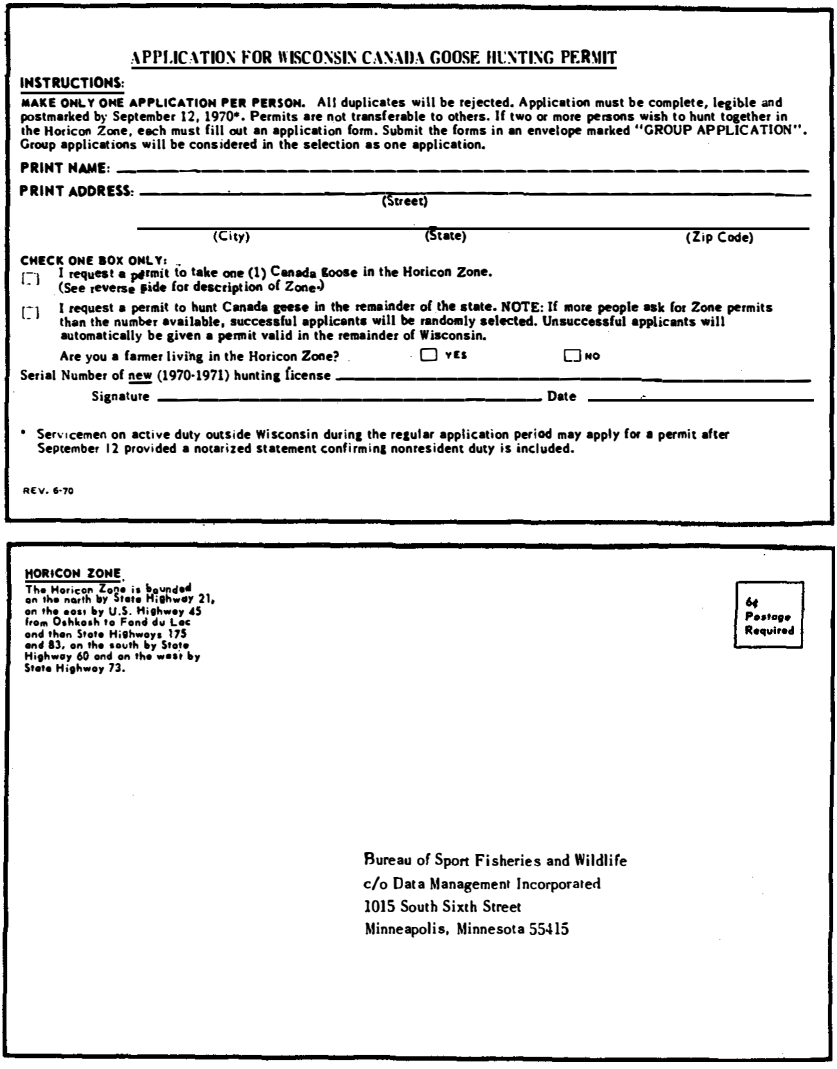
4. Successful applicants for Horicon Zone permits were randomly selected, and each was issued a permit and tag valid during one of several hunting periods. Unsuccessful Zone applicants were issued permits valid outside the Zone.
5. Persons killing a Canada goose were required to immediately tag the bird before transporting it in any way.
6. A post-hunt report on tag use or non-use was required.
7. The tagging system was authorized by both Federal and State regulations.

IMPLEMENTING THE 1967 TAGGING PLAN

One of the first and most important steps in implementing the tagging plan was to retain the services of a commercial automatic data processing company. Data Management Incorporated (DMI) of Minneapolis, Minnesota, was contracted to provide these services. The overall plan was discussed in detail with systems analysts and programmers, and performance standards and data needs were identified. DMI provide all the material and services associated with the project including preparation of a computer program and subcontracting paper supplies including application forms, special envelopes and tags.

It should be recognized that only by the advent of EDP support could such a massive permit and tagging system be implemented. The programmed computer received and stored large quantities of data, and accurately and rapidly processed and produced information. High-speed equipment associated with the computer printed specialized envelopes and cards with names and addresses of participants together with other useful information. In terms of complexity and magnitude, the Wisconsin program ranks first in EDP attempts to control the harvest of migratory game birds, and possibly first to control through automation the harvest of any game species on a statewide basis.

Application forms for permits were distributed to county clerks in numbers related to previous "duck stamp" sales, and to field offices of the Department of Natural Resources. Together these proved to be an effective way for making the forms generally available. The application form was printed on letter-size paper during the first two years of the program, but later on preaddressed cards to avoid the letter-opening task (See Figure 2). Hunters mailed their application forms directly to DMI.



APPLICATION FOR WISCONSIN CANADA GOOSE HUNTING PERMIT

INSTRUCTIONS:

MAKE ONLY ONE APPLICATION PER PERSON. All duplicates will be rejected. Application must be complete, legible and postmarked by September 12, 1970*. Permits are not transferable to others. If two or more persons wish to hunt together in the Horicon Zone, each must fill out an application form. Submit the forms in an envelope marked "GROUP APPLICATION". Group applications will be considered in the selection as one application.

PRINT NAME: _____

PRINT ADDRESS: _____ (Street)

_____ (City) (State) (Zip Code)

CHECK ONE BOX ONLY:

[ ] I request a permit to take one (1) Canada goose in the Horicon Zone. (See reverse side for description of Zone.)

[ ] I request a permit to hunt Canada geese in the remainder of the state. NOTE: If more people ask for Zone permits than the number available, successful applicants will be randomly selected. Unsuccessful applicants will automatically be given a permit valid in the remainder of Wisconsin.

Are you a farmer living in the Horicon Zone? ☐ YES ☐ NO

Serial Number of new (1970-1971) hunting license _____

Signature _____ Date _____

* Servicemen on active duty outside Wisconsin during the regular application period may apply for a permit after September 12 provided a notarized statement confirming nonresident duty is included.

REV. 6-70

HORICON ZONE

The Horicon Zone is bounded on the north by State Highway 21, on the east by U.S. Highway 45 from Oshkosh to Fond du Lac and then State Highways 175 and 83, on the south by State Highway 60 and on the west by State Highway 73.

6¢ Postage Required

Bureau of Sport Fisheries and Wildlife
c/o Data Management Incorporated
1015 South Sixth Street
Minneapolis, Minnesota 55415

Figure 2.—Application card for Wisconsin Canada goose hunting permit.

Applications were accepted for a two-week period about one month before the season opened. Late applications, except from certain military personnel, were rejected together with those that were illegible, incomplete or duplicate. Application data for the four years of this program are presented in Table 1.

TABLE 1. WISCONSIN CANADA GOOSE HUNTING PERMIT APPLICATION DATA, 1967–1970

	1967	1968	1969	1970
Acceptable applications	44,348[1]	51,076	74,187	94,358
Horicon Zone applications	20,984[1]	24,479	29,393	34,737

[1] Does not include Period 7.

Each applicant's name was coded and recorded on magnetic tape together with his address, hunting license number and permit preference. Inasmuch as the number of applications for Horicon Zone permits always exceeded the supply, successful applicants were selected on a random basis.

The 1967 Wisconsin harvest quota of Canada geese was 20,000 birds. Prior to 1967, it was estimated from band recoveries and goose tail fans submitted by cooperating hunters that about 5,000 geese would be taken outside the Horicon Zone.[1] On this basis, 15,000 birds were allotted to the Horicon Zone and 5,000 to the remainder of the State. To achieve the Horicon Zone harvest objective, 16,500 Horicon Zone permits and tags were issued. The 10 percent over-issuance was made to allow for non-participation or unsuccessful hunts.

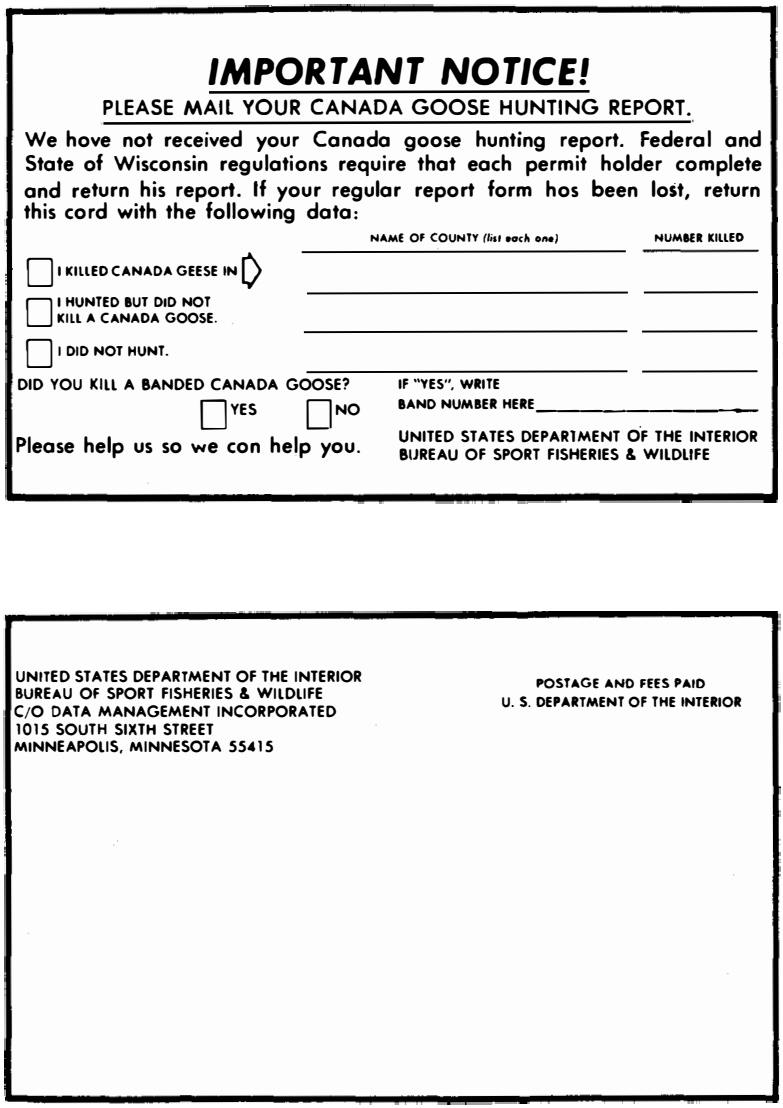
An unrestricted number of permits was issued outside the Horicon Zone. In 1967, each permit included two tags. Although a large number of permits was issued, the harvest outside the Zone was not expected to exceed 5,000 birds because hunting there was largely opportunistic.

A 37-day season was set for the Horicon Zone. It was divided into six hunting periods to distribute hunting pressure. Ten percent of the permits were made available during the first hunting period which consisted of the opening weekend. Periods 2 through 6 were each seven days long and 18 percent of the total number of permits were validated for each.

The tags were made of heavy paper and were just large enough to encircle a goose's "leg" (metatarsus). The tag was sealed by joining a metal grommet closure device. Once snapped, the grommet closure supposedly could be opened only by destroying the paper tag.

A report form was attached to each permit. After killing a goose, the successful hunter was required to submit the report form by mail within twelve hours. Unsuccessful hunters were required to submit their reports and unused tags within twelve hours after the close of the period or season for which their permit was valid. The Horicon Zone hunting periods ended on Sunday evenings. Reports were expected to reach DMI in Minneapolis by the following Wednesday

[1]The Bureau of Sport Fisheries and Wildlife asks selected hunters to provide tail feathers from geese they have shot to learn certain facts about the harvest.



IMPORTANT NOTICE!

PLEASE MAIL YOUR CANADA GOOSE HUNTING REPORT.

We hove not received your Canada goose hunting report. Federal and State of Wisconsin regulations require that each permit holder complete and return his report. If your regular report form hos been lost, return this cord with the following data:

	NAME OF COUNTY (list each one)	NUMBER KILLED
☐ I KILLED CANADA GEESE IN ▷		
☐ I HUNTED BUT DID NOT KILL A CANADA GOOSE.		
☐ I DID NOT HUNT.		

DID YOU KILL A BANDED CANADA GOOSE? ☐ YES ☐ NO

IF "YES", WRITE BAND NUMBER HERE _____

Please help us so we con help you.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF SPORT FISHERIES & WILDLIFE

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF SPORT FISHERIES & WILDLIFE
C/O DATA MANAGEMENT INCORPORATED
1015 SOUTH SIXTH STREET
MINNEAPOLIS, MINNESOTA 55415

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF THE INTERIOR

Figure 3.—Postcard notice sent to persons who were delinquent in submitting their post-season report.

evening. Persons whose reports failed to arrive by this date were mailed notices on Thursday morning advising that their report was overdue (See Figure 3).

RESULTS OF THE 1967 TAGGING PROGRAM

The most obvious result of the tagging system was a gross reduction in hunting pressure within the Zone. The carnival atmosphere was completely absent and experienced observers of the Horicon scene were favorably impressed with the return to a sane season opening. Competition for a place to hunt was virtually non-existent.

A number of flaws were found in the initial operation of the tagging system. It was learned, following the first rain, that the paper tags were not waterproof. A second flaw was that the grommet closure could easily be altered to allow re-use of the tag.

As the season progressed and kill data accumulated, a third flaw was revealed. The rate of kill was much less than anticipated. The ten percent allowance for non-participating or unsuccessful hunters proved to be too conservative. By the end of the fourth hunting period, it appeared that the 15,000 birds allotted for the Horicon Zone would not be killed. Consequently, an additional hunting period in the Horicon Zone was allowed by the Bureau. Period 7 was set for three weeks with 7,500 new permits authorized. The Bureau supplied permits and tags while the State administered their distribution. Although it was conceived and executed in great haste, Period 7 progressed smoothly, demonstrating that a cooperatively administered State-Federal tagging system could be both flexible and practical.

DISCUSSION, 1967 PROGRAM

Harvest

A summary of the 1967 kill data is presented in Table 2. Several reasons were advanced for the low rate of hunter success in the Horicon Zone. Field observations indicated that success was quite high; one commercial goose hunting club reported that 98 percent of their 1,086 customers killed a goose. The recorded success rate was low because many persons with permits simply did not hunt.

Tag reports provided useful data on the distribution by county of the Canada goose harvest in Wisconsin (See Figure 4). The predicted 75:25 division of kill between the Horicon Zone and the remainder of the State proved accurate. Report form data indicated that the actual apportionment was 74:26. These data were further supported by tail

TABLE 2. SUMMARY OF WISCONSIN CANADA GOOSE HARVEST DATA, 1967

	Hunting Periods in the Horicon Zone									
	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7		Remainder of State	
	Oct. 14–15	Oct. 16–22	Oct. 23–29	Oct. 30–Nov. 5	Nov. 6–12	Nov. 13–19	Nov. 20–Dec. 10	Zone Total	Oct. 7–Dec. 15	Grand Total
Valid tags	1,622	2,938	2,935	2,948	2,944	2,879	7,430	23,696	53,268[1]	76,964
Reported kill	1,091	1,905	1,870	1,847	1,677	1,035	2,234	11,659	4,180	15,839
Reported no kill	489	941	975	992	1,124	1,665	3,754	9,940	42,235	52,175
Non-respondents	42	92	90	109	143	179	1,442	2,097	6,853[2]	8,950[3]
Compliance rate	97%	97%	97%	96%	95%	94%	81%	91%	88%	89%

[1] Two tags were issued with each permit to 26,634 persons.
[2] Represents 4,010 persons who failed to report one or both their tags.
[3] Represents 6,107 persons.

fan submissions which indicated that 71 percent of the kill occurred in the Zone.

Hunter Acceptance

Compliance with the reporting requirement was quite high. The reminder notices, sent promptly to non-respondents, together with State and Federal regulatory support, were believed responsible for the high degree of compliance. Timely news releases also stimulated the return of the report forms.

Nearly all unsuccessful hunters returned their unused tags. This

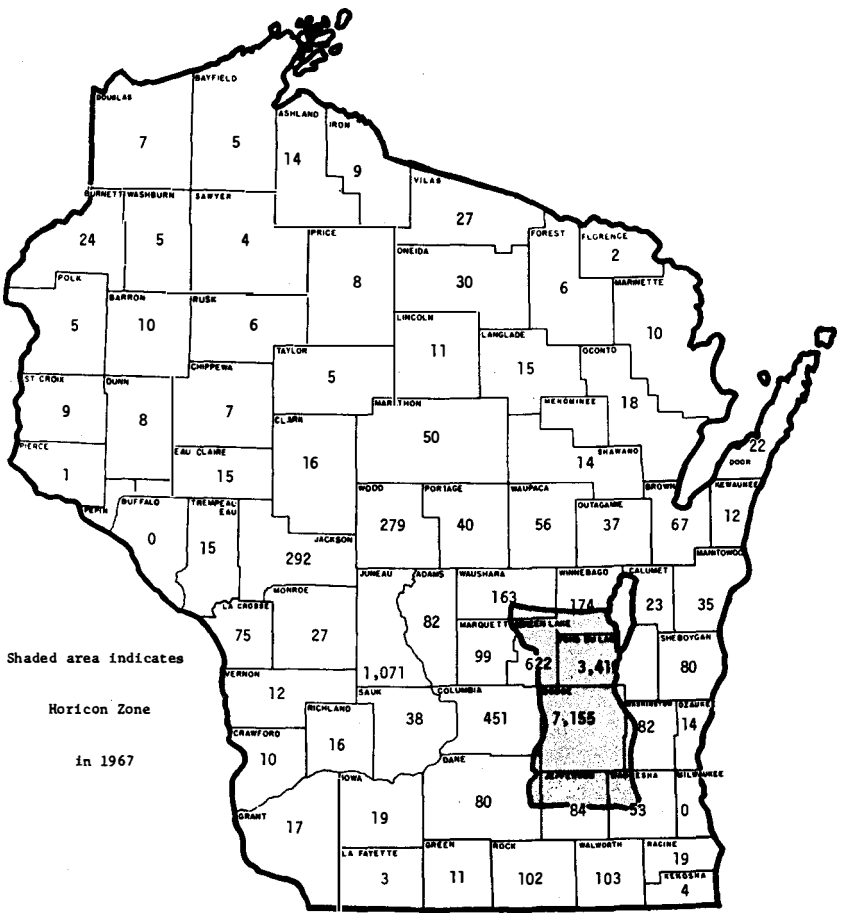


Figure 4.—Distribution of the 1967 Canada goose kill in Wisconsin.

response, coupled with the high rate of reporting compliance, clearly suggested that most Wisconsin hunters supported the tagging program.

Support, however, was not universal. Goose depredation occurred near Horicon in the fall of 1967, and some persons blamed the tag system for a problem created by late-maturing corn, unusual fall rains and a delayed harvest. They charged that crop depredation was a direct result of the low level of hunting pressure, but ignored the fact that no depredations occurred in 1966 following the close of the Horicon Zone after but two and one-half days of hunting. Presumably much of the criticism of the tagging program came from persons who formerly killed large numbers of geese each season or who suffered economic loss because of the "one man, one goose" regulation.

Enforcement

A major enforcement effort was organized to implement the new tagging system. Forty-two Federal Game Management Agents and 20 Federal Division of Wildlife Refuges personnel were assigned to Horicon at various times for tours of duty averaging almost three weeks. A total of 1,462 man-days of effort by Federal employees was expended on goose management in the Horicon Zone in 1967 with the bulk being for law enforcement. In addition, 18 Wisconsin wardens supported the enforcement program in the Horicon Zone. Federal and State officers apprehended 229 persons in 1967 for violating regulations directly related to the new tagging system.

The 1967 enforcement effort in the Horicon Zone may be summarized by stating that a substantial effort was made to impress Wisconsin goose hunters with the wisdom of compliance with the new regulations.

Costs of Tagging Program

The contractual cost of the 1967 program was $26,500. This cost was divided as follows: programming and systems design, 27 percent; computer time, 18 percent; keypunch and clerical time, 31 percent; and supplies and services, 24 percent. The cost was relatively high because the procedures were new and the needs unknown. The Bureau's franking privileges were used on all correspondence. Direct costs amounted to 51 cents per participant.

THE 1968 PROGRAM

The program was revised in 1968 in light of the previous year's experience. Major changes were:

1. The State prepared and distributed application forms.

2. The size of the Horicon Zone was reduced 30 percent by removing a low-harvest area.
3. The 1968 Wisconsin quota was again 20,000 birds with 75 percent allotted to the adjusted Horicon Zone. The over-run of permits in the Zone was increased to 20 percent.
4. The number of tags for each person hunting outside the Horicon Zone was increased from two to four.
5. The season in the Horicon Zone was reduced to 23 days to avoid conflicts with resident game seasons, improve depredation control benefits, and to reduce program costs. There was little reason to have a longer season when an individual could kill but one goose annually.
6. The 23-day season was divided into three overlapping nine-day hunting periods, each starting on a Saturday and ending on a Sunday.
7. A new tag was devised as part of an integral unit, including the permit and report card. The tag was backed with a pressure sensitive adhesive protected by a peel-off liner. After the tag was removed from the permit and report, it was applied by joining the adhesive surfaces around a goose's "leg." Tags were designed to be self-destructing if an effort was made to separate the adhesive surfaces.
8. Permits, tags and reports were printed on 36-pound wet-strength paper stock.

RESULTS OF THE 1968 PROGRAM

General

Although 6,000 tags were valid opening day, hunting pressure was very light in the Horicon Zone; conditions compared closely with those observed in 1967. Hunters approved of the nine-day hunting periods.

The permit system received little criticism from goose hunters. Their support of the program was again indicated by the very high reporting rate. Ninety-seven percent of Horicon Zone hunters filed their reports either voluntarily or after receiving post card reminders. Hunters approved of tags because it gave them access to good hunting in the Horicon Zone at reasonable cost.

Some new problems emerged in 1968. Although constructed of wet-strength paper, the tags still were not sufficiently durable. The directions for using the tag were folded inside the permit. As a result, many hunters did not study the instructions prior to the time for use.

Some observers felt that the instructions were too complicated and lengthy.

When properly used, the pressure sensitive adhesive was satisfactory for securing a tag to a goose. The adhesive could, however, be treated with talcum or oil, making tag re-use possible.

Harvest Data

Harvest in the Zone was 12 percent below the 15,000 Canada goose goal (See Table 3). Nine percent of the tag holders did not hunt, and

TABLE 3. SUMMARY OF WISCONSIN CANADA GOOSE HARVEST DATA, 1968

	Hunting Periods in Horicon Zone					
	Period 1	Period 2	Period 3	HORICON ZONE TOTAL	Remainder of State Oct. 5–Dec. 13	GRAND TOTAL
	Oct. 12–20	Oct. 19–27	Oct. 26–Nov. 3			
Valid tags	5,999	6,003	6,004	18,006	132,320[1]	150,326[2]
Reported kill	4,366	4,458	4,372	13,196	9,012	22,208
Reported no kill	813	804	842	2,459	93,258	97,454
Reported no hunt	609	541	587	1,737		
Non-respondents	211	200	203	614	30,050	30,664
Compliance rate	97%	97%	97%	97%	77%	80%

[1] Four permits were issued to 33,080 persons.
[2] Represents 51,086 persons.

almost 14 percent reported that they hunted unsuccessfully. Again, success in the Zone should have been very high. A commercial goose hunting club hosted 1,760 persons, and 98.6 percent were successful in taking a bird.

The distribution of harvest in Wisconsin changed significantly. The expected 75:25 division of kill between the Zone and the rest of the state shifted to almost 60:40 in 1968. Wider distribution of hunting opportunity was considered desirable because it improved hunting quality.

The 5,000 bird allowance for harvest outside the Zone was exceeded by 4,000 birds. A small part of this kill was a direct result of persons taking third or fourth birds (See Table 4). The fall goose migration

TABLE 4. NUMBERS OF CANADA GEESE KILLED PER PERSON HUNTING OUTSIDE THE HORICON ZONE WITH A FOUR-BIRD SEASON LIMIT, 1968

Season kill	Number of persons	Total kill
1 goose	4,010	4,010
2 geese	1,403	2,806
3 geese	416	1,248
4 geese	237	948
	6,066	9,012

through Wisconsin in 1968 was prolonged because of unseasonably mild weather and the kill occurred over a longer interval.

Enforcement

The intensive law enforcement program of 1967 was reduced in 1968. Twenty-three Federal Game Management Agents were assigned to Horicon Zone duty during the 23-day season. They were augmented by 14 full-time State officers. A total of 189 cases was made against persons violating tagging or closely related regulations. The lack of a completely fool-proof tag continued to be a major enforcement problem.

Costs of Tagging Program

Contracted services and supplies for the 1968 Wisconsin tagging program totaled $24,268, or 47 cents per participant. The small decrease in cost per person reflected reduced programming and operating costs and the increased number of participants.

THE 1969 PROGRAM

The program was modified in 1969, again in response to identified problems and to improve efficiency. The substantive changes were:

1. The State quota was increased to 25,000 birds in recognition of the numerical increase of the MVP of Canada geese.
2. Allocation of the quota outside the Zone was increased to 8,000 birds in response to the increased harvest recorded there in 1968.
3. The tag over-issuance in the Zone was increased to 23.5 percent.
4. Permits were required but tags were eliminated outside the Zone. Hunters were no longer restricted to a season bag limit.
5. Two overlapping hunting periods were set, each being fourteen days in length. Period 1 opened on a Saturday and Period 2 opened the following Monday. The intent was to avoid crowding on opening and closing weekends and to reduce field operating costs by shortening the season.
6. The basic design of the permit, tag and report was not changed, but heavier paper stock (100 pound wet-strength) was used. Language of the instructions was simplified and an illustration was provided showing how to apply the tag.

RESULTS OF THE 1969 PROGRAM

Although the Horicon Zone season was shortened seven days and the number of tags was increased almost 17 percent, hunting pressure was still considered light.

Durability of the heavier paper tags was satisfactory, and the simplified and illustrated instructions reduced confusion in using the tag. The only serious complaints from hunters concerned local shortages of application forms, failure to receive mailed permits and hunting parties that were split when some members failed to receive Zone permits. The tag still was not satisfactory because it was subject to tampering and re-use.

Harvest Data

Harvest data from hunter reports are presented in Table 5. The harvest in the Horicon Zone was 14 percent below the 17,000 bird

TABLE 5. SUMMARY OF WISCONSIN CANADA GOOSE HARVEST DATA, 1969

	Hunting Periods in Horicon Zone				
	Period 1 Oct. 18–31	Period 2 Oct. 20–Nov. 2	HORICON ZONE TOTAL	Remainder of State Oct. 4–Dec. 12	GRAND TOTAL
Valid permits	10,468	10,468	20,936	53,103	74,039
Reported kill	7,450	7,302	14,752	17,183	31,935
Reported no kill	1,835	2,031	3,866	30,155	34,021
Reported no hunt	891	875	1,766	7,306	9,072
Non-respondents	292	260	552	6,793	7,345
Compliance rate	97%	98%	97%	87%	90%

goal. About 18 percent of the tag holders hunted but failed to kill a goose and 8 percent did not hunt, resulting in 26.5 percent non-use of tags. This compares with the 23.5 percent anticipated non-use.

The reported kill outside the Zone was double the desired 8,000 bird harvest. The size of this kill could have been controlled by a season bag limit; however, this would have complicated goose hunting on a statewide basis and increased the costs. It was believed more feasible to make an allowance for this kill and then apply needed constraints to the harvest within the Zone.

The ratio of harvest between the Horicon Zone and the remainder of the state in 1967 was 75:25. The ratio narrowed to 60:40 in 1968, and to 47:53 in 1969. This favorable change was partly the result of mild fall weather in 1968 and 1969. Importantly, it also reflected the increased size of the MVP of Canada geese and its increased use of new State goose management areas in east-central Wisconsin. It is well to note that in 1969, more than half the Canada geese killed in Wisconsin were taken under conditions as sporting as management is capable of providing on a statewide basis to large numbers of hunters. It is also important to note that managers lost some of their ability to control the size of the statewide harvest as lesser amounts occurred in the intensive management zone. Some believed an enlarged zone would

be preferable to a season limit elsewhere in the state. Establishing new hunting zones with quotas in high kill areas away from Horicon was an alternative that appeared more practical than statewide control of individual season bags.

The 1969 season illustrated this logic. Removal of the four-bird season limit set in 1968 resulted in an added bag of 1,262 birds by 457 hunters, representing a four percent increase in the statewide kill by less than one percent of the participants (see Table 6). Seldomly do

TABLE 6. NUMBERS OF CANADA GEESE KILLED PER PERSON OUTSIDE THE HORICON ZONE WITH NO SEASON LIMIT, 1969

Season kill	Number of hunters	Total kill
1	4,949	4,949
2	2,333	4,666
3	785	2,355
4	377	1,508
5	208	1,040
6 to 10	205	1,468
11 to 15	36	438
16 to 20	7	118
Over 20	1	26
	8,901	16,568
Average kill per hunter	1.86	

managers have the ability to control either participation or harvest so precisely. There seemed little reason to add the burden of a statewide tag and season limit to either the hunter or to the agency administering the program.

Enforcement

The law enforcement effort in 1969 was again reduced. Ten Federal Game Management Agents were assigned to the Horicon Zone during the season. The State enforcement effort remained fairly constant with 16 officers assigned either full or part-time to this program. Federal and State officers apprehended 175 persons violating tagging or closely related regulations in the Horicon area. The lack of a tamper-proof tag continued to be a major enforcement problem. It was often difficult to identify a tag that had been re-used, and even more difficult to prove re-use in court.

Costs of Tagging Program

The 1969 program cost $19,700, or 26.5 cents per participant. This was substantially below the 47 cent cost in 1968. The saving resulted from improved program efficiency and the sharing of fixed costs among more persons. The 1969 program served nearly 50 percent more hunters than in 1968.

THE 1970 PROGRAM

Few operational changes were made in 1970. The Wisconsin harvest quota was increased to 35,000 Canada geese, and 20,000 of these were allotted to the Zone. The over-issuance of tags in the Zone was increased to 42.5 percent on the basis of 1969 experience. We can only speculate on why it was necessary to over-issue increasing proportions of tags. It could reflect deteriorating compliance, the increasing proportion of new and inexperienced hunters or possibly some other factor.

The most notable change concerned the tag and its method of issuance. As in previous years, DMI prepared and addressed the permits. Those valid outside the Zone were mailed from Minneapolis by DMI, but Horicon Zone permits were delivered to the Wisconsin DNR in Madison. The DNR provided metal tags that were serially numbered to match the permits. Tags and permits were then placed in window envelopes and mailed to hunters. The system functioned smoothly.

No significant changes in hunting pressure were noted despite the increased number of permits valid on opening day. Some problems were experienced with metal tags when hunters attempted to seal them backwards or, in the process of experimenting, accidentally tripped the locking mechanism.

Complete harvest data for 1970 was not available as this report was prepared. Kill in the Horicon Zone, however, exceeded 17,000 birds or 85 percent of the 20,000 bird objective. Harvest outside the Zone appears to have fallen sharply from the 17,000 birds recorded in 1969, and probably will not exceed 10,000 geese. Much of the goose kill outside the Zone is incidental to duck hunting. Early reports suggest that the 1970 duck season in Wisconsin was poor and that waterfowl hunting activity was depressed from 1969. If true, the kill of geese outside the Horicon Zone would also be expected to decline. Geese were less widely distributed in 1970 and smaller numbers concentrated on state management areas.

The total number of permits issued in 1970 exceeded 94,000, a marked increase over the 74,000 issued in 1969. This may have reflected the stimulated interest in waterfowl hunting that resulted from favorable pre-season publicity about the size of the fall flight of ducks. It is believed, however, that this also reflects the growing awareness among Wisconsin hunters of the opportunity for goose hunting and the need for having a special permit before taking a Canada goose.

Horicon Zone hunters continued to return report forms at the high

rate of 97 percent. More than 91 percent of the hunters outside the Zone also mailed their reports, giving a total compliance rate of almost 93 percent.

The Federal and State enforcement effort was little changed from 1969, but substantially more cases were made for tagging violations. This likely reflects the improved reliability of metal over paper tags.

The 1970 tagging program cost $24,850, or 26 cents per participant.

CONCLUSION

The Canada goose permit and tagging system in Wisconsin has matured into a smooth operational program which enjoys broad public support. The program has been flexible and responsive to changing conditions.

The objectives of the program have been reached with varying degrees of success. The most important goal was to control the size of the statewide kill. This has been accomplished but not with precision. Although averaging better than 96 percent, the harvest has ranged from 71 to 128 percent of the established quotas. This is an improvement over the gross overkills of previous years.

The improved status of the MVP of Canada geese reflects in part the success of the tagging program in controlling the kill in Wisconsin. The post-season population increased from 175,000 in January, 1967, to near the management objective of 300,000 in January of 1971. Also, the harvest quotas in Wisconsin have increased from 14,000 birds in 1966 to 35,000 birds in 1970.

The tagging program has had little influence upon the crop depredations problem, and there is no evidence that early migration of geese from Horicon has been stimulated.

The system has been costly in terms of contractual expenditures and the use of personnel on temporary detail from distant duty stations. A locally administered program would be less expensive, particularly if EDP equipment were available on a time-sharing basis, and there were an opportunity to recover operating costs by charging a nominal fee. For example, a $1.00 service fee for Zone tags in 1970 would have yielded a gross income of $28,500, enough to finance the entire tag program.

Valuable data have been gathered on the distribution of goose harvest in Wisconsin and on the number, distribution and hunting success of persons interested in the sport. The report feature of the program offers an opportunity to gather other field data such as the timing of kill, recovery of bands, number of hunting trips, crippling losses, etc. The list of names and addresses of participants, both

successful and unsuccessful, offers a fine sampling framework for parts collection or other selected contacts in future years. These opportunities were not explored under the federally-administered program because they fell outside the stated objectives.

The distribution of kill among hunters in the Horicon Zone has been much improved. Optimum numbers of persons now have the opportunity to hunt in choice areas. Unfortunately, the one-bird season limit does not encourage the development of goose hunting skills and traditions, and this is a profound loss to the sport.

The quality of the hunting experience under the tagging program is described by many as being very high. This is true in terms of uncrowded hunting conditions, lack of competition and high rate of success. Hunters see large numbers of geese, and this is an enjoyable experience. Unquestionably, hunting conditions under the tagging program are preferred to those of the past when a clean kill often was followed by an exhilarating foot race to claim the prize. But the true thrill of goose hunting, and thus the reward, lies in the challenge offered by a strong and wary bird, and in the knowledge that although many try, few succeed in fairly bringing one to bag. This prize is lost when Canada geese are concentrated, as at Horicon, and no system of harvest control will likely restore it.

The future role of permits and tags in goose management remains to be seen. We believe, however, that a useful and powerful tool has been developed to control harvests and to distribute widely among people the benefits of a resource. Indeed, the Canada goose tagging program in Wisconsin may provide useful guidelines for those faced with similar harvest management problems involving other species of wildlife.

ACKNOWLEDGMENTS

A number of persons deserve recognition for their part in developing and implementing the tagging program. Helpful advice was given by Arthur S. Hawkins, and many administrative problems were solved by Walter P. Schaefer, Allan T. Studholme, Floyd H. Davis, Frank H. King and John M. Keener. The law enforcement program was under the field direction of Miles J. Camery and Walter J. Zelinske. The computer system for the project was developed by Guy A. Nelson. Mrs. Dorothe A. Norton handled communications from Wisconsin goose hunters; her tact deserves special mention. Thanks are also due Dr. Charles J. Henny for reviewing the manuscript. And, lastly, we wish to thank those Wisconsin goose hunters who graciously forgave the occasional shortcomings that are an inevitable part of a new program.

LITERATURE CITED

Hunt, R. A., J. G. Bell and L. R. Jahn.
1962. Managed goose hunting at Horicon Marsh. Trans. North American Wildlife and Natural Resources Conference, 27:91-106.
Jahn, L. R.
1953. Aspects of a Canada goose management plan for Wisconsin, Part 1. Wisconsin Conservation Department. 19 p. mimeo.
Reeves, H. M., H. H. Dill and A. S. Hawkins.
1967. A case study in Canada goose management: The Mississippi Valley Population. In, Canada Goose Management. Dembar Educational Research Services, Inc., Madison, Wisconsin. 195 p.

DISCUSSION

DISCUSSION LEADER GULLION: This paper is most interesting in showing how a species in difficulty can be managed. Referring back to Dr. Howard's comments I hope we never have to do this with ruffed grouse, because we have got too many people we can't control.

DR. RICHARD D. TABER (University of Washington): Was there any difference in crippling loss between the old system and the new?

MR. BRAKHAGE: I doubt if the crippling loss changed much. The attitude of hunters prior to implementation of the tagging program would encourage crippling but we have no data to support saying the rate improved.

MR. M. L. PETOSKEY (Michigan): It costs around a quarter to take care of the permit system. Is this correct? Is there a service charge?

MR. BRAKHAGE: No. Pete, there's no charge at the moment. The permits and tags are free. Contractual costs averaged about 25 cents a person, exclusive of franking privileges, which the Government used.

DR. GULLION: In Minnesota, we have heard various stories about the public relations associated with this, and I remember some incidents concerned with the hazing that you fellows did. Have you resolved all your public relations programs and problems?

MR. BRAKHAGE: I think most Wisconsin goose hunters approve of the tagging program. We have very many complimentary letters from hunters in support of this. There are others who disapprove. These are persons who formerly killed large numbers of geese, or club operators living adjacent to the refuge, and obviously, these people are not in support of the system and I don't think anyone could blame them.

The public relations problems associated with hazing are something else again. We suffered rather severely under this particular program. But I would say that our public relations under the tagging program are preferable to those before.

MR. HOWARD SPENCER (Maine): I'm curious about possible or potential enforcement problems and whether you have any data from hunter observations as to the incidence of non-tagging of geese by hunters who perhaps held tags, but failed to place them.

MR. BRAKHAGE: The problems associated with the metal grommet tag were rather substantial. People found that they could alter it and reuse was fairly common. The adhesive tag used in the subsequent two years also was rather commonly abused; but I think the level of violation was a direct reflection of the level of enforcement effort. It's really not fair to compare violation rates between years because they primarily reflect how many officers we had in the field.

STATUS OF THE WOOD DUCK IN ONTARIO

ALEXANDER T. CRINGAN
Colorado State University, Fort Collins

INTRODUCTION, MATERIALS, AND METHODS

September 18, 1933. A hunter in the Kawartha Lakes area of Ontario, in the Lindsay Forest District, shot a wood duck (*Aix sponsa*) which had been banded as an adult male in South Carolina on Dec. 12, 1931—the first reported recovery of a banded wood duck in Ontario! In 1934, the late Thomas N. Jones, a pioneer game bird farmer from Union, Ontario, performed Ontario's first wood duck banding, of 14 hand-reared birds. The province's first wild-caught wood duck was banded in 1942, by permittee 0851, whose name I have not yet learned. It was not until 1948 that a recovery from a wild Ontario-banded wood duck entered the records, when an adult female, banded by Marshall Field near St. Thomas in the Lake Erie Forest District on November 7th that autumn, was reported from Kentucky later that month.

These events of the '30's and '40's, related, yet isolated in time, signalled the increasingly intensive efforts of the '50's and '60's, on the results of which today's paper is based. I have prepared this paper partly in response to the first gap in knowledge about the wood duck cited by McCabe (1966) in his summary of the Wood Duck Symposium held in Lansing in 1965:

"We need more data on population status and productivity from specific areas. These data must come largely from banding programs."

This paper is based upon: analysis of banding and recovery records, provided through the courtesy of the Canadian Wildlife Service and the United States Bureau of Sport Fisheries and Wildlife; estimated harvests of wood duck in Ontario, published by the Canadian Wildlife Service in its Progress Notes series; and wing collection survey results, both published and unpublished, courtesy the Canadian Wildlife Service, Ontario Department of Lands and Forests, and University of Guelph.

Fifty-five permittees banded 4,982 wood duck in Ontario between 1934 and 1969. Post-1941 bandings of 4,957 include 4,656 wild wood duck captured between June 1 and October 10, (principally during August and September), which are considered as summer bandings, and are used for the calculation of ratios and productivity indices herein. All Ontario bandings produced 598 recoveries and other kinds of reports through early 1970, which were made available for analysis.

In addition to Ontario's bandings, I have considered the records of 590 recoveries and other reports from Ontario of wood duck banded elsewhere. Four states, New York (128), Vermont (72), Maryland (50), and Ohio (44) together produced 294 of these, or almost half of the total. Another 11 states accounted for 214 such reports, South Carolina (42), Tennessee (30), Michigan (27), Wisconsin and West Virginia (19 each), Indiana (17), Illinois (15), Georgia (13), Massachusetts (12) and Maine and Mississippi (10 each). The remaining 82 recoveries and other reports from Ontario represent all other 17 states of the Atlantic and Mississippi Flyways, and the province of Quebec.

HARVEST

Harvests of wood duck in the U.S.A. have been estimated on the bases of kill surveys and wing collection surveys since 1959 (Geis, 1966), and had been estimated by means of questionnaire surveys for some years prior to that time. Procedures made possible after Canada's Migratory Game Bird Hunting Permit system was adopted in 1966 (Benson, 1967; Tener and Loughrey, 1970) permit estimation of annual harvests of wood duck in Ontario since the 1967-68 season, shown in Table 1.

Following the successful development of methods for determining the sexes and ages of ducks by their wings (Geis and Carney, 1961), and the integration of these methods with other investigative systems in the Mississippi Flyway in 1959, and in the Atlantic Flyway in 1960 (Geis, 1966), these sex and age determination techniques were applied experimentally in Ontario for the 1960, 1961, 1965, 1966 and 1967 seasons, (Lumsden, 1961; Cringan, 1962, 1966, 1967, 1968), before the Canadian Wildlife Service conducted more formal wing surveys in 1968 and 1969 (Benson, 1970c). Results of these wing collection surveys aid in estimation of harvests by age shown in Table 1.

These data suggest that Ontario's wood duck harvest changed by about —0.18 between 1967 and 1969, with a somewhat greater decline in the harvest of adults than in that of immatures, by —0.26 compared to —0.14. Total harvests in the eastern U.S.A. changed by +0.67 between 1967-1968 and 1969-70, with a greater increase in the harvest of immatures than in that of adults, +0.76 compared to +0.52 (Kimball, 1970).

POPULATIONS

In 1967, an estimated 39,000 adult wood duck were harvested in Ontario. Four out of 152 adults banded that summer were reported as direct recoveries from Ontario, for a direct recovery rate of 0.026. If a

TABLE 1. ESTIMATED HARVEST OF WOOD DUCK IN ONTARIO BY AGE, 1967–68 TO 1969–70

Season	Estimated Retrieved Harvest Game Ducks	Wood Duck as Percentage Harvest	Estimated Retrieved Harvest Wood Duck[7]	I/A Ratio Wood Duck Harvest	Estimated Harvest Immature Wood Duck	Estimated Harvest Adult Wood Duck
1967–68	1,036,000[1]	11.1[4]	105,000	1.69[8]	66,000	39,000
1968–69	794,000[2]	12.0[5]	88,000	2.56[9]	63,000	25,000
Proportional Change	−0.23	+0.08	−0.16		−0.05	−0.36
1969–70	928,000[3]	9.3[6]	86,000	2.00[9]	57,000	29,000
Proportional Change	+0.17	−0.22	−0.02		−0.10	+0.16

References [1] Benson, 1968; [2] Benson, 1969; [3] Benson, 1970b; [4] Anon., 1968; [5] Benson, 1970a; [6] Benson, 1970c; [7] calculated from foregoing corrected for + 0.085 response bias in 1967–68 and 1968–69 (Sen, 1970); [8] Cringan, 1968; [9] Benson, 1970c.

reporting rate of 0.24 is assumed, the same as that used by Kimball (1970) for the U.S.A. that year, the estimated rate of harvest of adults in Ontario was 0.11, and the estimated adult population was 356,000. Similarly, 7 out of 207 immature wood duck banded in Ontario in 1967 were reported as first-hunting-season recoveries within the province, for a direct recovery rate of 0.034 and an estimated harvest rate of 0.14. Thus, the 66,000 immatures harvested are estimated to have been from a population of 469,000. Total estimated preseason population for 1967 was 825,000, with an I/A ratio of 1.32. This may have been about 0.35 of the eastern continental population of wood duck estimated at 2,350,000 by Kimball (1970).

Ontario's pre-season wood duck population is a complex one, consisting of a breeding population, its young, and molt-migrants, mostly adult males. Consequently, the I/A population ratio is not necessarily a productivity ratio.

The 25,000 adult wood duck harvested in Ontario in 1968 were linked with banding operations which yielded 5 first-hunting-season recoveries in Ontario from 167 adult wood duck banded, for a reported recovery rate of 0.030. Using Kimball's (1970) 0.256 reporting rate for the U.S.A., a direct harvest rate of 0.12 and an estimated population of 214,000 are calculated. Similarly, the 20 out of 276 immature wood duck banded which were reported harvested within the province that autumn showed a reported recovery rate of 0.072, and a harvest rate of 0.28, from a population of 223,000 immatures. Total estimated pre-season population for 1968 was 437,000, with an I/A ratio of 1.04, and this represented 0.15 of the estimated eastern population of 2,980,000.

In 1969, some 29,000 adult wood duck were harvested in Ontario. Six out of 233 adults banded that year were harvested in Ontario as first-hunting-season recoveries, for a reported recovery rate of 0.026. Application of a reporting rate of 0.200, lower than Kimball's rate of 0.256, because of a delay in the reporting of recoveries, indicated retrieved harvest rate is 0.13 from a population of 226,000 adult wood duck. Similarly, the 15 out of 389 immatures banded in 1969 which were reported shot in Ontario that autumn showed a reported recovery rate of 0.038, and an indicated harvest rate of 0.19 from a population of 296,000 immatures. The total estimated pre-season population was 522,000 wood duck, with an I/A ratio of 1.31. This is judged to have been about 0.14 of the eastern continental population of 3,790,000 estimated by Kimball (1970).

Distribution of first-hunting-season recoveries of Ontario-banded wood duck within the U.S.A. show a much stronger relation with the Atlantic Flyway than with the Mississippi and Central Flyways

(0.75: 0.25: 0 for 73 immatures, and 0.70: 0.28: 0.02 for 52 adults). This generalization is supported further by the state of banding of wood duck recovered in Ontario, summarized in the introduction.

MORTALITY

Adult Mortality

Eighty-four hunting recoveries, 40 first-season, and 21, 6, 10, 3, 1, 2, 1 in subsequent seasons, have been reported for adult wood duck summer-banded in Ontario between 1954 and 1963. The regression equation describing the survivorship of such birds is:

$$\text{Log N Survivors} = 1.48 - 0.23X \; (r = -0.94) \quad \text{(Adults banded 1954–63)} \qquad (1)$$

The indicated mean mortality rate is 0.41. This may be overestimated considerably because of a regression in band reporting rates from 0.49 for 1954-56 (Geis and Atwood, 1961) to 0.256 for 1969 (Kimball, 1970), the sixth-hunting-season after 1963.

Eighty-four hunting recoveries during the first four seasons after banding have been reported for adult wood duck summer-banded in Ontario between 1964 and 1966, 50 in the first-hunting-season, and 19, 11, and 4, in subsequent seasons. The regression equation describing survival of these birds is:

$$\text{Log N Survivors} = 1.68 - 0.35X \; (r = -0.99) \quad \text{(Adults banded 1964–66)} \qquad (2)$$

The implied mean mortality rate is 0.56. It is unlikely that this has been overestimated greatly because of regression in reporting rates, which declined in the U.S.A. only from 0.288 in 1964, to 0.256 in 1969 (Kimball, 1970). Future recoveries may yet reduce this estimate slightly.

Thus it appears as if mean annual total mortality rate of Ontario's adult wood duck increased sharply, from 0.41 for those banded 1954-63, to 0.56 for those banded 1964-66. The latter value approximates Kimball's (1970) estimate of 0.54 as the eastern continental adult mortality rate for 1968 and 1969, whereas the former is much below the continental adult mortality rate of 0.50 for bandings prior to 1962. This suggests that Ontario's adults exhibited a lower-than-elsewhere mortality rate up until 1963 or so, but subsequently assumed a mortality rate characteristic of that of adults in the rest of eastern North America.

It is possible to make a first estimation of gun and non-gun mortality rates, in order to account for the increase in total adult

mortality rate. Regression in the reported first-hunting-season recovery rate for adult wood duck banded in Ontario is:

$$\text{Reported f-h-s rec. rate} = 0.062 + 0\ 0021X\ (r = +\ 0.31) \quad (3)$$
(Adults 1961–69)

This suggests a slow, rather variable, increase in reported first-hunting-season recovery rate of about 0.021 every 10 years. Reporting rates in the U.S.A. declined from 0.49 for birds banded in 1960 (Kaczynski and Geis, 1961) to 0.256 in 1969 (Kimball, 1970). It is not known to what extent reporting rates in the U.S.A. reflect those in Canada, but insofar as first-hunting-season recoveries in the U.S.A. of adult wood duck banded in Ontario characteristically exceed such recoveries in Ontario by 1.5/1 (data not shown), Equation (3) would underestimate the regression in actual first-hunting-season recovery rates.

Thus, retrieved harvest rates for adult wood duck banded in Ontario might be calculated at 0.13 for 1961, rising to 0.31 by 1969 (trend from Equation (3) regression values, corrected for reporting rates 0.490 declining to 0.256).

Kimball (1970) cited a mean crippling loss of 0.25 of the total kill of wood duck, based upon regular season hunter performance observations. Inclusion of this factor would produce estimated gun mortality rates of 0.17 for Ontario's adult wood duck in 1961, and 0.41 in 1969.

If total adult mortality rose from 0.41 for 1954-63 bandings to 0.56 for 1964-66 bandings, while adult gun mortality rose from 0.17 in 1961 to 0.41 in 1969, non-gun mortality must have declined during the '60's, from 0.24 to 0.15.

Immature Mortality

Immature wood duck which were summer-banded in Ontario between 1954 and 1963 produced 62 first-hunting-season and 11 second-hunting-season recoveries. This suggests a first year mortality rate of 0.82, perhaps overestimated slightly because of declining reporting rates. Twenty-four hunting recoveries reported after the first-hunting-season (11,5,3,3,0,1,1) suggest that survivors of the first year were characterized by an annual adult mortality rate of 0.34, as revealed by the equation:

$$\text{Log N Survivors} = 1.10 - 0.18X\ (r = -\ 0\ 95) \quad (4)$$
(Adult surv. imm. banded 1954–63)

The mortality rates characteristic of immature wood duck summer-banded in Ontario between 1964 and 1966 differed little from the above. Sixty-nine first-hunting-season and 13 second-hunting-season

recoveries indicate a first year mortality rate of 0.81. Survivors of the first year (13,8,5,1) showed a mean annual mortality rate of 0.38, as calculated from the regression equation:

$$\text{Log N Survivors} = 1.32 - 0.21X \; (r = -0.998) \quad (5)$$
(Adult surv. imm. banded 1964–66)

Future recoveries may yet reduce this estimated mortality rate slightly.

The mean reported first-hunting-season recovery rate for immatures summer-banded in Ontario between 1954 and 1963 was 0.11. Using a reporting rate of 0.49 (Geis and Atwood, 1961; Kaczynski and Geis, 1961), and a crippling rate of 0.25 of the total kill (Kimball, 1970), a gun mortality rate of 0.29, and a non-gun mortality rate of 0.53 are suggested.

The reported first-hunting-season recovery rate of 0.083 for immature wood duck summer-banded in Ontario between 1964 and 1966, linked with a mean reporting rate of 0.278 (Kimball, 1970), and a crippling rate of 0.25 of the total kill, indicates a gun mortality rate of 0.39, and therefore a non-gun first year mortality rate of 0.42. It appears as if the immature gun mortality rate rose between 1954-63 and 1964-66, and that the rise was largely compensated for by a decrease in non-gun mortality.

It seems paradoxical that mean adult mortality rates for wood duck first summer-banded as immatures in Ontario were considerably below those for birds first banded as adults, in 1956-63 (0.34 cf. 0.41), and particularly in 1964-66 (0.38 cf. 0.56). Among factors partially explaining this paradox may be:

1. Ontario summer bandings of adults are heavily biassed toward males, to the extent of 3.49 AM/AF, cf. 1.25 IM/IF; first-hunting-season adult recoveries (1.51 elsewhere/1 Ontario), and particularly indirect recoveries (2.74/1), suggest that these are more representative of the entire eastern North American population than immatures (0.61/1 as directs and 2.04/1 as indirects).
2. Birds first banded as immatures are homogeneous with respect to age when they survive to become adults; birds first banded as adults are heterogeneous with respect to age.
3. A cohort of adults already has its share of birds carrying body shot, pesticides, ingested and metabolized lead, and probably other pollutants; Ontario's immatures, females at least, are likely to return for a few months each year to their relatively clean natal environment, where exposure to pollutants may be less than in the rest of the eastern range of the species.

It is obvious that the statistical basis for mortality rate estimates presented herein is inadequate, despite banding efforts which can be rated as intensive for a decade or more. It is to be hoped that some biologist shortly will develop an accurate age determination technique based on some characteristic of the bird itself, which will do for waterfowl management what cemental layer techniques have done for mammalian management.

PRODUCTIVITY

Summer-banding of wood duck in Ontario has produced a mean of 5.60 I/AF banded. Since 1964, above-average productivity indices of 9.2—7.1 were recorded in 1964 and 1965, while below-average I/AF indices of 4.6—5.1 were registered in 1966 and 1967. Near-average indices of 5.9 prevailed in 1968 and 1969.

The recruitment rate which is required to maintain a stable population, when the characteristic mortality rate of that population is known, can be calculated readily. For example, Ontario's 1954-63 wood duck population, wtih its adult mortality rate of 0.41, and sex ratio of 1.25 M/F(IM/IF from banding), annually would have to recruit 410 yearlings to each 590 survivors from an initial cohort of 1000 adults. These 410 yearlings would have to be the surviving progeny of the original 444 adult females. To produce the 410 yearlings recruited with a first year immature mortality rate of 0.82, these females would have had to fledge 2,280 immatures, or 5.13 fledglings per adult female (2.28 I/A excl. molt-migrants). All-time records for Ontario show a mean ratio of 5.60 I/AF summer-banded. Even though immatures may be more trap-prone than adult females, a reproductive demand of 5.13 fledglings per adult female wood duck may have approached the capacity of the species in most years.

Advancing to 1964-66, we find that each 1000 adult wood duck from Ontario would suffer mortalities of 560 annually. Populations would have to recruit 560 surviving yearlings per 440 survivors, produced by each initial 444 adult females, in order to remain stable. With a fledgling-to-yearling mortality of 0.81, each 444 adult females would have had to fledge 2,950 immatures, or 6.64 I/AF (2.95 I/A excl. molt-migrants) in order to achieve population stability. This exceeds by 0.29 the reproductive demand of 1954-63, and is clearly beyond the normal capacity of the species, although it might have been reached during exceptionally favorable years.

ACTUAL AND POTENTIAL IMPACT OF MAN

In broad terms, it can be stated that Ontario's wood duck population has increased greatly during the past 50 years, or longer.

Quantification of the early phases of this increase is difficult, because precise observations relating to the status of the species in the province were few until recently, as related in the introduction. Lacking hard data over considerable periods of time, and in the absence of much intensive research on wood duck in Ontario, it is not possible to evaluate firmly the impacts of man's diverse land use activities upon the species within Ontario. Still there are certain areas of human activity which either clearly have had an impact on wood duck in Ontario, or else could be exploited so as to have such an impact, among them:

1. Regulation of the wood duck harvest.
2. Management of the beaver.
3. Management of the pileated woodpecker.
4. Forest management.
5. Potentially, regulation manipulation, with weather as a basis for prediction.

Before suggesting the impact of each of these land use activities upon wood duck in Ontario, I wish to summarize the major points developed in analysis of the banding collection, and harvest data for the species within the province:

—estimated harvests and populations of wood duck in Ontario declined between 1967-68 and 1969-70, but are thought to have increased previously until some time during the 60's; harvests and populations increased in both the Atlantic and Mississippi Flyways between 1967-68 and 1969-70;

—productivity was sufficient that recruitments generally equalled or exceeded deaths during 1954-63, when the immature mortality rate was 0.82 and the adult mortality rate was 0.41;

—the adult mortality rate of wood duck summer-banded from 1964 to 1966 rose to 0.56, principally because of a rise in the gun mortality rate; immature total mortality rate changed little, although immature gun mortality rate increased;

—elsewhere: Ontario recoveries of Ontario-banded adults are 1.5:1 in the first hunting-season and 2.7:1 in subsequent hunting seasons, indicating that factors effecting the higher mortality rate for adults banded 1964-66 may be largely operative outside the province.

(1) *Regulation of the Wood Duck Harvest*: Ontario allowed 1 wood duck daily, 2 in possession until 1960, 2/4 in 1961, and has allowed 4/8 since 1965 (Dawson, 1971). States in the Atlantic Flyway generally had 1/1 limits from 1948 to 1953, 1/2 from 1954 to 1959, 2/2 from 1960 to 1965, and 2/4 from 1966 to 1969, with minor exceptions. States in the Mississippi Flyway generally had 1/1 limits from

1948 to 1961, except in 1954 and 1956, which were closed, 2/2 from 1962 to 1965, 2/4 in 1966, generally 1/2 in 1967, and 2/4 in 1968 and 1969 (Reeves, 1966; Kaczynski, 1967, 1968; Kimball and Anderson 1969; Kimball, 1970).

The increased gun mortality rate for immatures banded 1964-66, compared to those banded earlier, may be largely related to Ontario's liberal 4/8 regulations adopted in 1965, insofar as most direct recoveries of Ontario-banded immatures are from Ontario. Total immature mortality rate did not increase, indicating that there were compensating reductions in non-gun mortality rate.

According to both band recoveries and wing collection survey results, most of the harvest of immature wood duck in Ontario occurs before mid-October, that is, before Ontario-produced immatures are four months old. Because of the compensatory nature of gun and non-gun immature mortality rates, it is doubtful whether regulatory changes have had, or are likely to have, much impact upon the total mortality rate of Ontario's immature wood ducks.

On the other hand, it appears as if total adult mortality rates presently are affected directly by rising gun mortality rates. Increases in gun mortality rate evident for adults summer-banded from 1964 to 1966 probably reflect the common regulatory liberalizations in Ontario and in both eastern Flyways.

The evident impact of regulation, first, has been to permit Ontario's wood duck population to rise to a recent historically high level, then to prevent it from rising further, largely because of adult mortality which could not be matched through recruitment of surviving yearlings. It may be inevitable that the greater the success of wood duck management in the eastern U.S.A., and the closer actual harvests approach allowable harvests there, the more excessive will be the harvest of Ontario-produced wood duck. After Ontario-produced birds have emigrated to the U.S.A., they cannot be distinguished from U.S.A.-produced birds.

(2) *Beaver Management:* Dawson (1966) first drew attention to the possible relation between beaver (***Castor canadensis***) and wood duck in Ontario. Novak (1970) of the Ontario Department of Lands and Forests, has provided me with data concerning beaver production in Ontario. Beaver production in 9 Forest Districts south of the French and Mattawa Rivers, which comprise the breeding range for 90%+ of Ontario's wood duck, for the period 1948-49 to 1968-69, may be described by the temporal trend equation:

$$\text{Annual Beaver production} = 4{,}500 + 2{,}700X \quad (r = +0.96) \qquad (6)$$
(1948–49 to 1968–69)

Beaver production has fluctuated below its peak since 1964-65, and is not likely to increase further at the high rate of 1948-49 to 1964-65. Assuming a direct relation between the numbers of beaver produced and the number of beaver ponds available to wood duck for nesting and brooding, it is clear that the beaver population which sustained a ten-fold increase in harvest between 1948 and 1968 produced greatly improved conditions for the production of wood duck within its principal breeding range in Ontario.

(3) *Pileated Woodpecker Management*: Wood ducks sometimes use nesting cavities of pileated woodpeckers (*Dryocopus pileatus*) and other woodpeckers as nest sites (Bent, 1923; Weier, 1966; Prince, 1968). Although such nesting sites generally are not important, ranging from 4 percent (Weier, *op. cit.*) to 7 percent (Prince, *op. cit.*) of suitable nesting sites, Weier pointed out that woodpeckers had a more important role simply in assisting in cavity formation in conjunction with other factors.

The pileated woodpecker has received increasingly effective protection in Ontario since before the Migratory Birds Treaty of 1916. It, like the wood duck, has increased so dramatically in Ontario over a period of several decades, that the direction and great extent of change is beyond dispute. Fortunately, Christmas census results permit verification of trend for the past 20-25 years.

Christmas census results from Ottawa, Toronto, Hamilton, and London, together more representative of heavily settled southern Ontario than of the province's best wood duck range, have been published for most of the years 1945-69 in either the *Canadian Field-Naturalist* or *Audubon Field Notes*. Regression in numbers of pileated woodpeckers reported annually has been:

$$\text{No. Pil. Wp. rptd. O-T-H-L} = 1.61 + 0.29X \quad (r = +0.62) \quad (7)$$
(1945–69)

Data extracted for a greater, but variable number of census locations within Ontario's main wood duck breeding range, from *Audubon Field Notes* for the years 1951-69, produce this regression equation:

$$\text{Mean No. Pil. Wp./census location} = 0.67 + 0.024X \quad (r = +0.59) \quad (8)$$
(1951–69)

Both sets of data show fairly consistent and small (0.026 to 0.053/yr.) annual increases in the numbers of pileated woodpeckers within Ontario's wood duck range during the past 20-25 years. To whatever extent pileated woodpeckers improve nesting conditions for

wood duck in the province, Ontario's success in wood duck management may be attributed partly to success in pileated woodpecker restoration.

(4) *Forest Management:* The Ontario Department of Lands and Forests maintains shoreline reservations, commonly of 125-150m, in Crown Lands which border upon lakes and navigable streams (Herridge, 1971). As long as a shoreline reservation policy is continned, wood duck nesting habitat should be maintained in reasonably good condition, but as time advances, there is increasing demand that overmature timber within shoreline reservations be selectively cut, a process which may operate to the disadvantage of the wood duck. This situation clearly presents an integrated resource use opportunity of interesting proportions.

(5) Southern Ontario is near the northern limit of the wood duck breeding range. Consequently, weather may have a substantial impact on the species. To the extent that weather considerations may function as feed-back inputs in regulatory decision-making, it should be possible to modify the future impact of regulations upon Ontario's wood duck population.

For example,there is little doubt that May temperatures affect productivity of wood duck in Ontario. In 1964 and 1965, when May temperatures were 2.3°C and 1.9°C above normal (Canada Dept. Transport), I/AF ratios in summer-banded samples were 9.2 and 7.1 respectively, compared to all-time means of 5.60. In 1966 and 1967, May temperatures fell to 2.9°C and 3.4°C below normal, and productivity indices were 4.6 and5.1 I/AF respectively. In both 1968 and 1969, when May temperatures were only 1.3°C and 1.1°C below normal, I/AF ratios were 5.9. Following a cold spring, it might be desirable to restrict wood duck harvest regulations, so as to retain breeding stock for what is hoped will be a more normal breeding season in the following year. The difficulty in doing this effectively throughout the eastern half of the continent is recognized.

As firm data continue to accumulate in the future, techniques of multiple and stepwise regression should be applied, in order to identify other weather parameters which may affect the wood duck significantly, and so allow the manager to exploit such knowledge.

SUMMARY

Estimated harvests of wood duck in Ontario declined from 105,000 in 1967-68 to 86,000 in 1969-70, while estimated pre-season populations dropped from 825,000 to 522,000 during the same time. Harvests and pre-season populations in both the Atlantic and Mississippi Flyways of the U.S.A. increased simultaneously.

An immature mortality rate of 0.81 (0.39 gun, 0.42 non-gun), and an adult mortality rate of 0.56 (0.41 gun, 0.15 non-gun) characterized samples of wood duck summer-banded in Ontario from 1964 to 1966, just prior to the 1967-69 decline in harvest and population. An immature rate of 0.82 (0.29 gun, 0.53 non-gun) and an adult mortality rate of 0.41 (0.17 gun, 0.24 non-gun) had characterized samples of wood duck summer-banded in Ontario between 1954 and 1963, presumably while populations were still increasing.

Evidently Ontario's wood duck population increased until some time during the '60's, but since 1964-66, mean adult mortality rates have been such as to effect a decline. Presumed increases of the '40's and '50's were associated with restrictive harvest regulations throughout eastern North America, and with expanding populations of beaver and pileated woodpecker within Ontario's prime wood duck breeding range. The decline of wood duck in Ontario in the late '60's followed regulatory liberalizations which were especially characteristic of 1960-65, and stabilization of beaver harvests from the prime Ontario breeding range between 1964-65 and 1968-69. Given present regulatory practices, Ontario-produced wood duck are necessarily subjected to greater gunning pressure than those produced in the U.S.A. Consequently, further attrition of the Ontario population is highly probable.

ACKNOWLEDGMENTS[1]

The analysis on which this paper is based was initiated while the author was employed by the University of Guelph, Guelph, Canada, and the study was funded in part by the Ontario Department of Lands and Forests. Taped files of banding and recovery records were provided through the courtesy of the Canadian Wildlife Service and the United States Bureau of Sport Fisheries and Wildlife.

Valued services and advice have been rendered to me by Blair Dawson, Milan Novak, Aelred Geis, Charles Kimball, Ronald Ryder, and Jack Gross. I am especially grateful to Mr. Randy N. Buie, presently with the Department of Industrial Engineering, University of Toronto, who, as a student at the University of Guelph, wrote the PL/1 programs for the partial processing of the banding and recovery data, and to the University of Guelph and Colorado State University for computing and other services provided in connection with this manuscript. Program development was funded by a grant from the Ontario Department of Lands and Forests to the University of Guelph.

[1]The author assumes full responsibility for interpretation of the data considered herein.

Individual banders who have contributed significantly to wood duck banding in Ontario include: eight permittees of the Ontario Department of Lands and Forests who banded 2,174; Ed Kroll of Oshawa with 730 between 1956 and 1969; John Anderson with 443; Marshall Field with 322, including the first significant bandings of wild wood duck in 1948; Robert Hubert with 175; John Miles with 173; David Hussell and the Long Point Observatory with 113; the University of Guelph and Ontario Waterfowl Research Foundation group with 106; and the Ontario Bird Banding Association, with 87. Together, these 16 permittees banded 4,323 wood duck, 86.8 percent on Ontario's total.

Other banders who have banded wood duck in Ontario, and individual banders with the Ontario Department of Lands and Forests include H. H. Krug, A. Bunker, W. J. Wasserfall, R. D. Harris, L. A. Gray, R. W. Stamp, L. J. Badger, R. C. Hanson, R. W. Catton, H. A. McLeod, A. W. Leman, F. H. Folemsbee, J. Miller, C. W. Douglas, L. H. Eckel, G. Garbutt, A. E. Walroth, N. D. Patrick, R. A. Balkwill, W. H. Fox, D. G. Dennis, K. Irizawa, and J. Halpenny.

Present holders of permits in the U.S.A. whose efforts have yielded significant numbers of recoveries in Ontario include: Eric Fried of the New York Department of Environmental Conservation (117 recoveries and reports), T. Myers of the Vermont Fish and Game Department (59), Ray Bonsel of the Ohio Division of Wildlife (38), Walter F. Crissey of the U. S. Fish and Wildlife Service (32), Melvin R. Evans of the Santee N.W.R., S.C. (21), Joe Rieffenberger of the West Virginia Department of Natural Resources (19), Woodrow Fleming of the Indiana Department of Natural Resources (17), Vernon G. Henry of the Tennessee Game and Fish Commission (15), and Donald V. Gray of the Upper Mississippi N.W.R. (14), whom together have accounted for 332 of the Ontario recoveries and other reports considered. Another three banders, Vernon D. Stotts of the Maryland Fish and Wildlife Administration (12), Carrell Ryan of the Cross Creeks N.W.R., Tenn. (9), and Dennis F. Holland of the Eufaula N.W.R., Ala. (5), have produced 5 or more Ontario recoveries each with their banding since 1965.

This paper would not have been possible without the help of hundreds of other persons—those sportsmen who individually have taken their time to submit band recovery reports and in so doing, have made analyses such as this possible.

LITERATURE CITED

Anonymous
1968. Species of waterfowl killed in Canada during the 1967-68 hunting season. Canada Dept. Indian Affairs & N. Dvlpmt., Cdn. Wildl. Serv., Prog. Notes No. 7. 22 p.

Audubon Field Notes
1952-1970. 52nd-70th. Christmas bird counts for 1951-69. Vols. 6-24, Nos. 2.

Benson, Dennis A.
1967. Report on sales of the Canada Migratory Game Bird Hunting Permit 1966-67. Canada Dept. Indian Affairs & N. Dvlpmt., Cdn. Wildl. Serv., Prog. Notes No. 2. 4 p.
1968. Waterfowl harvest and hunter activity in Canada during the 1967-68 season. Canada Dept. Indian Affairs & N. Dvlpmt. Cdn. Wildl. Serv., Prog. Notes No. 5. 39 p.
1969. Waterfowl harvest and hunter activity in Canada during the 1968-69 hunting season. Canada Dept. Indian Affairs & Dvlpmt., Cdn. Wildl. Serv., Prog. Notes No. 10. 44 p.
1970a. Species of waterfowl taken in Canada during the 1968-69 hunting season. Canada Dept. Indian Affairs & N. Dvlpmt., Cdn. Wildl. Serv., Prog. Notes No. 12. 14 p.
1970b. Report on sales of the Canada Migratory Game Bird Hunting Permit and waterfowl harvest and hunter activity, 1969-70. Canada Dept. Indian Affairs & N. Dvlpmt., Cdn. Wildl. Serv., Prog Notes No. 16. 34 p.
1970c. Species of waterfowl and age and sex ratios of ducks harvested in Canada during the 1969-70 season. Canada Dept. Indian Affairs & Dvlpmt., Cdn. Wildl. Serv., Prog. Notes No. 19. 55 p.

Bent, Arthur Cleveland
1923. Life histories of North American wildfowl, Part 1. U.S. Nat'l Mus. Bull. 126. 244 p. 46 pl.

Canada Department of Transport
1964-1969. Monthly records. Meteorologial observations in Canada. Meteorological Branch.

Canadian Field-Naturalist
1946-1960. Christmas bird censuses for 1945-1959. Vols. 60-74.

Cringan, A. T.
1962. Duck wing collection, southern Ontario, 1961. Unpubl. typescript. 13 p.
1966. Duck wing collection, Ontario, 1965. Unpubl. typescript. 6 p. and tables.
1967. Duck wing collection, Ontario, 1966, preliminary report. Unpubl. mimeo. 8 p. and tables.
1968. Ontario duck wing survey, 1967. Preliminary tables. Unpubl. mimeo. 20 p.

Dawson, J. B.
1966. Comment in discussion, Session VI. *In* Wood duck management and research: a symposium. Wildl. Mgmt. Inst. :181.
1971. Personal communication.

Geis, A. D.
1966. Establishing the status of wood duck populations—successes and problems. *In* Wood duck management and research: a symposium. Wildl. Mgmt. Inst. :183-192.

Geis, A. D., and E. L. Atwood
1961. Proportion of recovered waterfowl bands reported. J. Wildl. Mgmt. 25(2):154-159.

Geis, A. D., and S. M. Carney
1961. Results of duck-wing collection in the Mississippi Flyway, 1959-60. Bur. of Sport Fisheries and Wildl., Spec. Sci. Rept. Wildl. No. 54. 120 p.

Herridge, A. J.
1971. Personal communication.

Kaczynski, Charles F.
1967. Wood duck band recovery data for 1966 and pre-season population estimates, 1961-65. Bur. of Sport Fisheries and Wildl., Admin. Rept. No. 137. 23 p. (multilith).
1968. Wood duck recovery data for 1967 and pre-season population estimates, 1961-67. Bur. of Sport Fisheries and Wildl., Admin. Rept. No. 166, 9 p. (multilith).

Kaczynski, C. F., and A. D. Geis
1961. Wood duck banding program progress report, 1959 and 1960. Bur. of Sport Fisheries and Wildl., Spec. Sci. Rept. Wildl. No. 59. 41 p.

Kimball, Charles F.
1970. Wood duck band recovery data for 1969 and population trend in the eastern United States and Ontario, 1964-1969. Bur. of Sport Fisheries and Wildl., Admin. Rept. No. 188. 8p. (multilith).

Kimball, Charles F., and David R. Anderson
1969. Wood duck band recovery data for 1968 and pre-season population estimates, 1963-68. Bur. of Sport Fisheries and Wildl., Admin. Rept. No. 179. 7 p. (multilith).

Lumsden, H. G.
1961. Duck wing collection, southern Ontario, 1960. Unpubl. mimeo. 6 p.
McCabe, R. A.
1966. Symposium summary. *In* Wood duck management and research: a symposium. Wildl. Mgmt. Inst. :204-209.
Novak, Milan.
1971. Personal communication.
Prince, Harold H.
1968. Nest sites used by wood duck and common goldeneyes in New Brunswick. J. Wildl. Mgmt. 32(3):489-500.
Reeves, H. M.
1966. Influence of hunting regulations on wood duck population levels. *In* Wood duck management and research: a symposium. Wildl. Mgmt. Inst. :163-181.
Sen, A. R.
1970. On the bias in estimation due to imperfect frame in the Canadian waterfowl surveys. J. Wildl. Mgmt. 34(4):703-706.
Tener, John S., and Alan G. Loughrey
1970. The migratory waterfowl program in Canada. Trans. N. Am. Wildl. and Nat. Resources Conf. 35:287-295.
Weier, R. Wayne
1966. A survey of wood duck nest sites on Mingo National Wildlife Refuge in southeast Missouri. *In* Wood duck management and research: a symposium. Wildl. Mgmt. Inst. :91-112.

DISCUSSION

DISCUSSION LEADER GULLION: Thank you, Dr. Cringan. This is a particularly interesting example of interspecies relationships in the maintenance of breeding habitat. It would appear to me that in view of continent-wide management programs, that you are in a position where you will have to maintain high-quality breeding habitat for your wood ducks in order to maintain populations in Ontario. The question that comes to my mind, particularly, is protection of shoreline wood lands—supposedly forever, which we know cannot happen. What sort of management might be necessary to maintain suitable wood duck nesting facilities accessible to pileated woodpeckers, that beaver aren't going to chop down, long enough to maintain your wood duck population.

DR. CRINGAN: One of the main threats is the demand we hear from certain directions that we clean up these protected shoreline reservations and get rid of the overmature cull trees that are there. Until the present, this has probably been, in the net, beneficial to wood ducks; but should demands for clean forestry increase, we may find that even the shoreline reservation isn't of too much use to the species in the future.

DR. GULLION: We have to have mature trees, but mature trees have a very short lifespan as mature trees, and so the problem is having a crop of rotten trees coming on for wood ducks every so often; and it takes 90 years to grow a good rotten tree.

MR. HOWARD SPENCER (Maine): First, I'd like to compliment you on a fine presentation of an excellent and important paper. There was such a wealth of information that I may have missed a point, but there were a couple of questions that came to mind, one of which you called attention to—the potential reason for the high mortality rate in your adult segment of the population. You mentioned the possibility that this might be due to difference in the actual ages in terms of years of your adults. Do you plan any further follow-up on this?

My second question is whether there were differences in the recovery rates of adults and immatures in the U.S. versus Canada, or in Ontario.

DR. CRINGAN: Immatures which are banded in Ontario show a first hunting season distribution of about 0.6 elsewhere to 1 for Ontario; whereas, adults first banded in Ontario show 1.5 elsewhere for every recovery in Ontario. And to a large extent, adult birds banded in Ontario are representative of the adults of the Atlantic Flyway and, to a lesser extent, of the Mississippi Flyway. This is because of a large influx of molt-migrant males which takes place to varying extents every summer. As to your first question, the Ontario-produced immatures, once they become adults, show a lower mean mortality rate than birds first banded as adults

in Ontario. At the present rate of banding, with close to a thousand new birds being banded each year, it should be possible to re-examine this question in another two or three years and there may be adequate data to answer it more definitively. Right now, something is evident. What it means, I am not sure, but it may well be that the immatures, including as they do, roughly 45% females, most of which home to Ontario, have a different mortality rate than the adult males which are broadly representative of the Atlantic Flyway. I would hope that arrangements may be made so that the studies will continue.

MR. WESLEY M. BATTERSON (Oregon Game Commission): I don't think you mentioned anything about wood duck nest boxes. In Oregon, we have a program for putting up many hundreds of wood duck nest boxes and I wondered if you have ever tried that.

DR. CRINGAN: There are in the Province, a few successful wood duck nesting box programs. Ed Narraway, in the Ottawa Valley, has had one of the most extensive and most successful of these. Marshall Field and his associates around St. Thomas had some successes. I dabbled in this myself about 10 years ago and we found that starlings beat the wood ducks to the boxes and our efforts were singularly unsuccessful.

It's safe to say though, that in the whole of Ontario, with a nesting population of perhaps 100 thousand or so adult female wood duck, that certainly no more than 2 or 3 percent of these would be using artificial nesting boxes. And as far as we can tell, most of the production is related to natural nesting sites, primarily in the beaver pond country.

CHAIRMAN CHAMBERS: I think in discussing our human population-wildlife relationship, that we would be amiss if we did not bring in some of our large carnivores.

The increased problems with all species of bears throughout the continent not only reflect increased population pressures, but are symptomatic in demonstrating our lack of knowledge concerning these animals in their response to the presence of humans. Where we have secured appropriate data and put it to use, it has become apparent that bears and humans can co-exist.

STATUS AND MANAGEMENT OF GRIZZLY BEARS IN GLACIER NATIONAL PARK, MONTANA

C. J. MARTINKA

Office of Natural Science Studies, National Park Service, Glacier National Park, Montana

Glacier National Park in northwestern Montana was established in 1910 to preserve a representative area of the northern Rocky Mountains. The Park's status as a natural area requires that indigenous biota be retained under natural conditions for their aesthetic, educational, cultural, and scientific values. A population of grizzly bears (*Ursus arctos*) inhabits the Park as a native faunal species (Bailey and Bailey, 1918).

Research was initiated in 1967 to obtain quantitative data on the dynamics and ecology of the Park's grizzly population. This paper presents results relating to the status of the grizzly population between 1967 and 1970. Additional data on park visitation, human confrontations with grizzlies, and bear management procedures are

summarized and evaluated for the 25-year period from 1946 through 1970.

PROCEDURES

Grizzly population estimates were obtained from a 290-square-mile sample area in the northcentral region of the Park (Figure 1). Sample area boundaries were selected to include a distribution of habitats and physiographic features which was representative of the entire Park. Park personnel and other qualified observers, who regularly traveled trails through the area, were asked to report the number, location, and description of grizzly bears sighted. These data were supplemented with additional observations by the author.

The number of different bears observed on the representative sample

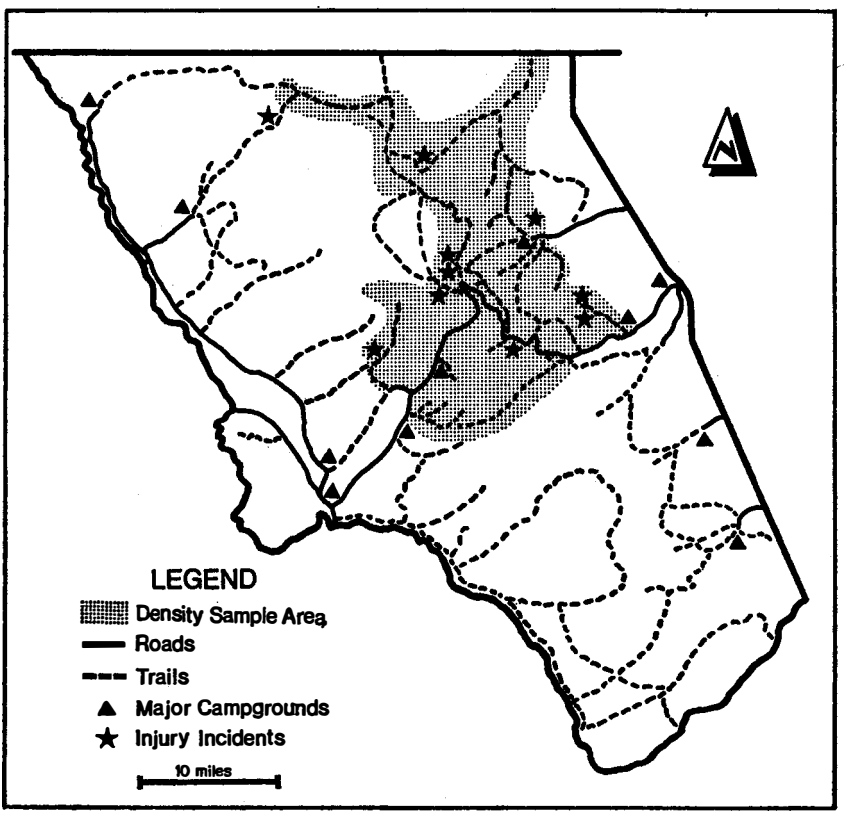


Figure 1.—Location of density sample area, access routes, major campgrounds, and personal injury confrontations involving grizzly bears in Glacier National Park.

area was determined each year. Bear locations, age classes, descriptions, and sighting dates were used to exclude possible duplicate observations. Density computations for the sample area were expanded to estimate the population for the 1583-square-mile Park area.

Park visitation data were obtained from annual travel reports, backcountry campfire permits, and trail registers. Annual wildlife reports provided data on confrontations (personal injury or equipment damage) and management actions (disposal, transplant, or visitor control) involving grizzly bears.

GRIZZLY POPULATION STATUS

Sample area densities and the expanded estimates for the Park's grizzly population are shown in Table 1. The mean density estimate of one grizzly per 8.1 square miles was intermediate as compared to other populations (Table 2). Troyer (1962) attributed the high

TABLE 1. DENSITY AND POPULATION ESTIMATES FOR GRIZZLY BEARS IN GLACIER NATIONAL PARK FROM 1967 THROUGH 1970 AS DETERMINED FROM SIGHTINGS ON A 290 SQUARE MILE AREA WITHIN THE PARK

Year	Number of Different Bears Observed	Number of Square Miles Per Bear	Expanded Estimate for the Park Population
1967	32	9.1	175
1968	34	8.6	184
1969	42	6.9	230
1970	37	7.8	203
MEAN	37	8.1	198

TABLE 2. DENSITY ESTIMATES FOR VARIOUS NORTH AMERICAN GRIZZLY BEAR POPULATIONS

Population Location	Estimated Number of Square Miles Per Bear	Source of Data
Kodiak Island, Alaska	0.5	Troyer (1962)
Glacier National Park, British Columbia	5	Mundy (1963)
Yukon Territory, Canada	10	Pearson (1970)
Mt. McKinley National Park, Alaska	15	Dean (1958)
Whitefish Range, Montana	15	Jonkel (1967)
Yellowstone National Park, Wyoming	11–17	Cole (1970)

density on Kodiak Island to ample food supplies that resulted from interspersions of high quality habitat types. In contrast, a low density adjacent to the northwest boundary of Glacier National Park was considered to reflect a lack of openings in extensive coniferous forests (Jonkel, 1967). The intermediate grizzly population density within Glacier National Park possibly relates to an intermediate composition and interspersion of important habitat types.

Observational data indicated that grizzly bears were not uniformly

distributed within the sample area. During a helicopter flight in September 1967, a density of one grizzly per 2.1 square miles was determined for a 25-square-mile area of the McDonald Creek drainage. Comparable densities were computed for the same area from reported sightings between 1968 and 1970. Consistently few sightings in certain other sample area localities suggested densities of one grizzly per 10 to 20 square miles.

Annual estimates of the Park's grizzly population prior to 1967 ranged from 90 to 130. These figures were generally derived from reported observations and area estimates of grizzlies by field rangers and the estimate for the previous year. Higher estimates during this study (Table 1) are considered to reflect greater efficiency of the sample area census technique rather than a population increase.

Annual differences in density and population estimates probably resulted from inherent defficiencies in the sample area census technique. General difficulty in observing grizzlies, even though they were known to frequent an area, suggested that computed figures were minimum estimates. Factors tending to inflate estimates included extensive wandering of subadult grizzlies and partial inclusion of adult home ranges on the periphery of the area sampled. Relatively consistent results over a four-year period and comparisons with other populations suggested that density and population estimates were reasonable and that the grizzly population was probably at or near habitat carrying capacity.

NUMBERS OF PARK VISITORS

Numbers of park visitors between 1946 and 1970 increased at a mean annual rate of 4.2 percent from 201,000 to 1,242,000. The rate of increase progressively declined through the early 1960s, but accelerated after 1965 (Table 3). Visitors used developed areas and backcountry areas resulting in two characteristic types of travel within the Park.

Developed areas included facilities directly accessible to motoring

TABLE 3. SUMMARY OF VISITATION TO GLACIER NATIONAL PARK DURING 5-YEAR PERIODS FROM 1946 THROUGH 1970

Period	Mean Annual Visits		Mean Annual Camper Days[1]	
	Number	Percent Increase	Number	Percent Increase
1946–50	354,000	—	95,000	—
1951–55	611,000	73	157,000	65
1956–60	726,000	19	172,000	10
1961–65	801,000	10	196,000	14
1966–70	1,006,000	26	267,000	36

[1] One camper for one day in developed area campgrounds.

visitors (Figure 1). In addition to hotels and motels, roadside campgrounds that totaled 1,225 sites by 1970 served as important overnight accommodations. Trends in numbers of campers using developed areas correlated with annual visitation trends prior to 1961 (Table 3). The increase in camping activity during the 1960s exceeded the increase in annual visits and accompanied a general replacement of tent camping by trailers and pickup campers.

Backcountry areas were accessible to foot and horse travelers. Numerous campsites, five trail shelters, and two concessioner-operated chalets served as overnight accommodations. Hiking has largely replaced horses as the principal form of backcountry travel and campfire permit records indicate that backcountry travel increases were as great or greater than increases in total annual visitation. In addition, hiking tours conducted by park naturalists contributed to increased backcountry use during recent years. Backcountry travelers annually comprised approximately 5 to 10 percent of total visitors from 1967 through 1970.

RELATIONSHIPS BETWEEN GRIZZLIES AND HUMANS

Ten confrontations with grizzly bears resulted in injuries to 14 humans between 1946 and 1970 (Table 4). Thirteen injuries occurred

TABLE 4. PERSONAL INJURIES AND EQUIPMENT DAMAGES INFLICTED BY GRIZZLY BEARS IN GLACIER NATIONAL PARK DURING 5-YEAR PERIODS FROM 1946 THROUGH 1970

Period[1]	Injury Incidents			Equipment Damage Incidents
	Number of Confrontations	Number of Persons Injured	Injuries per One Million Visitors	
1946–50	0	0	0	0
1951–55	0	0	0	2
1956–60	4	6	1.7	3
1961–65	3	4	1.0	1
1966–70	3	4[2]	0.8	8
TOTALS	10	14	0.8	14

[1] One personal injury was recorded prior to 1946.
[2] Includes two fatalities in 1967.

in backcountry areas and one along a road prior to spring snow removal (Figure 1). No injuries were recorded prior to 1956, but the injury rate sharply increased to a maximum of 1.7 per one million visitors between 1956 and 1960. Rates progressively declined after 1960. Injuries varied from superficial bites and scratches to two fatalities in 1967.

Six confrontations that resulted in injuries to nine humans were classified as defense-reaction (Table 5). Five involved small groups of

TABLE 5. SUMMARY OF GRIZZLY CONFRONTATIONS RESULTING IN INJURIES TO HUMANS IN GLACIER NATIONAL PARK FROM 1946 THROUGH 1970

Incident Type	Number	Visitor Activity	Class of Grizzly Involved	
			Female With Young	Adult(s)
Defense-reaction	6	Hiking[1]	5	1
Other	4	Camping	3	1
TOTALS	10		8	2

[1] One photographer included.

one to five hikers and one a single photographer. Female grizzlies with young were involved in 83 percent of these incidents as compared to a mean occurrence of 23 percent in the adult/subadult population segment (Martinka, 1970). Subadult and single adult grizzlies appeared to avoid direct conflicts with humans. These data suggest that most injuries to hikers (or photographers) resulted from protective responses of maternal female grizzlies when confronted. Herrero (1970) reported that females with young caused 71 percent of the injuries inflicted by grizzly bears to hikers in North American national parks.

Four confrontations that resulted in three injuries and two fatalities were classified as other than a defense-reaction relationship. Each occurred at night in a designated backcountry campsite, including two near a chalet. Female grizzlies with young were disproportionately involved, but the confrontations apparently resulted from attraction of the bears to a camping area by food or its odors. Stokes (1970) suggested that such behavior probably results from prior experience with unnatural food sources.

Fourteen confrontations involved damage to personal equipment (Table 4). Ten occurred in backcountry campsites and four in roadside campgrounds. In addition, sporadic damage to government patrol cabins occurred during early spring and late fall. Damage incidents were apparently related to attraction of grizzlies to the area by food or its odors and, in general, appeared to involve a few individual animals in which the desire for food overcame characteristic shyness toward humans.

MANAGEMENT OF GRIZZLIES

A total of 30 grizzly bears was disposed of or transplanted between 1946 and 1970 (Table 6). In backcountry areas, 13 grizzlies were destroyed in response to human injuries or personal equipment damages. In developed areas, 12 grizzlies were destroyed and 5 transplanted in response to equipment damages or to prevent human confrontations with bears frequenting these areas.

TABLE 6. GRIZZLY BEARS TRANSPLANTED OR DESTROYED IN GLACIER NATIONAL PARK DURING 5-YEAR PERIODS FROM 1946 THROUGH 1970

Period	Numbers Captured and Transplanted	Numbers Destroyed
1946–50	1	0
1951–55	1	1
1956–60	0	11
1961–65	1	3
1966–70	2	10
TOTALS	5	25

The increased number of human injuries and equipment damages between 1956 and 1970 led to an increase in the number of grizzlies destroyed. An average of 1.6 (range 0-7) grizzlies was destroyed each year during this period. Annual variations in the number destroyed reflected differences in the number of confrontations as well as the opportunity to selectively destroy the individual bears involved.

The number of troublesome grizzlies transplanted to remote park areas remained low and relatively constant throughout the 1946 through 1970 period. Inadequate techniques precluded the usefulness of capturing and transplanting grizzlies in backcountry areas.

Management to minimize the opportunity for grizzlies to use unnatural food sources was initiated prior to 1946. Closure of open refuse dumps with conversion to incineration facilities was completed by 1968. Installation of bear-proof refuse cans in roadside campgrounds and other facilities was initiated in 1963. These and other procedures to eliminate refuse and litter from park areas have progressed to the present. Visitor participation has been encouraged through implementation of a "pack-in, pack-out" policy, which requires removal of unburnable refuse from backcountry areas.

Management to reduce the potential for contacts between grizzlies and humans has been intensified since 1967. A monitoring program which systematically documents reported sightings and confrontations provides a basis for temporary trail closures and/or overnight camping restrictions in areas frequented grizzlies. In addition, ecological evaluations of present and proposed trails, campsites, and other facilities provide guidelines for preventative management where high human use could contribute to potential conflicts with bears. Understanding and cooperation by visitors are gained through an information program which stresses grizzly ecology as well as proper procedures for traveling in grizzly country.

DISCUSSION

A significant increase in the number of human confrontations with grizzly bears occurred in Glacier National Park between 1956 and

1970. Eighty-three percent involved hikers or campers in backcountry areas. The greater number and dispersion of backcountry foot travelers during this period appeared to increase the potential for defense-reaction confrontations as well as contribute to the availability of attracting unnatural food sources. This was particularly evident within the density sample area. Fewer backcountry travelers and a larger proportion of parties on horseback were accompanied by a low incident rate during earlier years.

Declining injury rates during the 1960s were possibly associated with progressive removals of available unnatural foods as well as the immediate removal of grizzlies which frequented areas of high human use. Intensified use of visitor hiking and camping controls and an expanded information program were accompanied by a further decline to 0.3 injuries per one million visitors from 1968 through 1970. Removal of unnatural foods has also helped to maintain a wild free-ranging grizzly population within the Park.

The relatively few grizzly incidents in developed areas occurred in roadside campgrounds and were limited to personal equipment damages. Characteristic shyness of bears appeared most significant in restricting intrusions into developments even though most were located in areas inhabited by grizzlies. In addition, immediate preventative management by transplanting or disposing of bears which frequented developed areas appeared to preclude confrontations, particularly those resulting in injuries. Cole (1970) concluded that removal of artificial foods and consistent preventative removals of bears from developed areas in Yellowstone National Park were necessary to reduce the opportunity for injuries to visitors.

A significant change in dynamics of the Park's grizzly population has apparently not resulted from intensified control of grizzlies. Disposal of troublesome grizzlies at a mean rate of 1.6 per year between 1956 and 1970 represented less than one percent of the estimated population. This low rate of man-induced mortality appeared to be reflected in a comparatively low natality rate of about 15 percent (Martinka, 1970). Troyer (1962) reported a natality rate of 27 percent for a hunted grizzly population.

Management objectives are to retain a natural grizzly population while providing for the reasonable safety of visitors in Glacier National Park. Programs of preventative management during recent years have been accompanied by reduced rates of human injury with minimal influence on the natural status of the grizzly population. A wild free-ranging grizzly population appears to afford the least opportunity for conflicts with humans.

SUMMARY

A population of 175 to 230 grizzly bears was estimated for Glacier National Park for the 1967 through 1970 period. From 1946 through 1970, human confrontations with grizzlies resulted in 2 fatalities, 12 personal injuries, and 14 equipment damages. Most incidents occurred in backcountry areas and were related to protective responses of female grizzlies with young and/or attraction of grizzlies to unnatural foods. Increased numbers of confrontations after 1955 appeared to result from greater backcountry use by hikers and campers. Progressive removal of available unnatural foods, immediate removal of troublesome grizzlies, intensified visitor travel controls, and an expanded information program were accompanied by declining injury rates during the 1960s. Numbers of grizzlies destroyed were sufficiently low to have minimal influence on the natural status of the Park's grizzly population.

ACKNOWLEDGMENTS

The author expresses appreciation to G. F. Cole and A. L. Lovaas, National Park Service, and T. S. Baskett, Bureau of Sport Fisheries and Wildlife, for critical review of the manuscript. Numerous personnel of Glacier National Park provided assistance in data collection and evaluation. The paper is a contribution from National Park Service Natural Sciences Project GLAC-N-16.

LITERATURE CITED

Bailey, V. and F. M. Bailey.
1918. Wild animals of Glacier National Park. U.S. Government Printing Office, Washington, D.C. 210 pp.

Cole, G. F.
1970. Preservation and management of grizzly bears in Yellowstone National Park. Proc. Second International Conf. on Bear Research and Management: (In press).

Dean, F. C.
1958. Investigations on grizzly bear in interior and arctic Alaska. Alaska Coop. Wildl. Research Unit Quart. Rept. 9(4):61-71.

Herrero, S.
1970. Human injury inflicted by grizzly bears. Bioscience 20(21):1148-1153.

Jonkel, C. J.
1967. Black bear population studies. Unpubl. Ph.D. Thesis, Univ. of British Columbia, Vancouver. 148 pp.

Martinka, C. J.
1970. Grizzly ecology studies, Glacier National Park. National Park Service Progress Report. 43 pp Xerox.

Mundy, K. R. D.
1963. Ecology of the grizzly bear (*Ursus arctos*) in Glacier National Park, British Columbia. Unpubl. M.S. Thesis, University of Alberta, Edmonton. 103 pp.

Pearson, A. M.
1970. Personal communication.

Stokes, A. W.
1970. An ethologist's views on managing grizzly bears. Bioscience 20(21): 1154-1157.

Troyer, W. A.
1962. Size, distribution, structure, and harvest of a Kodiak Bear population. Unpubl. M.S. Thesis, University of Montana, Missoula. 49 pp.

DISCUSSION

DISCUSSION LEADER GULLION: Thank you, Mr. Martinka. This is a most appropriate paper. In some respects, we're talking both about human population control and predator population control. You may be familiar with Dr. Latham's "Economics of Predator Relationships" in which he pointed out that man at one time was probably a major prey species. Here we have a species that certainly is capable of preying upon man. Maybe we haven't gone overboard on predator control on some of our big carnivores. They might solve some of the problems Dr. Howard was talking about.

MR. DALE JONES: (New Mexico): Have you recorded any competition between black bears and grizzly bears, and have you noticed different fluctuations between the population of either?

MR. MARTINKA: This is a question that I don't have the background to answer. There are substantial numbers of black bears in Glacier National Park. We have little quantative data which shows how many or what their relationship is to grizzlies. I suspect that there are almost as many grizzlies as black bears in Glacier Park, primarily because the habitat within the Park is more suitable for the grizzly than it is adjacent to the Park, where we find extensive coniferous forests. This appears to be much more suitable habitat for the black bear and the number of grizzlies on those areas is less. Direct competition may or may not occur between the two species. Available information relates mostly to observations on the use of unnatural food sources and, at this time, I am not too sure that it is really relevant. There appears to be a certain mutual avoidance on the part of both species. For example, we have areas with extensive numbers of grizzlies and black bears during late summer on seasonally occupied huckleberry range. It is quite obvious, when you fly over or go into them, that those drainage heads occupied by grizzly bears are not occupied or utilized by black bears at the same time. It would appear to be an avoidance situation rather than dominance or direct conflict.

DR. LEVI MOHLER (Idaho): You mentioned shyness as a characteristic of the grizzly, and we recognize this. We also realize that in the popular literature, the ferocity and savageness of the grizzly have been bruited about for many years. At what point in the mutual avoidance mechanism between humans and grizzlies does this shyness revert to what is properly called ferocity?

MR. MARTINKA: This is not the type of animal that you walk up to and measure distances that are best to stay away. However, from what limited information we have, some of this "ferocity" is related primarily to defense of young. This may be more important than we have considered it in the past.

The number of close confrontations with single grizzlies that we have recorded, where there was no direct contact, is not great, but it is great enough to suggest that the female protecting her young becomes very significant. I think the area they defend would be defended against nearly any intruder. But even females with young often show an amazing capacity to tolerate people. Some bears have a greater capacity to tolerate people walking by their particular domain than others. In the records of the few incidents that we've had, there is much suggestion that most defense-reaction incidents were related to people walking into a bear without making noise. Quite commonly, the first thing they report is, "I wasn't even talking."

So, characteristic shyness is something which does occur, and even in looking at some of the records in the past, which may or may not be completely factual, they generally indicate involvement of a female with cubs. Steve Herrero did some work throughout the North American parks, and this was one of his conclusions—that the major problem was the female defending her cubs. He brought this out where he compared the grizzly with the black bear which very seldom is involved in a defense reaction confrontation. Her defense mechanism is to send her cubs up a tree. The grizzly doesn't do this, so the alternative is to attack whatever happens to enter her particular realm.

DR. GULLION: How is the grizzly problem in Yellowstone? Do you have that under control, so the grizzlies aren't bothering people?

MR. MARTINKA: Several hours would be necessary to discuss that particular question. Probably this is not the place, because it is quite complex and bears much more thought and discussion.

MR. GULLION: It's interesting to be a prey species occasionally, and to see how we look upon one of our effective predators. Maybe it gives us a better idea of some of the prey-predator problems that we are dealing with in other wildlife species. We need to see how it looks from the other side, occasionally, and the grizzly gives us that opportunity.

If there is no further discussion, then I thank you, Mr. Martinka.

IMPORTANCE OF DAILY BAG IN SQUIRREL HUNTING

DONALD M. CHRISTISEN

Missouri Department of Conservation, Columbia

Hunting regulations assume a major role in game management, if not always for the benefit of the species, at least to the extent of influencing harvest by man. Bag limits have been used to ration game from the inception of game laws in this country. The first bag limit was imposed in 1878, in Iowa, to limit the harvest of prairie chickens (Palmer, 1912). Next to the dates of season, the bag limit is the most important regulation for the harvest of game.

Although the original intent of a bag limit was to ration, there is evidence that a limit has broader implications in the harvest of such species as fox squirrels (*Sciurus niger*) and gray squirrels (*S. carolinensis*) in Missouri. This information indicates that limiting the bag may be a two-edged management tool; it rations, but also it may encourage harvest. Bag limit can serve as a criterion, too, in measuring the success of a season.

Squirrel harvest data have been collected annually in Missouri since 1947, under the Pittman-Robertson program. During the 23-year study, the daily bag limit remained at six. Five different lengths of seasons were represented during this period, all relatively liberal, none less than 140 days in length nor more than 216 days. The present season of 216 days extends from May 30 through December 31.

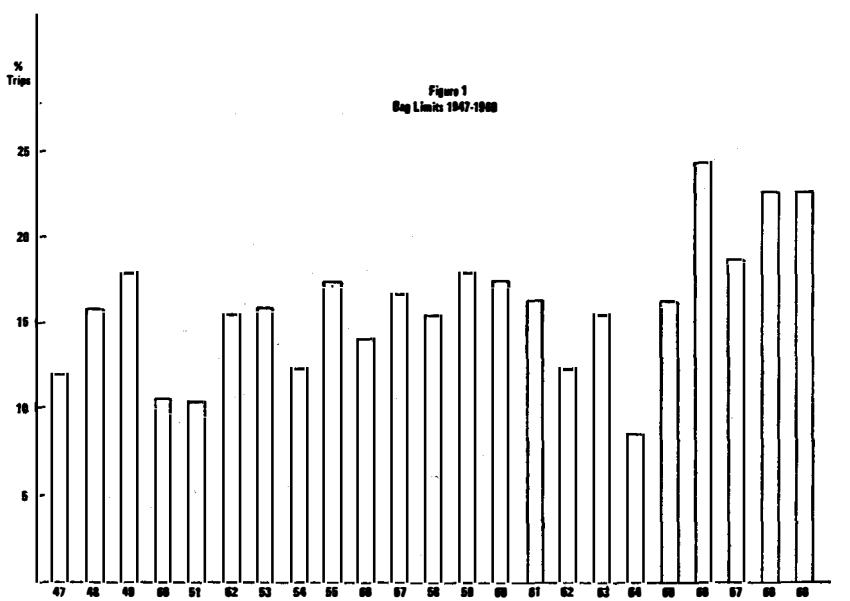
The major objective of this investigation was to obtain biological information on the harvest of squirrels. The best source of information available to us was that supplied by squirrel hunters. Since data on large numbers of squirrels were paramount, effort was directed toward maintaining a list of avid squirrel hunters who would voluntarily keep records of each hunting trip. Hunting record books were supplied 500 to 700 hunters each year from 1947 to 1969. The response ranged from 130 to 300 usable records per year, representing 3,236 to 9,823 squirrels and 1,447 to 3,599 hunting trips per year.

According to a post-season hunter survey of 1969, there were 206,000 squirrel hunters in the state who took 2.8 million squirrels (Sampson, 1970). Annual harvest varies with abundance of squirrels.

Data from the hunting record books included enumeration of hunting trips, hours hunted, and the number of squirrels killed. These data provided the basis for analyzing the number of squirrels taken per trip *i.e.*, bag class for each hunt, both by year and for the 23-year accumulation.

Leopold (1948) stated: "Bag records from large numbers of individuals . . . are useful indicators of trends in game abundance, provided no great change has taken place in numbers of hunters or hunting methods and equipment . . . If, however, a kill is sustained through a long period in spite of (such) variables, the record becomes very valuable as an indicator of productivity." This premise seems to be borne out with respect to good and poor squirrel hunting, based on bag limit records in Missouri (Figure 1). The years of 1950, 1951 and 1964, were very poor years by all standards of measurement. The decade extending from 1952 through 1961 was relatively a good era for squirrels and hunting as was the late 1960's. Outstanding production and harvest occurred in 1949, 1955, 1959 and 1966.

The Missouri squirrel hunter has opportunity to legally take squirrels eight months of the year. September and October were the



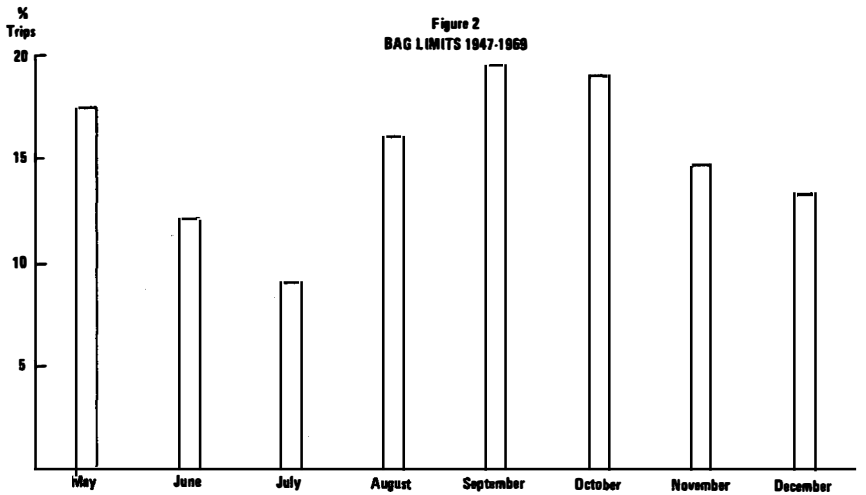


Figure 2
BAG LIMITS 1947-1969

best months in percentage of trips completed with full bag limits, 19 percent; July showed the lowest percentage of bag limits, 9 percent (Figure 2). This evaluation of squirrel hunting months was in agreement with other criteria used to measure success of harvest.

The incentive factor appears to be dependent on the availability of squirrels. As an example, September, a month noted for good hunting, had a 10.4 percent differential between the percentage of trips resulting in a bag of five and the limit of six squirrels. The difference was 2.9 percent for July, the poorest squirrel hunting month.

This incentive tendency was exhibited for seasons as well as months. The percentage of difference for trips on which five squirrels were bagged and for trips with bag limits amounted to 2 percent in 1964, a poor hunting season. An excellent year for squirrel hunting, 1966, exhibited a difference of 15.9 percent between a bag of five and six. Again, the abundance or availability of squirrels seemed to determine whether hunters achieved bag limits.

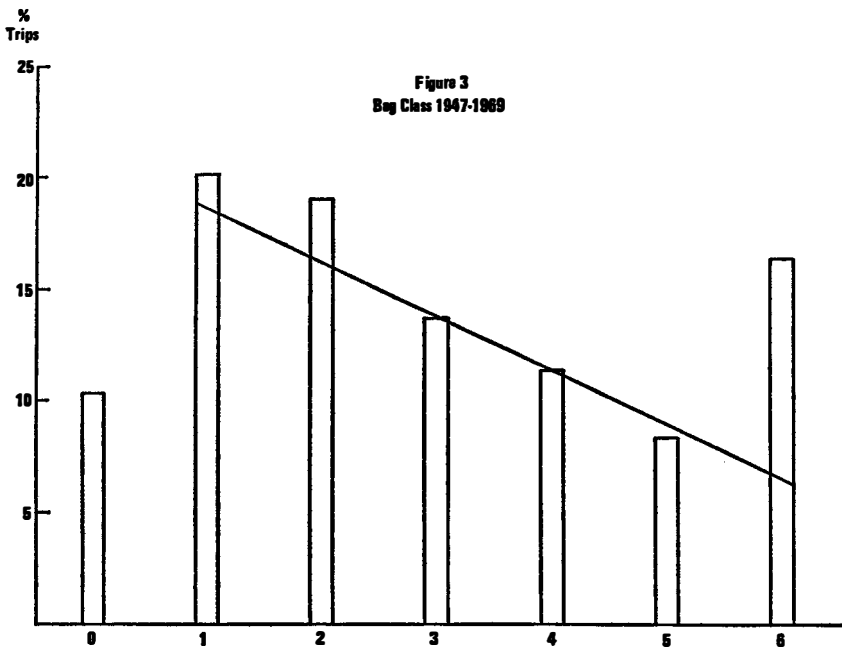
The objective here was to determine if incentive played a major role in achievement of a bag limit. Bag class frequencies and hours expended for each class were the criteria used in the analyses.

One or more squirrels were taken on 89.7 percent of the hunting trips. Hunter-check information for West Virginia as compared to hunter-record data for Missouri, showed about one-half of all hunters failed to kill even one squirrel and only 7.2 percent of the hunters attained a legal limit of four (Uhlig, 1956). The bag class percentages

for the 23 years in Missouri were: 0-10.3%; 1-20.1%; 2-19.0%; 3-14.8%; 4-11.3%; 5-8.3%; 6-16.2% (Figure 3).

Close agreement is found with dove hunting in the Eastern Management Unit where 19.4 percent of all tallied trips had bag limits of 12 in 1967-68, 22.2 percent, in 1968-69. Relative distribution of reported daily bag size showed that the bag limit exceeded all other bag classes for the year 1966 through 1968 (Ruos and MacDonald, 1969). A larger limit of 18 for 1969-70 reduced the percentage of trips with bag limits to 8.1 percent, which still exceeded percentages in other bag classes above three (Ruos, 1970). The similarity of response by hunters to bag limits on squirrels and doves, suggests incentive as a factor in the harvest of both mammals and birds.

The curious aspect of Figure 3 is the abnormal frequency of trips which resulted in the bag limit. If one ignores the zero and six bag classes, it appears that the decline in trips per bag class can be approximated by a straight linear relationship where percent of hunting trips (y) can be predicted by the equation: $y = a+b\ (x-\bar{x})$ where $a = 14.7$, $b = 3.13$, $\bar{x} = 3$, x = number of squirrels, or by a linear negative relationship for the one to five number of squirrels, *i.e.* as number of squirrels taken increased, the percent of hunting trips



showing this success decreased. Incentive may be the factor accounting for the abnormally high percentage of trips with limits.

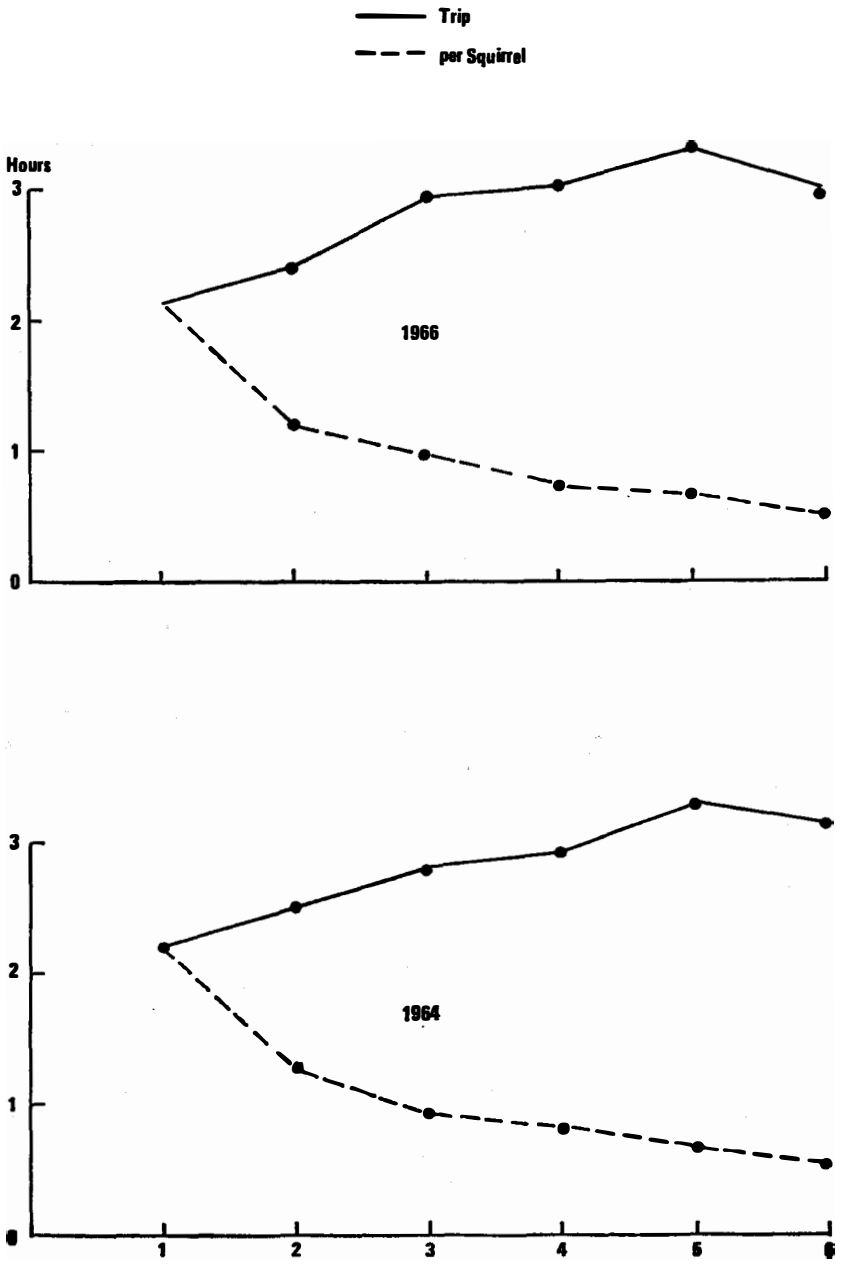
The proportion of bag limits taken, along with other criteria, serves as a measurement of harvest and hunting pressure for evaluating squirrel seasons. The cooperator group averaged only 0.86 squirrels per gun hour in 1964, a poor hunting year. Juvenile squirrels comprised 46.2 percent of the harvest and the juvenile to adult female ratio was 198:100. The proportion of trips on which bag limits were taken was 8.6 percent. Data from the 1966 season, excellent by most standards, showed 1.20 squirrels per gun hour, 52.1 percent juveniles, a ratio of 256:100 juveniles to adult females, and 24.6 percent of the trips yielded bag limits. Information for 1969, also a good year, showed averages of 1.20 squirrels per gun hour, 54.4 percent juveniles, 242:100 juveniles to adult females, and 22.9 percent of the trips resulted in bag limits.

Data from these three years (1964, 1966, 1969) were used to measure hunting effort in time, particularly for the trips resulting in bag limits. It was reasoned that if an incentive existed, then the time per trip would be longer for the bag limit class compared to the five squirrel bag class. The trip length in hours per trip by bag class, and hours per squirrel bagged by bag class, were examined for the three selected years. In 1964, the time per trip for bag classes one through six, respectively was: 2.18, 2.50, 2.79, 2.93, 3.31, and 3.12; the time per squirrel was 2.18, 1.25, 0.93, 0.73. 0.66 and 0.52. For 1966, the time per trip was 2.12, 2.40, 2.94, 3.04, 3.32, and 2.99; the time per squirrel was 2.12, 1.20, 0.98, 0.76, 0.66 and 0.50 (Figure 4). For 1969, the time per trip was 1.76, 2.23, 2.63, 3.06, 3.03, and 3.41; the time per squirrel, 1.76 ,1.12, 0.88, 0.76, 0.61 and 0.57.

It is apparent from these data that time per trip was very similar for the 3, 4, 5, and 6 bag classes. Likewise in all years the average time per squirrel in the bag was shorter for the six bag class than any other. Only minor exceptions were evident in 1969 for trip time, 0.43 hours less for the three bag class than for the four squirrel class, and 0.38 hour longer for the six squirrel class than for the five squirrel class.

One may conclude that there apparently is a "comfortable" trip time of about three hours duration. This seems to be rather constant among the 3, 4, 5, and 6 bag classes. Accomplishing the bag limit seems to be associated with availability in the six squirrel class, since time per squirrel is minimal. The possible effect of the bag limit as an incentive may be seen by comparing the time per squirrel in the five bag class to that for the six squirrel class. It is believed the hunter who kills the legal limit of six squirrels will leave the woods

Figure 4
Bag Class Effort



promptly, hence the trip time measures from the start of the hunt until the sixth squirrel is taken. The five-squirrel trip time measures the time from the start of the hunt until either the hunter kills number five and quits or continues to expend time unsuccessfully in search of number six before quitting. Actually, in the latter instance, the time should be charged to hours required to bag the legal limit of six instead of five.

Obviously, there is still much to learn about the meaning of a bag limit, as it has many ramifications. Analyses of these data are more provocative than conclusive but hopefully will be of value for encouraging in-depth studies of the bag limit as a tool of management.

In addition to data on bag classes by trips and hours, data on the time interval between each bag class is needed if the incentive aspect of hunter behavior is to be fully explored. Certainly, within the framework of a hunting trip, values of incentive must change while the hunt is in progress, due to hunter comfort, weather conditions, availability of squirrels, etc. The hunter has the incentive to initiate a hunt, but the situation and events which follow shape the end results.

This study of bag classes with relation to squirrels in Missouri suggests (1) that on successful trips the most frequent bag class is one or two squirrels (2) that most trips last no more than three hours (3)that the time per squirrel decreases as the bag increases (4) that incentive is directly related to squirrel abundance becoming functional only as squirrels become more available.

In conclusion, the attainment of a bag limit depends on matching the hunters skill with the game resource. A low bag limit in relation to availability restricts the hunters' ability to harvest a game species. A liberal limit beyond the abilities of the average hunter may depress the hunter's interest and initiative. A bag limit designed to more fully harvest a large surplus of game permits hunters to exercise their incentive to take a limit.

The bag limit is more often considered a restriction, but it can be an incentive for the hunter and a meaningful factor in game management.

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Doris M. Edwards of the Missouri Department of Conservation for patiently compiling and summarizing voluminous masses of figures from handwritten hunting records. Also, I am indebted to Cathy McKim and Gary Krause of the Department of Statistics, Agricultural Experiment Station, University of Missouri, Columbia, for thoroughly sifting the tabulations in a

statistical analysis of the data. Thanks to my fellow biologists who helped put this paper in order. Lastly, to those who made it possible, the many unnamed squirrel hunters of Missouri, a heartfelt thank you.

LITERATURE CITED

Leopold, Aldo.
1948. Game management. Charles Scribner's Sons, New York. p. 162, 481 pp.
Palmer, T. S.
1912. "Chronology and index of American game protection, 1776-1911". U.S. Dept. Agr. Biol. Surv. Bul. No. 41.
Ruos, James L. and Duncan MacDonald.
1969. Results of the mourning dove wing collection in the Eastern Management Unit, 1966-67, 1967-68, and 1968-69, multi. 30 pp.
Ruos, James L.
1970. Results of the fourth mourning dove wing-collection survey in Eastern Management Unit, 1969-70, multi. 41 pp.
Sampson, Frank W.
1970. Post-season small game harvest mail survey 1969-70. Mo. Fed. Aid Project 13-R-24, work plan No. 10-job No. 2, multi. 21 pp.
Uhlig, Hans G.
1956. Effect of legal restrictions and hunting on gray squirrel population in West Virginia. Trans. 21 N.A. Wildlf. Conf., 330-338 pp.

DISCUSSION

DISCUSSION LEADER GULLION: Thank you, Don. This is a most important paper and its significance extends far beyond squirrels in Missouri. As a general rule, those of us in the wildlife field, either as biologists or as managers in setting seasons, have been using the bag limit in the wrong way. We have been trying to limit harvest by using the bag limit rather than encouraging harvests. It appears to me, and I have had a little bit of experience with a few game species, that particularly the rangeland and the forest small-game species, are almost impossible to overshoot, even when the population is virtually extinct. So our goal is to get people out and give them the recreational opportunity for which we are managing these species. The bag limit is certainly one of the tools by which this can be done.

It's always encouraging to stand up before a group of sportsmen, particularly in the period of a low in ruffed grouse, for example, when everyone says they're extinct, there aren't any more birds, and the season should be closed. So you set a 3-bird limit; you talk to a group of sportsmen and ask, "All right, how many of you got your limit and hurt the population?" About 3 or 4 hands come up out of a hundred people. It's pretty obvious that they're not hurting the population and you're not hurting the population by a 3-bird limit, but you are getting people out there hunting.

I hope someone else has some discussion on this paper by Mr. Christisen, because I think this is an important thing.

MR. DUNCAN MACDONALD (Migratory Bird Population Station): With relationship to 5 versus the 6 bag limit, there was a suggestion in your graph of the overall data of the psychological impact of the bag limit in that the 5 bag limit fell below the line and the 6 was well above, the 5 being considerably lower than the 4, in relationship to the trend. This trend, when dealing with mourning dove data, which—with a much larger bag limit—is much more obvious, in that 10 is significantly higher than 11. Filling a straight line relationship down to 10, there is a very low number of 11 bag limits and of course, the total bag limit of 12 is much higher.

MR. CHRISTISEN: I don't know that I can offer too much on that. We have been fortunate in having this single limit through the years of the study. I wish now that we had an opportunity to test some other limit on squirrels. In examining the literature, of course, I found information pertaining to doves, which you and Mr. Ruos compiled. There may be some information available on waterfowl. However,

it would be difficult to analyze because of the varying limits for different species of waterfowl.

Regarding our squirrel data, in each of the 23 years, we had this upturn from a bag of 5 to a limit of 6; and it was only in years that we had poor production and a poor hunting situation that we noted a smaller difference between 5 and 6. It has been rather consistent.

DR. GULLION: This bag limit business is an important problem to consider, as it provides an incentive to get the hunter out. But we can't depend upon the bag limit alone. We need a public relations program—an extensive one—to inform hunters that the game is there and that they should get out and take advantage of it.

I had an interesting opportunity a number of years ago to experiment with Gambel quail in Nevada. Out of curiosity, we doubled the bag limit one year from 10 birds a day to 20 birds a day. The average bag increased by 2/10 of a bird. Hunting pressure increased from about 500 hunter days to about 1800 hunter days. We still fell way short of an adequate harvest, but I think we came a whole lot closer to playing the proper role of a wildlife resource manager with our double bag. There was only one problem. We sent quite a number of hunters to the hospital with fatigue from the long hunt.

MR. LEVI MOHLER: I think some of this could apply to big game too. Many of us recognize that there are at least two kinds of hunters. Most of them go out for 2 or 3 hours and then they've had it. Included in this group are some who want to get back for a coffee break or to watch the football game. Then there is the group of ardent hunters—they're probably those who will always take the 6 that Don mentioned. If we didn't have a bag limit, most of the hunters would still be taking their 3-hour hunt and bagging the 2 or 3, or whatever seems to be the ordinary amount. Those who take a full day or can spend more time, would likely take the 6, or some greater number.

It might be that if we have a bag limit that is a little beyond the reach of the average, this would give incentive for the ordinary 2 and 3 class squirrel hunters to try to get into this other class. It is an interesting thing to watch.

MR. CHRISTISEN: On learning that I had a paper on squirrels, my Oklahoma friend, Joe Ellis, related a story which about sums up the bag limit case on squirrels.

One of their mission-oriented game managers, geared to the local function of lecturing on-site for visitors, would give a short resume on the finer points of management for each species. When he came to squirrels, his stock commentary was to the point—"There are some years when the bag limit should be low; but then there are other years when it should be a bushel or two." I think that about sums it up on squirrels.

DR. GULLION: That would certainly be effective utilization of a renewable resource, and I think that's what this is all about. It's interesting to look at the bag limit and what can be done with it. It can be used very effectively as an incentive and most appropriately so, in this business that we've been in for so long. In trying to reduce harvest or limit harvest or ration harvest through the use of bag limits, I think we have been barking up the wrong tree. So I was particularly interested in Don's comments, because they come close to the way I have felt for a long time. I've felt that part of our wildlife resource can take a lot more harvesting than it ever gets. In our forest and range species, hunters are taking a very small fraction of what the predators take every year. If we're trying to produce wildlife for recreational hunting, then let's get some into the hunter's bag and not restrict hunting so severely that it doesn't pay to go.

I don't think we have much more discussion here, apparently, so I believe we can go on.

CHAIRMAN CHAMBERS: In our final paper, in looking into man's impact upon the environment and the reaction of some of species to it, we're going to hear a paper on the endangered species program.

Since he first appeared on the scene, man has affected other creatures in many

ways; mostly adversely, sometimes deliberately, but for the most part, unintentionally. But today, most endangered species are accidental victims of man's drive to produce a better standard of living for his increased numbers. Habitat destruction and environmental degradation are the primary reasons for the endangerment of wildlife.

So long as the human population increases, so also will the pressures on our wildlife. Until the human population is stabilized, the best we can hope to grant any wildlife species is temporary reprieve. Today, we have Mr. Harry A. Goodwin, of the Bureau of Sport Fisheries and Wildlife to talk to us about the endangered species program.

STATUS OF ENDANGERED SPECIES PROGRAM

HARRY A. GOODWIN AND ELEY P. DENSON

Office of Endangered Species, Bureau of Sport Fisheries and Wildlife, Washington, D.C.

INTRODUCTION

Man's interest in preserving endangered species is essentially self-centered. The fish and wildlife resources of the Nation are valuable and essential ingredients of our environment. Their preservation has a practical objective separate from the ethical consideration that each species has a natural right to survive. The extinction of a species reduces potential for future scientific, medical, economic, and recreational benefits.

In 1966 the Department of the Interior was directed to develop and coordinate a national endangered species program. The Endangered Species Conservation Act of 1969 directed it to support a comparable international effort. It seems appropriate at this time to report some of the accomplishments since 1966.

One of the first tasks was to identify native species in need of help. This was accomplished with the aid of the scientific community, federal and state biologists, and private conservation organizations. Some 101 names are on the most recent list published in the *Federal Register* October 13, 1970. A similar list was also prepared for foreign species in 1970. A few species have been removed from the list when they were placed under adequate management or when it became apparent that their condition was less serious than first believed. Four birds thought to have been extinct have been rediscovered, and the Caribbean monk seal was dropped after we reluctantly concluded it was extinct.

The name endangered species "Program" is somewhat of a misnomer, since "program" connotes movement toward a goal by a single agency, a pattern into which the national effort to save endangered species does not fit. Actually, the program has been a combination of

the actions of several agencies of the Federal and State Governments, private foundations, the press, corporations, individuals, and the scientific community. Acquisition of an underground pool by a private organization to save a unique blind cave salamander was as much a part of the program as the well-publicized international effort to save the whooping crane. Several professional groups have established committees to study endangered species and recommend appropriate action. The World Wildlife Fund has contributed $15,000 toward a study of the Puerto Rican parrot, and $10,000 to help fund a study of timber wolves. All this can be considered part of the "program."

Before a species can be saved, the public must desire its survival. And seldom has a government-sponsored effort received such overwhelming public support. Numerous books and articles published in 1968, 1969, and 1970 alerted the public to the problems of survival for both man and wildlife. Television series on individual endangered species and environmental programs became popular in 1970. Unfortunately, both television and the press have tended toward overdramatization and overly simplified solutions to complex problems.

LEGAL AUTHORITY

The Endangered Species Act of 1966 extended the Department of the Interior's authority to conduct research on native endangered fish and wildlife, engage in captive propagation for reintroduction in the wild and acquire habitat for their preservation. It directed the Secretaries of the Departments of Interior, Agriculture, and Defense to protect endangered species and their habitats on the lands which they administer when such action is consistent with the primary purpose of the area. The 1969 Act directed the Secretary of the Interior to develop a list of species in danger of worldwide extinction and to permit their importation into the United States only for very limited purposes. The Act also authorized technical assistance to other countries for the management of fish and wildlife but no money has been appropriated. It directs the Departments of State and Interior to seek international agreements for the protection of endangered fish and wildlife. Although not a part of the Endangered Species Conservation Act, the same law extended the prohibitions of the Lacey Act against shipment in interstate commerce of mammals and birds taken or exported contrary to state or foreign law to include reptiles, amphibians, molluscs, and crustaceans.

The Act provides no additional federal authority to control the taking of endangered species. The states have primary responsibility for providing legal protection. For example, the Louisiana Legisla-

ture recently prohibited the shooting, trapping, or killing of hawks, owls, eagles and ospreys. Similar measures have been adopted by many states. Several states have passed legislation specifically to protect endangered species. A model state law, developed for the International Association of Game, Fish and Conservation Commissioners, has been the basis for bills considered or passed in several states.

Protection by a state is not synonymous with a prohibition against hunting. As a practical matter, few currently endangered creatures are actively sought by hunters. When overharvest or deteriorated or probable loss of habitat has threatened game animals and birds in the past, the interest of sportsmen often spelled the difference between survival of the species and its unnoticed demise. The desire to view a species can often be satisfied by small populations in a few parks. Large numbers of a species are only essential for man's purposes if the animal has an economic or recreational use.

GOALS

The program's goal is to protect and preserve endangered fish and wildlife in their natural environment. Success will require dispersed, self-sustaining wild populations. If captive propagation is undertaken to produce animals for reintroduction, the inherent wild qualities of appearance and behavior must be retained. The impact of industrialization, urbanization, and intensified agriculture on the environment may prevent us from saving some species from extinction. Clean water and uncontaminated land is scarce as a result of farming and lumbering operations, controlling insects and diseases with pesticides and herbicides, and converting wild land to urban and industrial use. Many species are affected by insidious degradation of their environments or massive changes in land use. This is usually the root of the problem, rather than deliberate killing by man.

The goal is not to prevent the use of wildlife by man, though many would use the endangered species program to achieve this objective, but rather to prevent the extinction of those species which can be saved and encourage their management and conservation.

RESEARCH

Concurrent with identifying the species endangered, it is necessary to identify the reasons for their plight and the measures by which the condition can be improved. Information about the environmental needs of some endangered species is being obtained but life history data on many other species of endangered wildlife and most species of endangered fish are still inadequate. Some forms require preservation

or restoration of habitat; others, protection from man or reduction of competition from introduced species. The methods to assure the preservation of many endangered species are still unknown.

Just as it may be almost impossible to identify a single factor most responsible for the endangerment of a species, there is rarely a single, well-defined solution. The center of Federal basic research on endangered birds and mammals is the Patuxent Wildlife Research Center's Endangered Wildlife Research Program at Laurel, Maryland. This facility is being used to study diseases and nutrition of threatened species and to maintain small captive populations to produce stock to replenish depleted wild populations.

Seven biologists from the Center are currently investigating the status, distribution, ecology, behavior, and physical characteristics of endangered or numerically rare species and devising management techniques to improve the chance of survival of these species. The black-footed ferret, Puerto Rican parrot, California condor, Everglades kite, and a number of species in Hawaii and the Southeastern States are being studied. Ultimately, 17 biologists will be in the field, and an ecological study of the higher vertebrate fauna of American Samoa and the Trust Territory of the Pacific Islands is planned.

We have no similar center for studying endangered species of fish. Part of the reason for this is that endangered fish, for the most part, do not capture public attention and support to the degree that birds or mammals do. The lack of public support undoubtedly influences the lack of budgetary support—that difficult process where those who are responsible must decide which current priority to support with limited resources. In lieu of establishing a center for studying endangered fish the Bureau has supported numerous small studies in the Cooperative Fishery Unit program and we are supporting a small-scale study of the nutritional and environmental requirements of the Lahontan cutthroat trout.

Research is the underpinning for the other program components. A better understanding of ecological requirements of endangered species is essential for developing management practices to maintain optimum conditions in existing habitats or for acquiring new habitats.

No federal, state or private agency has the facilities or personnel to perform all the needed research. This must be a cooperative venture between the Federal and State Governments and the universities.

CAPTIVE PROPAGATION AND REINTRODUCTIONS

Captive propagation insures against calamitous loss of the wild population. This possibility is only too real when a bird or mammal occupies an extremely limited range during all or part of each year. A

late hurricane, an oil spill on the wintering grounds, or a severe hailstorm across the breeding grounds constantly threatens whooping cranes.

Individual scientists, zoos, and the Bureau of Sport Fisheries and Wildlife are studying, exhibiting and raising endangered or potentially endangered species in captivity. Among such species are the Texas red wolf, Aleutian and nene geese, and the whooping crane.

Captive propagation complements conventional wildlife management methods. It is most applicable with those species whose response to other restoration measures is not sufficient to assure their survival.

Whenever possible, experimentation with endangered species is avoided by testing techniques with closely related, but more abundant, forms. For example, three races of sandhill cranes are being utilized to develop propagation methods for use with whooping cranes. The abundant South American snail kite, the Andean condor and domestic ferret are serving as stand-ins for the Everglades kite, California condor and black-footed ferret.

With protection and management, endangered species frequently increase to the point where some of them can be transplanted to vacant habitats elsewhere, thus increasing the probability of the ultimate survival of the species. Delmarva Peninsula fox squirrels were transplanted in 1969. Greenback cutthroat trout (the original cutthroat of the upper South Platte River, Colorado) have been moved from Black Hollow Creek into Hourglass Creek in the Roosevelt National Forest, where they can be protected from competition with introduced brook trout.

Low populations and prolonged periods of adversity eventually may pass and conditions then become more favorable for the survival of a species if only some stock remains. Successful propagation techniques were known for passenger pigeons in the late 1800s; but no sustained effort was made to preserve a reservoir of captive breeding stock, and their loss is permanent.

Remarkable accomplishments have been made in building depleted game populations and furbearers by reintroducing them to their former ranges, but we do not intend to introduce species into habitat outside their natural range—unless such action is necessary for their survival. Transplanted endangered birds include Laysan teal and Laysan finch from Laysan to Southeast Island off Pearl and Hermes Reef and the Nihoa finch removed from Nihoa Island and released on French Frigate Shoals.

Mexico is cooperating. Masked bobwhite quail, a subspecies extirpated from the Southwest near the turn of the century, still exist in limited numbers in northern Mexico. Mexican officials permitted a

Bureau biologist to study the birds and capture 36 in 1968 and 21 in 1969 for propagation in the United States. In cooperation with the state, over 325 offspring of the Mexican birds were released in Arizona in 1970 in habitat restored to productivity.

The Canadian Wildlife Service and the Bureau of Sport Fisheries and Wildlife are endeavoring to strengthen wild populations of whooping cranes which migrate between the two countries. This venture includes taking a single crane egg from each of several nests in the Canadian wilds to be hatched at the Bureau's Endangered Species Research Station at Laurel, Maryland. Cranes normally lay two eggs, but a pair of cranes rarely raises more than one chick to maturity. Descendants of these birds will be returned to the wild to establish additional wild populations. This program has added 14 birds to the captive population without detriment to parallel efforts by both countries to increase the wild population.

Brood stocks of rare or endangered fish are being developed in Bureau hatcheries to renew or reestablish depleted populations that have value for sportfishing. The Bureau is propagating blue pike in South Dakota and Lahontan cutthroat trout in Nevada.

HABITAT PRESERVATION

The Bureau of Sport Fisheries and Wildlife administers the National Wildlife Refuge System within which endangered species preservation is one of the primary objectives. The trumpeter swan, bison, pronghorn antelope, and desert bighorn are proof of the possibility of keeping a species from passing into oblivion; all are perpetuated on national wildlife refuges. Bureau administered refuges harbor twenty-five endangered forms of wildlife. The Bureau has acquired 2,991 acres in fee for the key deer in Florida, 252 acres for the bald eagle in Virginia, and 19,172 acres for the alligator in Georgia. There are plans to acquire lands for the Columbian white-tailed deer, Delmarva fox squirrel, bald eagle, black-footed ferret, dusky seaside sparrow, and additional land for prairie chickens.

Hawaii is attempting to preserve the remaining habitat of its endangered species. Four areas, totalling 44,138 acres, have been set aside as nene goose sanctuaries by cooperative argeement. Two ponds on Maui have been classified as sanctuaries for the Hawaiian stilt, duck, gallinule, and coot. On Kaui, 9,939 acres of the Alaskai Swamp have been designated as a wilderness preserve, primarily for the benefit of endangered native forest birds.

Nevada, in cooperation with federal agencies, is identifying and preserving remnant habitats of its native fish. California has estab-

lished the Owens Valley Native Fish Sanctuary to protect the Owens Valley pupfish and is considering an area for the Modoc sucker.

Habitat is more than land alone. Red-cockaded woodpeckers use only decaying pine trees about 80 or more years old for nest sites. Routinely such trees are eliminated in the course of timber management. The Forest Service and the International Paper Company are now searching out and saving such trees. The Forest Service has set aside an area in Oregon for ospreys and is identifying and preserving bald eagle nest trees along the coast of Admiralty Island in Alaska. The Bureau of Land Management has given public notice of its intention to designate 26,000 acres of public lands as a birds of prey sanctuary. The proposed "Snake River Birds of Prey Natural Area" would cover canyon walls, rims, and floor of a 30-mile stretch of the Snake River in Idaho. It is also developing additional water areas for pupfish.

Private groups are also helping. The World Wildlife Fund has purchased a sanctuary for the Attwater's prairie chicken in Texas. The Texas Chapter of The Nature Conservancy has acquired Ezell's cave in Hays County, Texas, to preserve the only known habitat of a rare blind salamander.

Loss of habitat has caused the extinction of many species, but acquisition of habitat alone will save only a few species from extinction. It is neither a panacea nor a realistic solution to the problem. No refuge, no matter how remote, is secure from the effects of pesticides and other pollutants. The quality of total environments must be protected.

PROTECTION AND MANAGEMENT

Management and protection take many forms. Bald eagles and condors tend to be intolerant of disturbance while they are nesting; they need isolation from man at this time. Alligators must be protected from poachers, and the states in which they occur now attempt to give them this protection; the 1969 amendment of the Lacey Act is helping. Killing grizzly bears was generally unregulated a few years ago, but they are now managed as game species; wilderness areas where they can survive without serious conflict with man have been designated. Their future is reasonably secure, and it has been possible to remove them from the endangered list. It will probably be possible to remove the eastern timber wolf and the alligator from the list when it is next revised thanks to recent legislation and management decisions. Methods used to reduce predation on livestock or rodent damage to rangelands have been modified to minimize the

chances that species such as the condor, black-footed ferret, and San Joaquin kit fox will be accidentally harmed during operations aimed at noxious wildlife.

Action programs have been developed in some states, Nevada's Endangered Species Committee, Oregon's designation of its rare and endangered species, California's new section of its Fish and Game Department which deals primarily with nongame birds and mammals, and Wisconsin's efforts to restore species formerly native to that state are examples.

Proposals to introduce exotic species into the environment must be critically evaluated. Introductions should be prohibited unless effects on the native wildlife can be predicted accurately.

Diseases have been brought to native species through the introduction of alien hosts. Introduced birds and mosquitoes brought avian malaria to the Hawaiian Islands with fatal results to some of Hawaii's native birds.

Introduced animals may prey directly on endangered native forms. Eradication of arctic foxes, which were landed on the Aleutian Islands by early fur traders, is necessary before the reintroduction of Aleutian Canada geese on the Bureau's island refuge in 1971.

Private individuals or companies own virtually all the cropland, 70 percent of the grassland, pasture, and range, and 60 percent of the forests of our Nation. Many private concerns have issued policy directives and regulations to provide protection for endangered wildlife on lands under their control. The Northern States Power Company of Minneapolis has adopted rules to protect bald eagles on 30,000 acres along the St. Croix River in Minnesota and Wisconsin. The Boise Cascade Corporation has issued a policy statement covering protection of bald eagles in their 2,300,000-acre Minnesota operating area. The Red Lake Band of the Chippewa Tribe has placed its 500,000-acre reservation in north-central Minnesota under a bald eagle protective program. The Weyerhaeuser Company is protecting eagle nest trees on its Washington and Oregon tree farms and is conducting public education programs.

Some endangered trouts have been hybridized and overwhelmed by repeated planting of related species. To prevent their complete extinction, selected areas have been set aside and will be protected from further intrusions. The Arizona (Apache) trout has been introduced into two lakes (one built especially for that purpose by the White Mountain Apache Tribe) and fishing is prohibited in Ord Creek and the Upper East Fork of the White River, where remnant populations survive.

Bureau fishery biologists are surveying the status of endangered

species of fish on federal lands and are cooperating with state biologists in work on private lands. Biologists review plans for habitat rehabilitation or fish stocking which could affect those species that need special protection or place competitive varieties of fish in waters which support endangered species.

Bureau studies of proposed reclamation and flood control projects direct particular attention to the potential effects on endangered species. On the basis of probable effects on the California condor, the Bureau recommended that dams and recreational developments not be placed in the Sespe Creek area of the Los Padres National Forest, California. The effects on the Yuma clapper rail of dredging along the lower Colorado River and construction of a power facility at the head of the Havasu Reservoir are currently under investigation.

Some of the commercially valuable sturgeons and the Atlantic salmon continue to decline from the loss of freshwater spawning habitat and from overfishing. Overfishing can reduce a population to the point that exploitation is no longer feasible, but it is doubtful that because of the diminishing return for fishermen's effort, overfishing alone can actually cause the extinction of a species of fish. Nevertheless, we must manage declining populations of potentially valuable food and sport fish properly as well as protect their riverine and estuarine habitats.

Estuaries are the least understood and most abused of our water resources. They are, in many places, richer than the richest farmland. Pollution continues to reduce their biological productivity, dredging ruins bottom flora and fauna, and filling for residential and industrial expansion eliminates them forever. The recent successful fight to delay the filling of San Francisco Bay is a cheering example of citizen concern for the environment closely tied to the preservation of endangered species.

Diversion of streams from one basin to another and misuse of scarce water supplies threaten the existence of a number of little-known native fish. Few of these species offer any promise of recreational or commercial use, but they are being protected on federal lands for their scientific value.

Unfortunately, the majority of funds for fish and wildlife management in most states comes from license fees and taxes imposed on sportsmen. Sportsmen alone cannot be expected to finance the effort to protect endangered nongame fish and wildlife. Additional sources of revenue are needed.

The basic premise of the 1969 Act was that United States citizens should not contribute to the extinction of the wildlife of other countries. Despite great publicity to the contrary, we have concluded

that international trade is a relatively minor factor for most species which are endangered today. Certainly there is poaching, overuse and inadequate management of some species but these factors are insufficient to threaten extinction in most cases. An outstanding exception has been the whaling industry in which persistent overharvest has driven species after species to the brink. Here, the United States has contributed 25-30 percent of the world market. In the fall of 1970 after many involved legal maneuvers and diplomatic protests, all the great whales were placed on the list of foreign endangered species and importation of their products prohibited. We are happy to report that our action appears to be encouraging more effective management and that realistic quotas and an international observer system may soon be enforced. If so, whale products may once again enter the United States market. As an interesting aside, officials of one company have informed us that they have reformulated their sulfonated lubricants with a cheaper ingredient than sperm oil, an accomplishment which the importers asserted was impossible only six months ago.

THE BENEFITS

Preserving endangered species cannot be quantified or evaluated by ordinary economic procedures. There are not standards for establishing the monetary worth of preserving species for unforeseeable future uses. The question is: Can we afford to discard them because we cannot now foresee an economic or scientific benefit? Fifty years ago few would have foreseen the value of fruit flies for genetic research or would have believed that the sea otter and saiga antelope could be restored to become items of economic significance. The value of primates and other lesser animals for biomedical and pharmaceutical work was largely unsuspected 50 years ago. The suitability of night monkeys for research on malaria was discovered just six years ago.

Many of the threatened species can supply information on the basic biological processes, products for the needs of man, and information on behavior and response that has direct application to man, and can provide living "gene pools" from which better strains of domestic stock may be developed. In their natural environments they provide living laboratories for study of ecosystems in all their variety and complexity.

Benefits accrue to human health and welfare. But what is the value, in terms of dollars, of the resource that permits such advancements in science and medicine? The techniques of heart transplant were pioneered with subhuman primates. But apes and monkeys are becoming scarcer every year. The endangered species program would

protect these diminishing resources and assure a supply for future achievements.

Rewards for research expended may not accrue as rapidly for endangered species as they have for some of our game species, such as the elk and wild turkey, which were once in serious straits. Even the game species were not restored to productive use until much money for research, habitat acquisition, and management had been expended.

Throughout the world, animals once found only in the wild are raised commercially for products or for food. In parts of Russia and Africa, wild animals once threatened or nearly extinct have proven capable of producing meat more economically than domestic livestock and are being regularly harvested for meat and hides.

One can speculate at other benefits. Experiments are being conducted on the use of Florida manatee to clear southern waterways of the imported pest water-hyacinth. Millions have been spent on unsuccessful chemical attempts to control this plant.

Each year a healthy animal population will produce young. If food and water supplies and habitat are available, it is possible for the young to survive and the population to increase. But if these conditions are not present, then adults and young will die and the number of breeding animals will gradually decrease. Over the years this can lead to extinction. Rational management of wildlife keeps the population in balance with available habitat and birth rate.

Today we enjoy both aesthetic and economic benefits from species once threatened with extinction. Economic benefits arise from the sale of services and goods to those who travel to see a whooping crane wintering on the Texas coast, from the $3.4-million value of the raw skins harvested from fur seals and northern sea otters, and from supplying those whose favorite recreation is hunting restored species, such as the turkey, white-tailed deer, pronghorn, and wood duck. It should be possible to rebuild huntable populations of the Sonoran pronghorn, Hawaiian goose, Aleutian Canada goose, Mexican duck, and masked bobwhite quail. The endangered trouts and blue pike should once again fill fishermen's creels. Alligators can again become the basis for a multimillion-dollar hide and leather products industry.

The values of wildlife go far beyond the market value of the individual fish, bird, or mammal, and the value of each group is clearly associated with the diversity of species. A zoo with nothing but bears or lions would attract few visitors. A world inhabited only by domestic species could not compare favorably in interest with the natural world and its variety. The value of threatened wildlife exceeds any tangible market price. Without being able to enjoy any of the other benefits, more and more Americans are finding satisfaction

in knowing that the timber wolf or blue whale or any of the other endangered species still lives.

DISCUSSION

DISCUSSION LEADER GULLION: Thank you, Mr. Goodwin. I'm glad you mentioned the timber wolf. I live in northern Minnesota and we have some problems with that endangered species there. Wolves are accused of taking children off school buses as they come home from school, and we have a strong movement afoot to put the timber wolf back on the bounty list, from which we were able to remove it about 4 or 5 years ago. I wonder if Mr. Goodwin has any comments about what to do when you have a predator species that is supposedly preying upon people. Of course, I don't believe it.

MR. GOODWIN: I am happy that you mentioned the bounty, because the bounty in Minnesota obfuscates the critical issue in Minnesota. The critical issue is that the animal is not protected. It is an unprotected animal. It can be killed any place, any time and—with one or two exceptions—by almost any method in Minnesota. This, I don't consider a correct attitude toward any animal.

DR. GULLION: You expressed my sentiments completely, because we have what I believe to be a ridiculous situation in our state. Of course the Forest Service has taken strong measures within the last 2 or 3 months to extend protection to the timber wolf in the Boundary Waters Area, and I don't think that the present danger to the timber wolf is great, though they do range out and are certainly being killed in other parts of the state. But we have some problems with our endangered species management. It is really a public relations program as much as anything else, convincing people that the wolves are not a real hazard to school children. You'd be surprised at what we see in letters to the editor. There was an episode last year when I had a technician come back in and report that he had been chased up a tree by timber wolves; and this supposedly was a fairly credible individual. It can get to be a pretty emotional problem in dealing with some of the large predators in their relations to man.

MR. LARRY GALE (Missouri): We all have noticed a great increase in the amount of public interest and public support for protection of endangered species. Mr. Goodwin, do you feel that this public interest may make it difficult to reclassify animals when they have again become numerous enough to support harvest? I am thinking of the alligator as an example. Does the Bureau have any plans to conduct an educational program to sell the idea to the public that *once* an endangered species doesn't necessarily mean always?

MR. GOODWIN: I think we have a real serious matter before us. There is going to be, without any question, public reaction against placing once-endangered species on a list that permits them to be taken. This is a result of the tremendous emotional concern that we find rampant today and misdirected in many instances, over man's effect on wildlife—carried to the extremes of closing markets to products that probably should not be so closed.

We intend to take the alligator off the endangered species list. It will be removed. We have worked with the southeastern states. The critical factor with alligators, as far as the direct matter was concerned, was poaching. Now, we have poaching under control—not completely eliminated, but under control. Through marking and tagging systems and through the 1969 amendment to the Lacey Act, we can control interstate commerce, or at least, see that illegal commerce does not go on. Then we should reopen the markets to alligators.

Many of the marshlands throughout the Southeast could provide a very valuable resource to commerce. There should be no inhibitions against the use of wildlife, so long as it is not misused or abused.

We have removed the grizzly bear, as an example, from the original endangered species list. Our concern at that time was that it was not being adequately managed by the state. This could be argued, once the state showed us that they did

intend to manage it adequately and to preserve it, then we were perfectly happy to take it off the endangered species list.

MR. JERRY PRATT (Hawaii Chapter of the Wildlife Society): There seems to be a slight error in the understanding of the status of the Hawaiian stilt. There are not, at the present, any refuges for that bird on Maui as was stated. The most important area, Kanaha Pond, is state property, but it is part of the Kahului Airport, and the state has just restated its position and it has no intention of transferring that land to the Department of Land and Natural Resources so it can become a permanent wildlife refuge.

The other area is privately owned and could not be considered as a wildlife refuge either. So the stilt is in a bad way, and everybody should know it.

MR. GOODWIN: I know of that, Mr. Pratt, I agree with you. Kanaha Pond is in that status, but, at the same time, it is posted, if I am not mistaken, as a wildlife refuge. Certainly, I agree with you that it should be brought under the direct administration of the Fish and Game Department in the Department of Natural Resources. You're going to have to work on that a little more, though.

MR. DENNIS RUSSELL (Texas): What evidence have you that the possibility of enforcing the laws on the traffic in alligator hides has been developed to such a point that the alligator market would be tightly controlled? It never was in the past. Has the law enforcement situation improved that much? It's been closed, that's why it's improved.

MR. GOODWIN: Before the amendment to the Lacey Act, there were no federal laws on alligators. There were very few state laws because only a few states had alligators. Any alligator hides that could be taken out of the southeastern states and shipped into New York and New Jersey, was home free, because there was no law in those states on alligators and there was no Federal law that would apply. This was the objective of the amendment to the Lacey Act, to make it illegal to put into interstate commerce, any reptile or amphibian that was taken illegally in the state of origin. With that, any hides that are not properly marked and shipped become contraband and can be confiscated and the guilty persons, and even the carrier, can be fined. So that is the potential of the law.

DR. GULLION: I did not participate in the selection of papers for this session, so I can take the freedom of commending the Chairman for the very fine choice of papers we've had. We've had a wide selection all the way from discussing a species that is beginning to far exceed its habitat and overrunning its habitat to one that could effectively prey upon man if we let it do so, to species that are indeed in danger as a result of this one species so badly mutilating its habitat. So I think we've had a very fine diversity of papers and I would like to applaud the Chairman for his choice.

CHAIRMAN CHAMBERS: Thank you, Gordon. This concludes our Field and Forest Session today, and I would again like to thank each of the persons that participated in the program.

TECHNICAL SESSION

Wednesday Morning—March 10

Chairman: DAVID WALLACE
Director, Marine and Coastal Resources, Department of Environmental Conservation, Ronkonkoma, New York

Discussion Leader: RICHARD VAN CLEVE
Dean, College of Fisheries, University of Washington, Seattle

INLAND, COASTAL AND MARINE

REMARKS OF THE CHAIRMAN

DAVID WALLACE

Ladies and gentlemen, I would like to welcome you to this technical session on inland, coastal and marine matters.

I have the unpleasant duty of announcing that our discussion leader, Dr. Richard Van Cleve, of the University of Washington, two weeks ago suffered a severe heart attack and is hospitalized and will not be able to be with us today. Therefore, under the circumstances, I am going to serve in a dual capacity and I hope that you will bear with me.

We have a most interesting group of papers to be presented this morning and I am sure that you will enjoy them. We will welcome questions to the speakers as soon as they have finished their particular presentation.

PROBLEMS CONFRONTING MIGRATORY BIRDS IN ALASKA

JAMES C. BARTONEK
Bureau of Sport Fisheries and Wildlife. Fairbanks, Alaska;
JAMES G. KING
Bureau of Sport Fisheries and Wildlife, Juneau, Alaska; and
HARVEY K. NELSON
Bureau of Sport Fisheries and Wildlife, Jamestown, North Dakota

There is little nationwide concern for the welfare of migratory birds in Alaska because the extensive habitat is still relatively unspoiled and sparsely populated. We believe there should be concern by all Americans who seasonally share this resource with Alaskans and a greatly expanded program to study, understand and safeguard it. Hindsight can only suggest the many values of such a program if started, for example, in the northern prairies during the early 1900's or on the Atlantic seaboard in the 1850's when waterfowl and their breeding habitats were still plentiful. In Alaska Americans have their last opportunity to apply what they know about conservation principles and practices to a yet relatively unspoiled area.

We describe in this paper problems affecting the well-being of Alaska's migratory birds in the belief that recognition of these problems is a step towards finding solutions and a requisite for effective management.

MIGRATORY BIRD RESOURCE

Alaska is about one-fifth the size of the conterminous United States and has one-half of the nation's coastline and two-thirds of its continental shelf. Its lands and waters support a tremendous bird resource of international value to people throughout the continent and across the Pacific Basin. Gabrielson and Lincoln (1959) reported that the avifauna consisted of 321 species, nearly half being waterbirds. These birds disperse to the four great North American flyways and to Arctic, Asiatic, and Pacific Oceanic flyways as described by Gabrielson and Lincoln. Over one-fifth of the state's 586,000 square miles is good waterfowl and shorebird breeding habitat (Figure 1) and most of the remainder of the ice-free land, although marginal, is productive of birds. Portions of the 34,000-mile coastline are used by nesting seabirds (Figure 1) and the offshore areas provide a vast, unmeaured habitat for summering and wintering birds. Information on the

Oklahoma Cooperative Wildlife Research Unit
404 Life Sciences West
Oklahoma State University
Stillwater, Oklahoma 74074

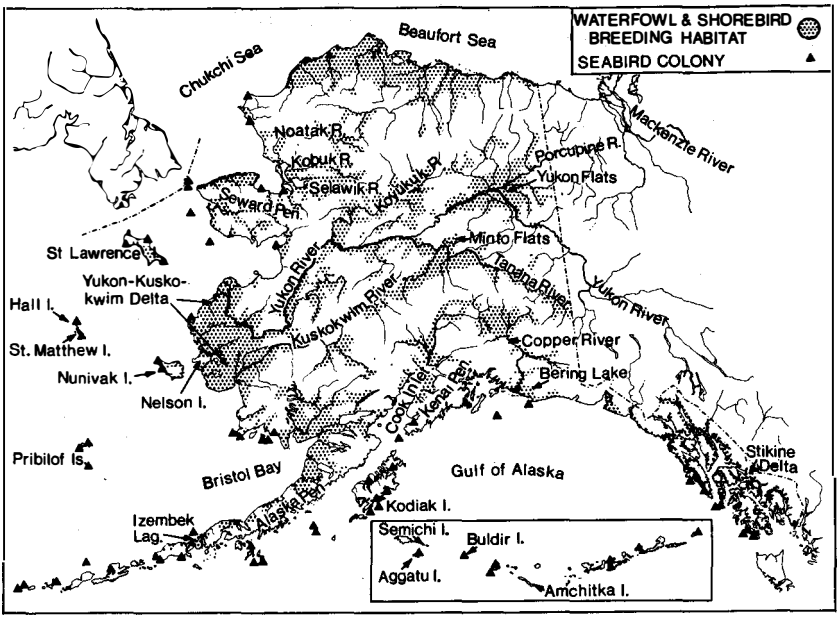


Figure 1.—Principal habitat of breeding waterfowl and shorebirds and known sites of major seabird colonies.

distribution and populations of most species of birds is, at best, scanty.

Several species and subspecies of waterfowl nest either primarily or entirely within the state. Dusky Canada geese (*Branta canadensis occidentalis*), cackling Canada geese (*B. c. minima*), Aleutian Canada geese (*B. c. leucopareia*) and Aleutian common teal (*Anas crecca nimia*) breed only in Alaska. Emperor geese (*Philacte canagica*), black brant (*Branta nigricans*), Taverner's Canada geese (*B. canadensis taverneri*), Vancouver Canada geese (*B. c. fulva*) and common scoters (*Oidemia nigra americana*) breed mainly within Alaska. More than two-thirds of all trumpeter swans (*Olor buccinator*) and about half of all whistling swans (*O. columbianus*) and white-fronted geese (*Anser albifrons*) nest in the state. Many other species of waterfowl either nest, summer, or winter there; but they can also be found elsewhere in North America and in Asia in equally important numbers.

Pelagic birds, loons, gulls, raptors, shorebirds and passerines are a conspicuous part of Alaska's bird resource. Alaska is the only place where black turnstones (*Arenaria melanocephala*), bristle-thighed

curlews (*Numenius tahitiensis*), surfbirds (*Aphriza virgata*), western sandpipers (*Ereunetes mauri*) and Kittlitz's murrelets (*Brachyramphus brevirostre*) are known to breed. McKay's snow buntings (*Plectrophenax hyperboreus*) breed only on Hall and St. Matthew Islands. Red-legged kittiwakes (*Rissa brevirostris*) breed only on the Pribilof Islands and the Komandorskie Islands. Alaska is the only breeding area in North America for such otherwise Palearctic breeding species as the bluethroat (*Luscinia svecica*), white wagtail (*Motacilla alba*), yellow wagtail (*M. flava*), Arctic warbler (*Phylloscopus borealis*), bar-tailed godwit (*Limosa lapponica*), long-billed dowitcher (*Limnodromus scolopaceus*) and rock sandpiper (*Erolia ptilocnemis*). Sandhill cranes (*Grus canadensis*) nest throughout most of Alaska and many thousands pass through to nesting grounds in Siberia. Alaska provides an uncertain stronghold for bald eagles (*Haliaeetus leucocephalus*) and peregrine falcons (*Falco peregrinus*). Slender-billed shearwaters (*Puffinus tenuirostris*) and sooty shearwaters (*P. grisenus*), numbering in the millions, spend their winter in the Bering Sea and north Pacific Ocean and resort there the year around as subadults before returning to southern Australia and New Zealand where, as "muttonbirds," they are commercially harvested.

Arctic birds have evolved to survive most vicissitudes of nature, but natural disasters in this rigorous region are frequently recorded. Barry (1968) estimated that 100,000 eider ducks died from starvation along the Beaufort Sea during the extremely cold spring of 1964. Edgar P. Bailey (pers. comm.) estimated that at least 86,000 common murres (*Uria aalgae*) washed ashore after a Bristol Bay storm early in 1970. In the fall of 1970 observers along Alaska's Beaufort Sea coast reported finding eider ducks and oldsquaws (*Clangula hyemalis*) dead and dying from the cold weather. With additional pressures from man the survival of some arctic nesting birds becomes precarious.

The importance of the North for waterfowl, and probably other birds, displaced by prairie droughts has been documented (Hansen and McKnight, 1964; Smith, 1970); but a better understanding of this phenomenon is needed. There have been no long-term studies in Alaska to determine the relationships between water conditions, ranging from flooding to drought, habitat and bird production.

NATURAL RESOURCE DEVELOPMENT AND MANAGEMENT

Most of the 300,000 Alaskans are directly or indirectly dependent on the exploitation of natural resources for a living. A greatly

increased use of most resources is inevitable. If development is orderly, well-planned and in compliance with strict regulations the adverse effects upon birds and other wildlife can be minimized. However, poorly planned and regulated use of Alaska's resources may be as effective in reducing migratory bird populations as was drainage, pollution and adverse farming practices in the breeding grounds of northcentral United States and southern Canada. The following items are affecting the well-being and future of Alaska birds.

Land Administration

Under the Statehood Act, 103 million acres of unappropriated Public Domain are given to the State. State selection of lands and other nonfederal withdrawals have been curtailed pending a settlement of Native land claims. Soon after the settlement we expect a large portion of the authorized land will be claimed by the State, with some lands going into private ownership. New land-use policies will be needed. Petroleum, mining, fishing and timber interests, which are "big business" in Alaska, will continue to influence politics and land-use policies.

Nearly 27 million acres of Alaska are managed by the Department of the Interior under the National Wildlife Refuge and the National Park Systems which afford good protection to birds and habitat. The Forest Service gives wildlife a primary consideration in multiple-use management of the Copper River delta, the principal nesting area of dusky Canada geese and an important nesting area for trumpeter swans, and the Stikine River delta, which is used by migrant waterfowl. The National Marine Fisheries Service manages the Pribilof Islands where there are several great seabird colonies. The size of some of these federal withdrawals may be reduced significantly in partial settlement of native claims. The Alaska Department of Fish and Game's 10,000-acre Walrus Islands State Game Sanctuary was established to protect walrus, but it provides management authority that could be used on behalf of several immense colonies of seabirds. These federal and state lands upon which birds are given special management consideration are shown in Figure 2, with emphasis on primary breeding areas for waterfowl, shorebirds and seabirds.

Imperfections in the Statehood Act and statutes establishing the Izembek, Arctic and Clarence Rhode National Wildlife Ranges, the Kenai National Moose Range and several smaller refuges gave no authority for federal control of tidelands within the intended boundaries of these refuges. For example, the entire west coast population

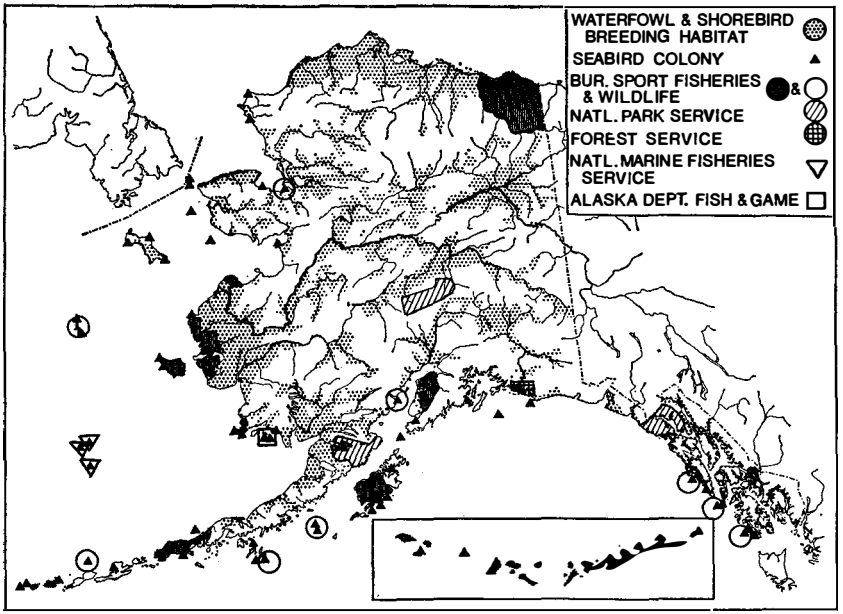


Figure 2.—Lands administered by Federal and State resource management agencies upon which migratory birds receive special management consideration as related to breeding habitat of waterfowl, shorebirds and seabirds.

of black brant and a majority of all emperor geese stop over in Izembek and Moffet Lagoons within the intended boundary of the Izembek National Wildlife Range to feed upon eelgrass (*Zostera marina*); however, the Federal Government has no controlling authority over these very tidelands for which the Range was established to protect.

High costs of operation, great distances and reduced mobility during bad weather are obstacles confronting effective management and investigations of wildlife resources in the North. The Alaska Department of Fish and Game with its enormous responsibility for resident fish and game has not been able to emphasize waterfowl research and management, and it relies on federal programs in this area. The Bureau of Sport Fisheries and Wildlife in Alaska has too few people for too many places with too many tasks to do more than token justice to migratory birds. Its refuge program characterizes the situation with only 5 "resident" managers for Alaska's 18 national wildlife refuges and ranges that cover 19.9 million acres—an area almost the size of New Hampshire, Vermont, Massachusetts and Connecticut, combined.

Figure 2 shows that only a few of the many areas important to waterfowl, shorebirds and seabirds are either within the National Wildlife Refuge system or given special-use consideration. There are many areas in coastal and interior Alaska with important and often unique avian populations and habitat warranting protection through state and federal classification and withdrawals of land.

Oil and Gas Resources

Discovery of the Prudhoe Bay field during 1968 overshadowed all previous oil and gas discoveries in Alaska which date back to 1902 at Katalla on the Gulf of Alaska. According to Pichel (1970) the North Slope discovery, which represents an estimated one-fourth of U.S. oil reserves, took place in just one of 15 large sedimentary basins in the state that have oil potential. These basins underlie many of the principal areas used by breeding waterfowl, shorebirds and seabirds (Figure 3) and suggest to us, and to McKnight and Hilliker (1970), many future conflicts between bird management and oil and gas development.

Birds that are adaptatively restricted to coastal waters or in-

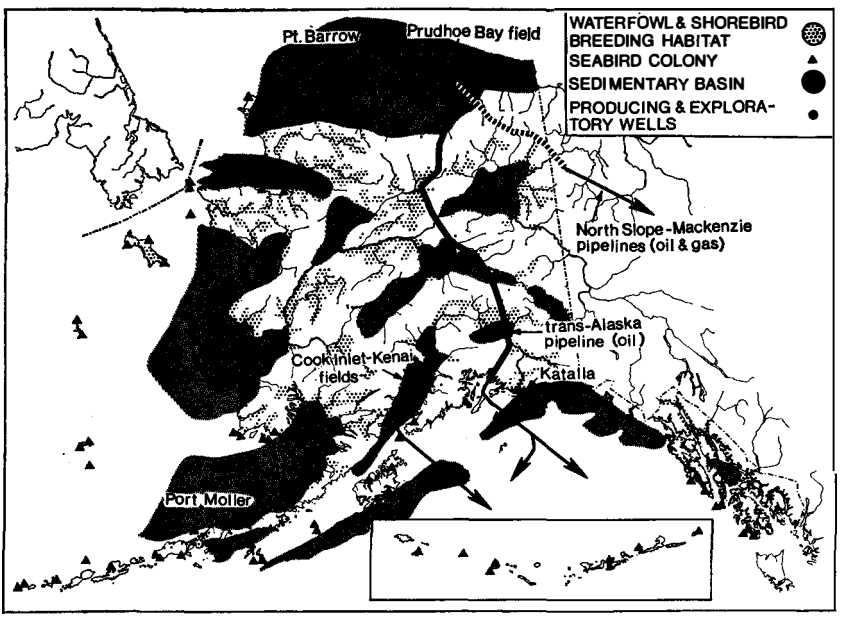


Figure 3.—Sedimentary basins having a potential for oil development (adapted from Grantz and Patten, 1964), sites of previous and current oil and gas production and recent exploratory drilling, proposed pipeline and tanker routes as related to breeding habitat of waterfowl, shorebirds and seabirds.

tolerant of disturbance may be the groups most seriously affected by petroleum-related activities on the North Slope. Tidal amplitudes in the Beaufort Sea are small, and the resulting intertidal habitat is limited. Offshore islands, reefs and spits afford protection from winds and sea ice to tens of thousands of molting oldsquaws and thousands of greater scaup (*Aythya marila*), eider ducks and black brant; and they are important to nesting eider ducks, oldsquaws, glaucous gulls (*Larus hyperboreus*), Arctic terns (*Sterna paradisaea*), and shorebirds. These areas have a potential value to industry as sources of readily available gravel and as drilling sites.

Petroleum development on land and offshore in Bristol Bay, the Gulf of Alaska, the Yukon-Kuskokwim delta and the Selawik, Noatak and Kobuk deltas would seriously threaten birds, especially those using the intertidal zone. Oil spills in marine waters could be expected to cause large losses of shearwaters, fulmars (*Fulmar glacialis*), black-legged kittiwakes (*Rissia tridactyla*), red phaloropes (*Phalaropus fulicarius*) and a variety of gulls, alcids (auklets, murres, murrelets, puffins) and seaducks. Oil entering certain of the several lagoons and embayments on the north side of the Alaska Peninsula could conceivably eliminate the west coast population of black brant and decimate populations of migrating emperor geese, cackling Canada geese, and other waterfowl, dunlins (*Erolia alpina*) and a variety of other waterbirds.

The nation's attention has been focused on development of the Arctic Slope oil field and concern for the environment along the route of the trans-Alaska pipeline. Until recently, little attention has been given the problems related to shipping this same oil which will pose the greatest threat to birds in marine and estuarine habitats.

Oil pollution regularly occurs in Cook Inlet in spite of concerned scrutiny by federal and state resource agencies and commercial fishermen. The Federal Water Quality Administration logged 51 *reported* cases of oil pollution in that locality during 1970 that stemmed from offshore wells, storage and transportation of oil and petroeleum products and other causes; and between 1966 and 1970, they recorded 9 pipeline breaks between offshore wells and onshore storage facilities and 3 tanker collisions involving a loss of 16,000 barrels of oil. Despite assurances by petroleum engineers that gushers are a thing of the past, blowouts of gas wells have occurred in the Cook Inlet, Kenai and North Slope fields. King estimated at least 100,000 birds, mostly alcids and waterfowl, died from oil pollution in the vicinity of Kodiak Island during February and March of 1970. Ballast dumped by tankers entering Cook Inlet was believed to have

been the source of pollutant. There is every reason to believe that such kills continue, but they go undetected because only rarely is the evidence in the form of affected birds blown ashore. Such incidents proliferate in Alaska waters in spite of a strong expression of concern by then Secretary of the Interior Stewart L. Udall, who in a March 27, 1968 letter to the Western Oil and Gas Association stated ". . . nowhere else on the North American Continent does the prospect of pollution from oil development pose such overwhelming threats to birds and other wildlife and to fishery resources." We are doubtful that cleaner offshore and shipping operations will be conducted in more remote regions where surveillance would be more difficult.

Aldrich's (1970) review of birds contaminated by oil suggest that birds in marine and estuarine areas are in jeopardy wherever oil is shipped. Even if pollution stemming from the 2-2½-million barrels-per-day output of North Slope oil is only a fraction of that calculated by Blumer (1970) for oil lost within the new oilport of Milford Haven, England (0.01 percent of that handled), and for worldwide losses at sea (0.1 percent of that shipped), the prospects for the port of Valdez, Prince William Sound and shipping lanes remain oily. Tankers using Alaska seaports are not regulated with respect to hull design, and the supertankers being constructed for shipping North Slope crude oil are still of the pollution-prone "single skin" design.

We believe that the *construction phase* of the proposed trans-Alaska pipeline would not be devastating to *birds in general*; however, locally it would deprive some birds of limited habitat. The greatest threat would come from oil in water either as a result of pipeline breaks or terminal and tanker operations.

A pipeline that would carry North Slope oil over an entirely inland route outwardly appears safer for birds by avoiding marine transportation. This summer, industry will study one such route (Figure 3) for *both* oil and gas lines to join the proposed Mackenzie pipelines. Several inland routes have been mentioned but have not been studied. Many residents will press for the trans-Alaska route to keep construction and operation moneys in the state, regardless if a Mackenzie route is used for oil.

River Basin Projects

Some of the potential damsites proposed by the U.S. Army Corps of Engineers and the Bureau of Reclamation that would affect waterfowl and shorebirds are shown in Figure 4.

Dams designed to create power, aid navigation and control floods deprive birds of breeding habitat within the reservoir areas; and seldom do they enhance bird habitat. Such projects generally result in

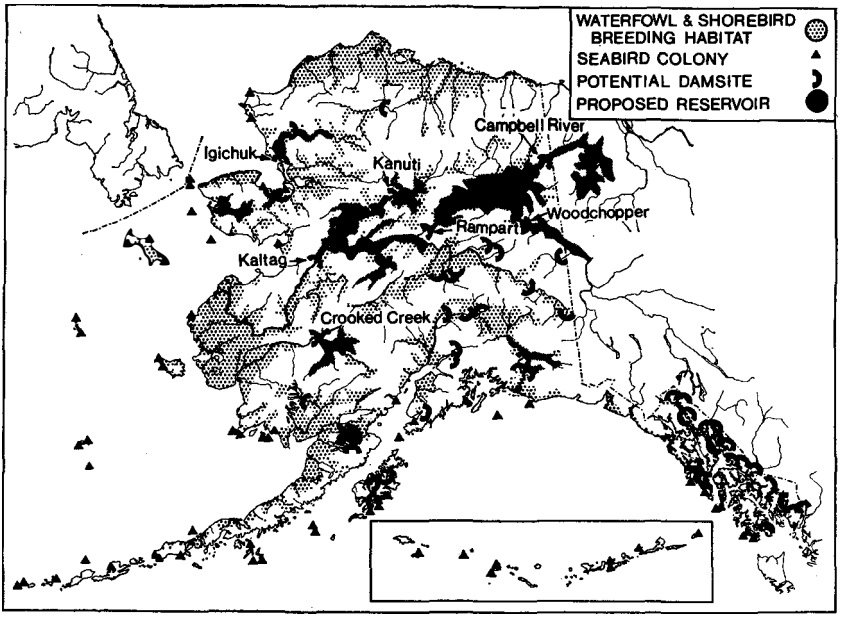


Figure 4.—A portion of the potential damsites selected by the U.S. Army Corps of Engineers and the Bureau of Reclamation and the proposed reservoirs of those damsites that would most seriously affect large blocks of productive and often unique bird habitat (excluding downstream effects) as related to breeding habitat of waterfowl, shorebirds and seabirds.

decreased bird populations and less diversity of species. Large, deep reservoirs in Alaska could be expected to remain ice-covered until June or early July and, therefore, would be of little or no value to waterbirds during spring migration. Regulated outflow from an impoundment may save some nests from flooding, but at the same time it can lower overall production of some species by reducing wetland habitat that is normally maintained through periodic flooding. Dirschl (1970) regarded the reduced outflow from the W. A. C. Bennett Dam to be significantly detrimental to breeding waterfowl in the Peace-Athabasca delta in Alberta.

The proposed Rampart Canyon Dam would have caused great damage to the migratory bird resource. An estimated fall-flight of 1.5 million ducks and several times as many other birds could be lost by the inundation of nearly 10,500 square miles of the Yukon Flats. Downstream adverse effects on habitat could be significant. The engineering of this dam is feasible, but hopefully the Executive decision that it should not be built will stand.

Smaller dams at Kaltag, Woodchopper, Crooked Creek, Kanuti,

Campbell River, Igichuk, Upper Canyon, Wood Canyon and Bremner are being considered but have not been promoted. Yet, if they were to be constructed, these insidious losses of bird habitat could collectively be as destructive as the Rampart project. Increased availability of oil, gas and coal for power generation may temporarily lessen demands for hydroelectric power.

The North American Water and Power Alliance envisions diverting water from Alaska and the Yukon Territory to southern Canada and the United States. Canadian concern and a Congressional moratorium on interregional water diversion studies should bring a pause in the schemes that would alter water resources of the North.

Timber Resources

Most of the commercial timber is harvested in southeastern Alaska on national forests. The Forest Service's multiple-use plans include provisions for managing many small deltas for waterfowl and protecting them from log storage and other disruptions. In some areas where logs have been rafted on mud flats, the accumulated bark has altered the biota. Wastes from pulp mills at Sitka and Ketchikan have an adverse effect on waterbirds by killing marine organisms used for food.

The Bureau of Sport Fisheries and Wildlife and the Forest Service are cooperatively working to save nest trees of bald eagles in timber sale areas. As yet the long-term effects of wind on the nest tree and trees included in a buffer zone are not known. Picnickers and campers attracted to the remaining "islands" of trees may pose a new threat. Increased activity in sale areas has resulted in some indiscriminate shooting at eagles.

Vancouver Canada geese, most of which nest in national forests in southeastern Alaska, are not receiving comparable attention to bald eagles. So little is known about their ecology and status that the effects of logging and other special uses of these lands, whether harmful or beneficial, cannot be evaluated.

Although the Bureau of Land Management's policy to suppress wildfires on timber and recreational lands sometimes protects important caribou (*Rangifer arcticus*) wintering areas and provides jobs for many otherwise unemployed Alaskans, the short-term and long-term effects of fire and fire suppression upon waterfowl habitat and production are not known and merit study.

Mineral Resources

Mineral resources are varied and widely scattered throughout the state. They are attracting renewed interest as new transportation

routes open mineralized regions to economical development. Increased operating costs in contrast to the fixed price of gold has stopped most placer mining. Gold dredging, especially in interior and western Alaska, has altered wetlands and destroyed some salmon streams. Mineral exploration and surface mining in Alaska, as elsewhere, is done without rehabilitating the land.

Japanese interest continues in the Bering River coal field because of its potential for coking coal and proximity to the Klukwan and Snettisham iron deposits in southeastern Alaska. Development of this field, which is adjacent to the Copper River delta, may be detrimental to a portion of Alaska's trumpeter swans. Pollution from mine acids, disturbance from mining activities and hazards of power lines would reduce the importance of Bering Lake and downstream areas to the local population of swans and other wildlife.

A million-dollar program is scheduled by industry this summer to explore the Lost River area of the Seward Peninsula for tin and tungsten deposits. Interest in gold lying offshore from Nome increases as methods for extracting minerals from the ocean's floor are perfected. These methods, regardless of type, would disrupt marine and estuarine habitats used by birds. Mining for platinum in the Goodnews Bay area could destroy eelgrass beds that seasonally attract black brant and other seabirds.

Reindeer and Livestock

Reindeer (*Rangifer tarandus*) sometimes eat eggs and trample nests. Bailey *et al.* (1933) suggest that either reindeer or their herdsmen extirpated Alaska's last snow goose (*Chen hyperborea*) colony which was located near Barrow. Now, only a few scattered pairs of breeding birds and small flocks of non-breeders can be found in this general area. Wrangel Island to the west and the Mackenzie delta to the east are sites of the nearest nesting colonies.

Reindeer populations grew to 640,000 by 1932, following their introduction in the 1890's but have since declined to less than 50,000. Reindeer are managed through a Bureau of Indian Affairs program. with the largest herds being on the Seward and Baldwin Peninsulas and St. Lawrence, St. Paul, Nunivak and Hagemiester Islands. We will never know for certain what species and populations of birds were affected by reindeer, but should this industry regain its importance future losses can be reduced by controlled grazing.

Sheep and cattle graze on two of the Aleutian Islands, Kodiak Island and the mainland. Herds are generally small and so confined that few conflicts with birds are possible.

Other Agriculture

Farming is not now a dramatic part of the Alaska scene although in the gold-boom years much food was produced in the interior valleys. When American farm surpluses dwindle and as new crop varieties are developed agriculture could pose problems for some waterfowl areas. In Alaska, unlike other states, the most productive and fertile lands are still devoted to wildlife production.

Fur Resources

Russians and American introduced foxes (*Alpox lagopus* and *Vulpes fulva*) to at least 77 of the Aleutian Islands where open-range fur farming was practiced up to World War II when military necessity and changes in fur fashions halted operations (Elkins and Nelson, 1954). Foxes still persist on these islands; and they and introduced rats (*Rattus norvegicus*) have drastically reduced populations of most ground-nesting birds. The Aleutian Canada goose is one of the apparent victims of fox introductions. Formerly breeding throughout most of the western half of the Aleutian Islands, Bering Island and Kurile Islands (Turner, 1886), this endangered race now numbers under 1,500 birds and breeds only on 5-square-mile Buldir Island (Robert D. Jones, Jr., pers. comm.).

Raccoons (*Procyon lotor*) were introduced by fur farmers on Kodiak Island and several islands in southeastern Alaska, and one population has extended its range (Elkins and Nelson, 1954). The effect of raccoons upon Alaska birds is not known but assumed to be undesirable.

Early reports (Banko, 1960) suggest that trumpeter swans formerly had a larger breeding range within Alaska than that found today. Swan skins in Alaska were apparently of little importance in the fur trade in contrast to that in Canada (Banko, 1960); however, swans are still valuable as food and are particularly vulnerable on part of their range to spring hunting by trappers seeking muskrats (*Ondatra zibethica*). The present decline in trapping benefits trumpeter swans.

Subsistence and Sport Hunting

Spring and summer waterfowl hunting is still traditionally a part of subsistence economy in many Native communities. Under provisions of the Migratory Bird Treaty Act of 1918, Eskimos and Indians may take alcids and their eggs for food at any time of the year; and, perhaps discriminatingly permissive, Indians may also take scoters. Aleuts are not mentioned. Availability, preference, and tradition are important in determining the numbers and species of birds harvested

by natives; and these factors vary from place to place. Because most spring and summer hunting of migratory birds is illegal, species management cannot be applied even though harvests of some species may be biologically justifiable. Increasing availability of guns, motorboats and snowmachines has tended to inflate the spring kill, and as native populations grow some situations could become serious.

Eskimos traditionally shoot king eiders (*Somateria spectabilis*) and other waterbirds migrating over Point Barrow during summer. Indians of interior Alaska shoot waterfowl in the spring while hunting muskrats; and later in the summer, they gill-net and drive-trap flightless waterfowl. Klein (1966) estimated that in 1964 Eskimos on the Yukon-Kuskokwim delta harvested 83,000 geese and brant, 38,000 ducks, 5,600 swans, 1,000 cranes and 40,000 eggs. They harvested 38,200 cackling Canada geese and 21,600 white-fronted geese, with more than half being taken in the spring, eggs being additional. The swans represented 13 percent of the 1954-64 average (Chattin, 1965) of 41,700 whistling swans counted in the Pacific Flyway during winter inventories. Harvests of these magnitudes have continental significance, and they must be given consideration by governmental agencies and flyway councils when establishing harvest quotas.

Although there is little evidence to suggest that subsistence hunting in Alaska has contributed to major declines of species or populations of birds, the possibility exists. Subsistence hunting in nearby Siberia was apparently responsible for elimination of certain populations of snow geese that formerly migrated to North America, Japan, and the Caspian Sea. Uspenskii (1968) described the virtual disappearance of snow geese from the Siberian Coast within the past 150 years. Although he attributed the loss mostly to hunting and agricultural changes on the west coast of North America, it seems likely that summer hunting and egging which he described were the chief causes. This is substantiated by the persistence of snow geese on Wrangel Island which was one of the last areas to become inhabited. The Wrangel Island population has increased in response to Soviet regulations initiated in 1957 that greatly restricted summer harvests.

Most sport hunting of waterfowl occurs in Minto Flats, Healy Lakes, and the Tetlin-Northway in the interior, the Susitna and Chickaloon Flats near Anchorage, the Copper River delta near Cordova, and the Mendenhall Flats and the Stikine River delta in southeastern Alaska. Large commercial airplanes are chartered to carry hunters from Anchorage to Pilot Point, Port Heiden and Cold Bay on the Alaska Penninsula for goose and brant shooting. In

comparison to hunters from most other states, Alaskans are permitted more liberal bag and possession limits and longer seasons. Hunters in interior Alaska, like those across the northern tier of states, complain when freezing weather and the early departure of birds greatly reduce the effective season.

Other Resources and Problems

United States and foreign fishing fleets find waters off Alaska's coast commercially valuable and have been removing over three billion pounds of fish annually. Commercial fishing is an unknown entity in the ecology of both fresh and salt waters that possibly affects birds. Overfishing could alter food chains and reduce migrations of anadromous fish which cycle nutrients into some of the otherwise infertile bodies of fresh water. For example, Schaefer (1970) observed that in Peruvian coastal waters fishermen compete with guano birds for anchovies (*Engraulis ringens*) and the commercial harvests are suppressing the expected recovery of bird populations from a periodic low associated with the warming of the Peru Current.

Alaska's network of surface transportation is expanding and opening up heretofore remote areas to homesteading, mining and recreation. Although industries must sometimes comply with stringent regulations when developing transportation routes, such as the Alyeska Pipeline Service Company's proposed pipeline and road, private individuals using and proliferating from new routes will not be similarly restricted.

Alaska's cities are expanding into the countryside in response to rapidly growing populations; and the resulting drainage and filling of wetlands, pollution, land clearing and general disturbance have eliminated habitat and displaced wildlife. Tidal marshes near Juneau that are used by a variety of resident and migrant birds are threatened by urban development. The Municipal Utilities System of Fairbanks accidentally dumped 100,000 gallons of fuel oil into the Chena River in February, 1968, causing unknown effects on wetland habitat and fish spawning beds.

CONCLUSIONS

Three years ago resource managers had more pressing matters at hand than to ponder what problems might result *if* exploratory drilling on the North Slope found oil in marketable quantities, but that is all changed now. Considering modern technology and industrial development, it is difficult to predict with certainty where and what the greatest problems will be in the future.

Gabrielson (1952) nearly 20 years ago, outlined a course of action for management of Alaska's waterfowl which included: (1) establishing refuges in areas long-known to be of high value to waterfowl, (2) surveying other areas to determine their value to waterfowl for the purpose of either including them within the refuge system or providing some other form of land-use classification, and (3) expanding waterfowl inventories and banding programs to better determine the value of Alaska birds to both the state and the continent. Only a portion of Gabrielson's recommendations have been achieved, but all are still valid today and equally appropriate for other species of migratory birds.

Information on numbers, distribution and habitat requirements of most species of waterfowl, much less other migratory birds, is still inadequate for many management decisions that could have far-reaching consequences. "Task force" groups gathered together to find solutions to crises must rely on scant information that is available on Alaska birds; and, therefore, their observations are directed toward only the more obvious problems. Banding efforts should be expanded in an effort to determine the status of species from all regions of the state and to recognize populations so that none may be placed in jeopardy. Manipulation of wetlands to enhance waterfowl production has not been tried in Alaska, but methods should be developed if moneys provided for mitigation for lost habitat are to be used effectively. Habitat and bird populations must be inventoried by both intensive and extensive surveys if future classifications of lands are to be meaningful. Long-term studies are needed in each of several types of waterfowl breeding habitat if production is to be accurately predicted.

The problems of bird protection on land can probably be recognized and dealt with by using more or less conventional methods, but not so at sea. A whole new range of concepts, laws and techniques will be needed if we are to deal effectively with problems at sea. The value of the vast marine habitat of the continental shelf to birds must be recognized, studied and protected from the tragedy of oil uselessly wasted in the water or from other associated threats of industrial development.

Until Alaska has for its size a normal compliment of interested citizens, bird watchers, and universities studying broad resource programs, it will be up to task forces and governmental agencies to guard the public's interest in birds. It would surely be a national tragedy if the great non-game bird populations are decimated during the "Environmental Decade" without even being properly described.

This paper has covered a mixture of major problems of the day and other problems of lesser significance that may adversely affect the migratory bird resource. Everyone who values and shares migratory birds with Alaska should maintain an active interest in developments in the North.

LITERATURE CITED

Aldrich, J. W.
1970. Review of the problem of birds contaminated by oil and their rehabilitation. U.S. Dept. Int., Fish and Wildl. Serv., Bur. Sport Fisheries and Wildl. Resource Publ. 87. 23 pp.

Bailey, A. M., C. D. Brower, L. B. Bishop.
1933. Birds of the region of Point Barow, Alaska. Chicago Acad. Sci. 4:15-40.

Banko, W. E.
1960. The trumpeter swan. N. Am. Fauna 63. 214 pp.

Barry, T. W.
1968. Observations on natural mortality and native use of eider ducks along the Beaufort Sea coast. Canadian Field-Natur. 82(2):140-144.

Blumer, M.
1969. Oil pollution of the sea, pp. 5-13. *In* D. P. Hoult, Ed., Oil on the sea. Plenum Press, New York. 114 pp.

Chattin, J. E.
1965. Pacific Flyway winter waterfowl survey—1965. Pacific Waterfowl Flyway Rept. 53:1-16. Processed.

Dirschl, H. J.
1970. The W. A. C. Bennett Dam and the ecology of the Peace-Athabasca Delta. Paper presented at the 34th Fed.-Prov. Wildl. Conf., Yellowknife, Northwest Territories, July 14-16, 1970. 5 pp. Processed.

Elkins, W. A., and U. C. Nelson.
1954. Wildlife introductions and transplants in Alaska. Paper presented at 5th Alaska Sci. Conf., September 7-10, 1954, Anchorage. 21 pp. Mimeographed.

Gabrielson, I. N.
1952. Alaskan waterfowl and their management, pp. 292-305. *In* H. B. Collins, Ed., Science in Alaska. Arctic Inst. N. Am., Washington, D.C. 305 pp.

———, and F. C. Lincoln.
1959. The birds of Alaska. The Stackpole Co., Harrisburg, Pa., and Wildl. Mgmt. Inst., Washington, D.C. 992 pp.

Grantz, A., and W. W. Patten, Jr.
1964. Petroleum and natural gas, pp. 43-77. *In* U.S. Geol. Survey, Mineral and water resources of Alaska. Comm. Int. and Insular Affairs U.S. Senate, 88th Congr., 2d Sess. 170 pp. + 25 figs.

Hansen, H. A., and D. E. McKnight.
1964. Emigration of drought-displaced ducks to the Arctic. Trans. N. Am. Wildl. and Natur. Resources Conf. 29:119-127.

Klein, D. R.
1966. Waterfowl in the economy of the Eskimos on the Yukon-Kuskokwim Delta, Alaska. Arctic 19(4):319-336.

McKnight, D. E., and B. L. Hilliker.
1970. The impact of oil development on waterfowl populations in Alaska. Paper presented at 50th Conf. Western Association State Game and Fish Commissioners, Victoria, B.C., July 13-16, 1970. 12 pp. Processed.

Pichel, G. P.
1970. The impact of prudhoemania. Oil and Gas J. 68(16):146, 148, 150, 152, 154, 156.

Schaefer, M. B.
1970. Men, birds and anchovies in the Peru Current—dynamic interactions. Trans. Am. Fisheries Soc. 99(3):461-467.

Smith, R. I.
1970. Response of pintail breeding populations to drought. J. Wildl. Mgmt. 34(4):943-946.

Turner, L. M.
1886. Contributions to the natural history of Alaska. U.S Army, Signal Service, Arctic Ser. Publ. 2. 226 pp. + 10 plates.

Uspenskii, S. M.
1968. Snow goose in the Soviet arctic, pp. 275-281. *In* G. Belkov, Ed., Problems of the North 11 (English transl. by Natl. Res. Council Canada, Ottawa, of *Problemy Severa* 11, 1967, Acad. Nauk S.S.S.R.).

DISCUSSION

CHAIRMAN WALLACE: I would like to ask Mr. Bartonek how much of the wetlands in Alaska have been lost in the last 20 years? Is there any way to come to a figure?

MR. BARTONEK: I would say the percentage has been small, except perhaps around the established communities. When you consider the absolute loss of habitat or the loss in value of habitat, this may be another question.

For example, on the North Slope, I feel that we have inadequate data to properly assess the results of all activity. We believe that birds in those areas will be most affected. But, on the other hand, because we know so little about the breeding behavior of some species, we cannot really assess what the increased traffic of helicopters would do to some species. Therefore, even though we may still have the wetland habitat, we could conceivably lose its original value.

MR. ART KENNEDY: Yesterday we heard Mr. Gavin tell us that the duck breeding population was 2.8 birds per square mile. Now, this doesn't sound like a very large population in relation to other populations. I wonder if you will comment about the North Slope as a duck breeding area?

MR. BARTONEK: We had the state survey on the North Slope early in the 1950's and an occasional survey in the 1960's; however, because of transportation difficulty and cost, it was not regularly surveyed.

Early population estimates, however, would approach the figures presented by Mr. Gavin. These were made with aircraft but with no ground control studies to reflect the true value. If the data were adjusted, the whole bird population would be considerably higher.

We have had one individual who did a study in the area of oil development this past summer using a helicopter and his density approached 16 ducks per square mile.

DR. DAVID KLEIN (Alaska): I wonder if you could point out some of the comparisons between management of lands that are valuable for waterfowl under the various agencies, state or federal? In other words, what is your appraisal of the most desirable management with regard to various agencies, ranges and all?

MR. BARTONEK: The Bureau of Land Management, which is the biggest land holder, is still under the process of classifying these lands and, therefore, the land that is managed is more subject to uses that may be detrimental to some form of wildlife. Until such time as a classification system is developed, we feel that the National Park Service and the Bureau of Sport, Fisheries and Wildlife would have the greatest management control over any specific land.

We recognize that the policies pertaining to the management of either state or federal lands can change. It depends upon the administration. This has been especially so in the past in relation to the state but perhaps is more flexible due to administrative changes.

MR. ART KENNEDY (Bureau of Land Management): I would like to clarify one point that you made. This has to do with the misconception of many people that the Bureau of Land Management is now classifying lands. We lost that authority at the end of last year. With regard to the land we do have under classification, this is a very small percentage of the land we manage.

IMPACT OF CHANNELIZATION ON WETLAND HABITAT IN THE OBION-FORKED DEER BASIN, TENNESSEE

C. J. BARSTOW[1]

Tennessee Game and Fish Commission, Nashville

The loss of wetlands has been of major concern to natural resource managers for decades. This has resulted in some progress in regard to related research needs, development of some public awareness, and acquisition programs by both state and federal agencies. The Water Bank Act of 1970 represents the most recent direct attempt to provide ways and means of salvaging these rapidly diminishing resources.

Government sponsored channelization projects, designed for flood control and drainage purposes, represent one of the major threats to remaining wetlands. Because of the obvious gross losses of natural resources and basic adverse effects on wetland environment, these so-called works of improvement are currently the subject of intense national criticism. The problems of organized, large-scale drainage in the lower Mississippi, however, were well documented and forecast by Wood (1954).

A few detailed ecological case histories of long-term effects of existing channel projects have been documented (examples: Bayless and Smith, 1964, and Holder, 1970). However, in most instances, evaluation of the environmental impact of a specific channel job has been generally based on projected estimates of future damages. This study represents a current review of the Corps of Engineers Obion-Forked Deer Rivers Project (part of Mississippi River Tributaries System), which is approximately 32 percent complete. This situation provided the opportunity of predicting future losses on the basis of what has actually occurred in one-third of the basin. This paper represents a synopsis of a detailed unpublished report (Barstow, 1970).

DESCRIPTION OF AREA AND CORPS PROJECT

Detailed descriptions of the area and Corps channelization project are documented in U. S. D. I. (1959), U. S. D. A. (1957) and Corps of Engineers (1965) reports.

The Obion-Forked Deer Rivers, a system of over 470 miles of stream and old channel, comprise the primary drainage pattern for the northern half of West Tennessee. The primary floodplain is narrow, averaging slightly over one mile in width. The lowland soils are of alluvial origin and internal drainage is moderate to poor. Most

[1]In the absence of the author, this paper was read by O. Earle Frye.

of the basin is bisected by small drainage ditches which were constructed in the early 1900's. These channels have not been maintained, and thus have created many problems which the new project is supposed to correct.

The floodplain, prior to drainage and/or anticipated drainage, consisted of a wetland area totaling over 198,000 acres, composed of an expanse of overflow woodland and swamp, interwoven by old meandering river channels and scattered oxbows. Most of this habitat was classified as of moderate to high value for wildlife in a report on Tennessee wetlands (U. S. D. I., 1954). The area has a rich tradition for fishing and hunting, and it is also recognized as being of national significance in regard to migratory waterfowl and the Mississippi Flyway.

The Tennessee Game and Fish Commission owns three wildlife management areas in the basin totaling 13,300 acres (Moss Island, 3,400 acres; Gooch, 6,000 acres, and Tigrett, 3,900 acres). Intensive development and management has been initiated only on part of the Gooch area.

Channel improvement for drainage and flood control benefits on these rivers was authorized by Congress in 1948 and work initiated in the early sixties. Basically, the project consists of 241 miles of channelization, realignment and enlargement of existing rivers and old ditches. In some segments, the new channels are designed with bottom widths of 100 feet. Maintenance and acquisition of rights-of-way are supposed to be the responsibility of the State of Tennessee. Estimated first cost of construction is as follows: federal, $20,900,-000.00 ($8,765,000,00 in 1948); non-federal (state), $1,216,000.00 ($710,000.00 in 1958).

The Corps has indicated that the project will, by reducing extent, frequency and duration of flooding, improve health conditions and local economy by providing effective drainage for 118,000 acres of cropland. Previous drainage efforts have been generally ineffective. The first Corps report (1948) indicated that flood damages were small, and that major benefits would accrue to agriculture via increased yields and production on higher elevation, rather than preventing flood damages.

For purposes of determining feasibility of the project, the flood plain was divided into three zones: "A" Zone above maximum flood line (does not flood); "B" Zone between maximum flood line and once-in-three year floodplain line; and "C" Zone of once-in-three year flooding. Drainage benefits were applied to both "A" and "B" Zones. Flood control benefits were applied primarily to "B" Zone.

Because of heavy flooding, no significant amount of benefits were justified for "C" Zone. Zone "C" comprises the bulk of the total project area (69 percent) and wildlife habitat. *These initial plans stated that due to continued flooding, Zone "C" would remain in timber.* Thus, the project was initially justified on the basis of enhancement of agriculture on a small proportion of the total project acreage.

STUDY METHODS

The following are general descriptions of information and factors regarding habitat, habitat changes, recreation and related natural resources, values, and subsequent losses as developed and utilized in determining effects of the channelization project. In essence, the magnitude of various habitat components is the basic foundation upon which primary resources and values are constructed. Thus, losses of potential recreation and other resources were determined directly as related to change in habitat with the channelization project. Complete details concerning methods utilized are documented in a preliminary report (Barstow, 1970).

I. *Habitat*

It is believed that the estimates of total pre-project habitat (218,907 acres) and wetlands (198,962 acres) are conservative.

(A) Woodland: Woodland acreage was taken from land-use tables provided by the Corps (May, 1970). Data represent total future woodland in "B" and "C" Zones without the project and corrected for their estimate of clearing (clearing which would occur without the project).

(B) Wetland: Total wetlands are composed of permanent water, swamps (Type VI and VII), high significance wetlands and Zone "C" woodlands (Type I-BH). Area of high significance habitat was taken from *Wetlands of Tennessee* (U. S. D. I., 1954).

(C) Water: Acres of water were determined by a combination of two means: (1) extracted from U. S. D. A. report (1957) and (2) determination of magnitude of swamp-type-water area by use of aerial photographs and data taken from *Soil Survey, Dyer County, Tennessee* (U. S. D. A., 1965).

(D) Edge Habitat: Edge habitat for two primary upland species (cottontail rabbit and bobwhite quail) was estimated by (1)actual measurement of the length of perimeter of woods and field boundary on U. S. G. S. topographic maps; and (2) multiplication of this figure by average width of good habitat along this edge (by two acres, or one acre on each side of edge).

(E) Habitat losses: Habitat and thus basic wildlife and fisheries resource losses were determined by actual measurement of woodland clearing and estimates of other losses via field surveys within the completed portions of the project. This involved use of existing maps and aerial photographs, new aerial photo surveys, and visual estimates of habitat changes both from the ground and the air.

II. *Resource Values*

Maximum trip values as presented in Senate Document #97 (Supplement No. 1, 1964)' were used for principle recreation uses. Furbearer values were taken from the U. S. D. I. report (1959). Value of commercial fisheries was based on population samples and current wholesale market prices. Value of the habitat for wood duck population was based on average production from swamp habitat, relative portion of total population harvested out-of-state, and man days of hunting required to harvest this segment at $6.00 per trip. Commercial value of the woodland was determined by use of current market prices and data on average yield index for bottomland hardwoods.

III. *Recreational Trips*

Recreation or trip indices (trips per acre were developed by a combination of (1) Commission records of usage and/or population inventories of similar habitat and (2) general literature on bottomland habitat, fish and wildlife carrying capacity, harvest, harvest per trip, etc. Essentially these sources were used to develop "reasonable potential trips" for major species which the habitat of this basin can annually provide. The indices are not based on maximum biological potential of the various species. The development of these factors or indices was necessary since specific data relating to this basin and all the species involved are not available. The trip indices were used in connection with acres of appropriate habitat to provide estimated annual recreation potential and value (Table 1).

(A) Small Game: Trips per acre for major small game species are (1) squirrel = .260, (2) raccoon = .108, (3) swamp rabbit = .110 and (4) edge species, cottontail rabbit and bobwhite quail = .260.

(B) Big Game: Although deer and turkey populations are not now fully established throughout the basin, the habitat has excellent potential for future hunting opportunity of this type. The trip indices are thus based upon future potential with established populations. Turkey hunting at .067 trips per acre is based on spring gobbler hunting. Deer at .097 trips per acre is dependent upon either sex hunting.

(C) Waterfowl: Trips per acre utilized for waterfowl hunting were .50 for general wetland habitat and 1.50 for high significance wetlands. This is based upon the generally recognized high potential of this basin during good waterfowl years, surveys by the Commission and indirect harvest estimates based upon band recoveries (Bellrose, pers. comm., 1967).

(D) Sport Fishing: Trips per acre utilized for sport fishing were 31.4 for streams and 41.8 for natural lakes, sloughs and swamps. These factors are related to (1) populations, species, harvestable size and weight in each habitat as determined by actual sampling, (2) known average catch per trip and (3) potential annual harvest of 50 percent. Because of local tradition part of the carp and catfish are included in sport fishing segment of the population. Total acres of swamp habitat were reduced by 50 percent in developing potential sport-fishing trips. This was done to conservatively estimate the above and correct for annual or periodic drying of portions of this habitat type.

(E) General Wildlife Oriented Recreation: Recreational trips for bird watching, nature observation, etc., were estimated by using a ratio of hunting activities to this type of recreation as determined from data recorded in a regional planning survey for West Tennessee (M. R. I., 1969). This data indicates potential general wildlife oriented visits at 2.27 trips per hunting trip.

RESULTS

Prechannelization (without project) habitat, composed of a complex of overflow bottomland hardwood timber, swamp and permanent water, totaled approximately 218,900 acres. The projected estimate of annual potential recreation and related wildlife and fisheries resource values that this habitat can reasonably provide are as follows: (1) trips = 1,453,925, and (2) value = $2,616,043.00 (Table 1). The commercial value of the hardwood forest, approximately $2,087,-700.00, represents an additional value of this area. Investigation of the completed sections of the ditch system has indicated the following: (1) approximately 60 percent of previously existing woodland and wetland have been cleared, (2) aquatic habitat (natural lakes, sloughs and swamps) have almost been eliminated, (3) edge habitat has been minimized, (4) soil moisture has been reduced, (5) severe erosion problems have occurred, (6) frequency and duration of flooding has been reduced (Corps indicated an 80 percent reduction in flooding) and (7) direct losses to state wildlife management areas

TABLE 1. ANNUAL FISH AND WILDLIFE VALUES, WITHOUT PROJECT, WITH PROJECT AND NET LOSSES; OBION-FORKED DEER RIVERS, TENNESSEE

Resources	Without Project				With Project		Net Loss	
	Habitat (Ac.)	Index Trip/Ac.	Total Trips	$ Value	Trips	$ Value	Trips	$ Value
Small Game								
Squirrel	196,177	.260	51,006	76,509	15,302	22,953	35,704	53,556
Raccoon	215,977	.108	23,326	34,989	6,997	10,497	16,328	24,492
Swamp Rabbit	215,977	.110	23,757	35,636	7,127	10,690	16,630	24,946
Edge Species	26,239	.260	6,822	10,231	1,706	2,559	5,116	7,673
Subtotal	—	—	104,911	157,367	31,133	46,699	73,778	110,667
Big Game								
Deer	215,977	.097	20,949	125,694	6,285	37,708	14,664	87,986
Turkey	215,977	.067	14,470	86,820	4,341	26,046	10,129	60,774
Subtotal	—	—	35,419	212,514	10,626	63,754	24,793	148,760
Waterfowl								
"Sign. Wetlands"	42,000	1.5	63,000	378,000	8,820	52,920	54,180	325,080
Overflow	154,032	.5	77,016	462,096	10,782	64,693	66,234	397,403
Perm. Water	2,050	1.5	3,075	18,450	431	2,583	2,644	15,867
Wood Duck Prod.	22,730	—	—	94,102	—	4,705	—	89,397
Subtotal	—	—	143,091	952,648	20,033	124,901	123,058	827,747
Furbearers	—	—	—	10,000	—	500	—	9,500
Fishery								
Sport								
Streams	80)	31.4	27,632	41,448	1,382	2,072	26,250	39,376
Lake & Swamp	11,950	41.8	499,510	749,265	24,976	37,463	474,534	711,802
Commercial	—	—	—	171,120	—	8,556	—	162,564
Subtotal	—	—	527,142	961,833	26,358	48,091	500,784	913,742
Gen. Outdoor Rec.	—	—	643,362	321,681	193,009	96,504	450,353	225,177
Total	—	—	1,453,925	$2,616,043	281,159	$380,449	1,172,766	$2,235,593

Note: 1. Trip values: general outdoor recreation = $.50; small game hunting and sport fishing = $1.50; waterfowl and big game hunting = $6.00.
2. "With Project" loss rates: forest small game, big game and general outdoor recreation = −70%; edge species = −75%; waterfowl hunting = −86%; wood duck production, fisheries, and furbearers = −95

have occurred (rights-of-way, development costs of existing state areas).

Based on the above, the following were used as loss factors for various species and habitat components for estimation of future with project resources:

I. *Habitat*

(A) Woodland and Wetland Habitat = —70 percent. As noted, habitat of this type has been cleared at a rate of 60 percent. Based upon this trend and sections known to be scheduled for clearing, it is predicted that at least 70 percent of 135,700 acres of woodland and wetland will be converted to agriculture.

(B) Aquatic Habitat = —95 percent. The project has and will cause a reduction in frequency and duration of flooding and cause almost total elimination of aquatic habitat via drainage. In time, only the new channel and an occassional oxbow will remain.

(C) Edge Habitat = —75 percent. Land clearing, on-farm drainage, and intensive clean farming will practically eliminate the previously existing "rough" transition zone between the woods and field areas.

II. *Wildlife and Fisheries*

(A) Forest Species: The —70 percent factor as related to woodland-wetland loss was applied to squirrel, raccoon, swamp rabbit, deer and turkey.

(B) Edge species: The —75 percent factor was applied to cottontail rabbit and bobwhite quail.

(C) Waterfowl

1. Waterfowl Hunting: Projected loss of this resource amounted to approximately —86 percent based upon a combination of factors (reduction of frequency and duration of winter flooding clearing of woodland-wetland habitat and loss of lakes, slough and swamp).

2. Wood duck production: The —95 percent factor for loss of aquatic habitat (streams, lakes sloughs and swamps) was applied to wood duck production values.

(D) Fisheries: The —95 percent factor for aquatic habitat was applied to both sport and commercial fisheries.

(E) Furbearers: The factor for loss of aquatic habitat (—95 percent) was used for this resource since primary species involved are those associated with this habitat type.

(F) General Wildlife Oriented Recreation: The —70 percent factor for primary habitat loss (woodland-wetland) was applied to this recreation use.

(G) Commercial Timber: A factor of —85 percent was used for

future timber values. This is based on loss of woodland (—70 percent) and estimated loss of productivity (—50 percent) due to reduced soil moisture and flooding of remaining woodland.

(H) State Wildlife Management Areas: The channelization project has and will have a severe impact on existing state wildlife areas. Approximately 675 acres of habitat, with a land value of $150.00 per acre, will be lost to channel right-of-way. Preliminary cost estimates for restoring wetland (*i. e.* water supply and control) on these state areas total approximately $1,680,000.00.

The estimated (with project) future annual potential fish and wildlife resources and related recreational trips and net losses for same are presented in Table 1. The net losses for items quantified by this study are as follows: (1) annual losses = $4,010,155.00 (fish and wildlife = $2,235,595.00, commercial timber = $1,774,560.00), and (2) other = $1,781,250.00 (state wildlife area related).

DISCUSSION

The effects of the completed portions of the drainage and flood control project, the soybean market, and improved status of the general economy have shown that previous projections of land-use and loss of natural resources were grossly in error. Massive timber clearing, farm drainage systems, intensive cultivation, continued flooding, and demands for more drainage have followed right on the heels of the dragline. The clearing is also occurring in some reaches where the channel has not been started, *i. e.* in anticipation of drainage.

A large amount of the land conversion and attempts at intensive agriculture are occurring in Zone "C." This situation is taking place regardless of the fact that this area has flooded, even in the completed portions of the project, almost annually; and regardless of the fact that the Corps is still estimating that this Zone will flood at least one year out of three during the cropping season. Considering these factors, it would seem that long-range agricultural operations in this Zone, insofar as good land-use or conservation practices are concerned, are subject to serious question. Because of the change in land use, the Corps is now claiming higher flood damages and applying significant benefits to the project for improvement of Zone "C" for agricultural purposes (B/C ratio now 1.3). In addition to the obvious gross losses there will probably be a substantial reduction in the basic biological productivity, resulting in lessened carrying capacity of remaining habitat. Based upon the methods used by Wharton (1970), the deterioration of productivity induced by this project will ap-

proach a reduction of 50 percent. The implication of this to wildlife and fisheries resource managers and others considering possible mitigation features is staggering.

As indicated above, and presented in Table 1, estimated potential wildlife and fisheries resources, recreation and values will be substatially reduced; such being related to the reduction of habitat. Estimates of with project values are considered high since they were not discounted for the effects of lowered basic productivity and/or reduced carrying capacity related to loss of continuous large blocks of habitat.

The expanse of high-quality waterfowl area will be essentially ruined by this project. Thus, another major unit of migration and wintering habitat in the Mississippi Flyway and an important wood duck production area will be lost.

The aquatic habitat will be severely modified by loss of water area (especially fertile slough and swamp type) and reduction of stream productivity. The latter has been documented for other southeastern streams by Bayless and Smith (1965). The remaining bottomland aquatic area will probably also be further modified by increased sedimentation and accumulation of pesticides from agricultural lands similar to that noted by Broach (1969) for natural lakes in Arkansas. In this case, these predicted damages indicate a conflict of resource use and established legislation. The waters of the Obion Basin have been classified, according to guidelines established by the Water Quality Act of 1965, for the designated use of "Fish and Aquatic Life." Such classification became legally effective by state law on February 8, 1971. Accordingly, the Tennessee Department of Public Health has stated that channelization of this stream, if allowed to proceed, will be in violation of said law and thus subject to prosecution.

It is estimated that at least 70 percent of the woodlands will be converted to agriculture; and further, that the potential future value of commercial timber of the remaining woods will be lessened via decreased productivity of approximately 50 percent due to changes in flooding and soil moisture (Broadfoot, pers. comm., 1970). The increasing loss of bottomland hardwoods throughout the Southeast to clearing is of major concern to ecologists, the hardwood industry, wildlife managers and conservation-minded individuals (Ark. Planning Comm., 1969).

A recent study of the swamps of the Alcovy River in Georgia indicated that this type of wetland area had significant importance for natural purification of water, as an essential factor in ground water recharge and storage, and as a natural flood control mechanism

(Wharton, 1970). It would therefore seem essential that similar evaluations should be made in this basin prior to further construction.

The effects of channelization in regard to tributary outlets have not been adequately considered in project design. Such drainages have been left to cut and erode, laterally and longitudinally. Erosion of the new channel banks is also evident within the completed portions of the project. No one, including the Corps, will accept the responsibility for these secondary damages. These conditions do not seem to be indicative of a real interest in good soil conservation practices.

Sportsmen, of course, are the first to feel the gross loss of recreation area. They are also hit square in the pocketbook through direct loss of publicly owned habitat (right-of-way) and high cost of attempting to restore water to state wetland habitat. Ironically, the hunter and fisherman are thereby in this case having to pay for restored habitat on "his" lands which were previously flooded by nature.

If the project is continued, some of the habitat may be salvaged through mitigation. The Tennessee Game and Fish Commission has recommended the acquisition and partial water control development of 44,000 acres. Such of course, will not replace the previous total wetland ecosystem or estimated total loss of habitat. The existing situation whereby mitigation must be justified by standard Corps benefit/cost analysis procedures is ridiculous, and may actually be in conflict with letter and intent of the Wildlife Coordination Act of 1958. By the Corps approach (B/C) this project will, with public funds, essentially minimize a wildlife-fishery complex. Then, possibly, it will replace a "fraction" of the previously existing resource with more public funds, if said "fraction" is justified by the cost/benefit evaluation. This would seem to indicate that the public is paying for rehabilitation of a small slice of a large natural environmental system that they had previously paid to destroy. If mitigation is to be successful, it must be initiated prior to further channel construction. Otherwise, acquisition is impractical due to loss of habitat (clearing) and increased land values.

The use of Senate Document #97 monetarv values and associated methods of relying on recreational trips for estimating worth of an environmental system are wholly inadequate. In essence, the total value of this wetland ecosystem is being measured by only a few of its products—i. e. primarily hunting and fishing. No practical means are presently available for establishing value of the other real but intangible components. These basic problems and need for new approaches are thoroughly discussed by Swartz (1968). Essentially the future will be partially dependent upon gaining a better basic

ecological understanding of various wetland types, development of new evaluation methods, and involvement of other specialists (economists, hydrologists, engineers, land-use experts, etc.).

The results of this study substantiate the widespread criticism of channelization. The initiation of such public works brings about subsidiary drainage enterprises (watershed and on-farm types) and demands for more flood relief. In other words, the big canal is just the start in the drainage enterprise and further habitat damage. Natural resources are adversely affected and, as noted in other similar projects, flood damages seem to increase as people attempt to utilize supposedly "improved" areas in the floodplain. In this case, estimated annual flood damages have increased tremendously (1948 = $55,000.00; 1965 = $757,000.00; and 1970 = $2,000,000.00). These flood damages, high costs of construction and maintenance of channel projects, costs of land conversion and subsidiary drainage, and timber and wildlife losses all lend support to perhaps the only real solution of this problem—stop channelization and implement land-use zoning.

Swartz (1968) suggested that water development programs have historically been determined by a combination of social, political, and economic forces rather than a rational engineering-economic approach. Until such time as this is corrected and natural environments are fully considered by the responsible agencies, possible help may be gained through development of real public concern and the courts.

The Obion-Forked Deer project has been temporarily halted via a declaratory suit filed in federal court by four private citizens (J. Clark Akers, *et al.* vs. U. S. Army Corps of Engineers, *et al.*, Civil Action No. C-70-349). In essence this suit asks that all agencies involved (U. S. D. I., Corps, Tennessee Game and Fish Commission and State of Tennessee) resolve the various conflicts prior to further project construction. Major points involve questions pertaining to the Wildlife Coordination Act of 1958, National Environmental Policy Act of 1970, and state maintenance responsibilities. Such civil action may, in time, provide the stimulus necessary for change, and a real legal basis for protection of natural resources.

SUMMARY

The authorized Corps of Engineers project has caused substantial damages to the wetland ecosystem of the Obion and Forked Deer Rivers. Completion of the channel project will, in time, almost eliminate fish and wildlife resources via drainage and woodland conversion.

It is estimated that aquatic habitat will be reduced by 95 percent and forest area by 70 percent. Based upon these habitat losses the estimated net economic loss of resources measured in this study (fish, wildlife and commercial timber) amount to over $4,000,000.00 per year.

The wetlands of this basin have significant tangible and intangible values for present and future generations, and it is believed that these resources represent the best long-range potential and product of land use of the floodplain. The total natural complex should be fully recognized and weighed against the other so called benefits prior to further project construction.

The project is an excellent example of expenditure of public funds for work which will benefit a few people, and of one for which no real consideration has been given to natural resources and good conservation practices.

The merits of channelization projects for flood-control purposes is questionable. Such public works encouage the development of hazardous floodplain areas, can result in increased flood damages and promote additional drainage ventures. Land-use zoning of such bottomland areas would seem to be the best long-range approach to this national problem.

Destruction of the wetlands of the Obion-Forked Deer has been temporarily halted by a civil suit filed in federal court. This suit and similar actions can perhaps offer immediate relief; but, of more importance, they may provide the necessary pressure and legal foundation for protection of renewable natural resources.

ACKNOWLEDGMENTS

The initiation of this study and current interest in the Obion-Forked Deer Basin are primarily the results of the dedication and work of Mr. Carl Yelverton (deceased). Fred Stanberry provided administrative guidance and support. Robert M. Hatcher, Eugene S Cobb, William R. Allen, James F. Gore, Leslie Haun and Don Orr provided other assistance. Mr. J. Clark Akers, Dr. Sam Harwell, Dr. John Tudor, and William Dillon deserve special credit. Through their concern and action (Civil Suit) the results of this and other studies may in time actually be used to assist in the preservation of wetlands.

LITERATURE CITED

Anon.
1969. Tennessee statewide comprehensive outdoor recreation plan. Midwest Res. Inst. Append. IV. 76 pp.
Arkansas State Planning Commission
1969. The Governor's seminar on the Mississippi Delta hardwoods. 63 pp.
Barstow, C. J.
1970. Fish and wildlife resources, Obion-Forked Deer River Basin, Tennessee. Unpub. Rept., Tenn. Game & Fish Comm. 37 pp.

Bayless, Jack and Wm. B. Smith
1964. The effects of channelization upon the fish population of lotic waters in eastern North Carolina. N. C. Comm. Wildl. Resources.
Broach, Richard W.
1969. A management survey of public fishing in delta regions of eastern Arkansas. 23rd Ann. Conf. S. E. Assoc. of Game and Fish Comm. p. 388-397.
Holder, Trusten H.
1970. Disappearing wetlands in eastern Arkansas. Ark. Plan. Comm. 72 pp.
Swartz, Albert H.
1968. Estuarine research opportunities. Tran. No. Amer. Wildl. Conf. 33: 91-101.
U. S. Corps of Engineers
1965. West Tennessee tributaries—Mississippi River tributaries. House Doc. 308, 88th Congress.
U. S. Department of Agriculture
1957. Present and anticipated agricultural conditions, West Tennessee tributaris. S.C.S. 338pp.
1965. Soil survey, Dyer Co., Tennessee. S. C. S. 79 pp.
U. S. Department of Interior
1954. The wetlands of Tennessee in relation to their wildlife value. U. S. Fish & Wildl. Serv. 23 pp.
1959. A fish and wildlife conservation plan for the Obion and Forked Deer Rivers project, Tennessee. U. S. Fish Wildl. Serv. 22 pp.
Wharton, Chas. H.
1970. The southern river swamp, a multiple-use environment. Ga. State Univ. 49 pp.
Wood, Roy
1954. Water, wetlands and wildlife. U. S. Fish & Wildl. Serv. 35 pp.

DISCUSSION

DR. FRYE: Let me say that I believe this offers an excellent example of the serious problems that face all of us. I don't believe that there is a state in this country that has not been faced with this same problem and we sit back frustrated very frequently because we cannot quite come up with the proper answer.

In this connection, I am most encouraged by developments that are occurring throughout the nation, occurring quite strongly, as a matter of fact, in the State of Florida. People are finally becoming aware of what is going on and are taking action.

I urge all of you professionals to work closely with the private sector, with the individuals in the various conservation associations throughout the nation in trying to bring about a realistic approach to this very common problem.

CHAIRMAN WALLACE: Thank you, Dr. Frye, for making the presentation for Mr. Barstow. While this is not Dr. Frye's paper, he has agreed that he would try to answer any questions.

DR. CLARENCE COTTAM (Texas): I want to ask what cost-ratio benefits the Army Engineers came up with on that. I happen to know this particular area.

CHAIRMAN WALLACE: That particular figure is not in the paper. I am sure Mr. Barstow could give it to you.

MR. ROLAND CLEMENT: (National Audubon Society): I wonder if Dr. Frye knows what the attitude of the present governor is. I have a comment that might be of interest.

DR. FRYE: No, I do not.

MR. CLEMENTS: My purpose in asking this question is to alert you to the fact that the Corps of Engineers insists that they will not push any project against the wishes of the governor. This particular project was authorized and pushed in another political regime. There is now a new governor there and the State Fish and Game Commission is involved in a suit to try to stop it. The point is that the fish and game people really ought to get their governor involved in putting a stop to this.

I am now a member of the Environmental Advisory Board to the Chief of the Corps of Engineers. I have been on this board for nine months and we are just getting acquainted, and I think we are beginning to zero in on the problem.

As I identify the problem, we are really up against a national philosophy of

regional development. Every region wants to get the maximum development possible without any national planning to retain diversity. And, of course, this pressure is made effective through the Congress. In other words, it is the Congress that accepts the demands to these things. In turn, the Corps of Engineers insists that it is only carrying out the mandates given to it by the people through the Congress.

Therefore, we do have this regional development problem and the way to approach it is, first of all, to insist on national planning so that every region will be put into perspective. Some regions have a lower carrying capacity and it makes no sense at all, from a national point of view, to invest our federal taxes in bringing the desert up to par, for example, with some more favorite region.

Finally, the real hope that we have now, and which you should be cognizant of, is the new Section 102 requirement of the National Environmental Policy Act amministered by the Council on Environmental Quality.

There was a case this past month which came forward and which ought to be inscribed and put on the walls of every office of every conservationist. This case involves the State of Arkansas—the so-called Gillham Dam Project, which was stopped by the Corps at the request of a group of citizens. The court ordered the Corps of Engineers to provide a detailed statement of the five points that are required by Section 102 of the law. The Court told the Corps of Engineers that it owed the public, the Congress, and the President of the United States a full analysis of all the implications of this project.

The Court said, "We will not allow this project to go through until you have satisfied this order; that you have indeed given the public the full implication of the project." Now, once the public has the options and the alternatives, if it wishes to have the project, it may have it. However, the problem involved is that of the cards have not been put on the table in the past and this is what all of us need to insist upon now.

DR. FRYE: With rgard to the question by Dr. Cottam, I found the information. 1:3 is the cost-benefit ratio.

I have one comment that I would like to make because it reflects what so frequently happens in relation to these projects. This has to do with the large amount of land conversion and intensive agriculture occurring. This has taken place regardless of the fact that this area has flooded, even in the completed portion of the project, almost annually and regardless of the fact that the Corps of Engineers still estimate that this area will flood at least one year out of three during the crop season.

In other words, this is a self-building operation. You create the problem and then try to solve it. This is where we get the 1:3 cost-benefit ratio.

DR. COTTAM: My answer to that this is a beautiful case of plain bureaucracy.

DR. LAURENCE JAHN (Wildlife Management Institute): I would like to emphasize that it is the system that we are involved with. We are simply going to have to change it. We are trading off a complex of public values when we permit cost-benefit ratios calculated in the manner now prescribed. Fortunately the Water Resources Council is changing the procedures and evaluating them at present under a 4-point system. I would suggest that state conservation organizations and other agency personnel examine in detail the new proposal and make absolutely certain that the environmental values and the natural eco-systems and the complex of public values are preserved and maintained and not put on the auction block for potential benefits to agriculture.

The second point is to examine the flood-plain and shoreline zoning and management acts which some states have taken leadership in enacting. Wisconsin has one. Nebraska has one. Minnesota has one. These acts, in effect, do not limit total development but guide development so that human activities actually agree with the characteristics of the stream and its associated flood plains.

My last point is that the National Land Use Policy Bill is before Congress at the present time. Again, people should become familiar with this. As I see it, a

National Land Use Policy Planning Act and the new guidelines of the Water Resources Council for planning water projects, give us two avenues whereby we can change the system. This is a tremendous avenue for input. If we don't do it, then we are again going to lose an opportunity to change the system.

MR. JAMES MORRISON (Bureau of Sport Fisheries & Wildlife): I want to make sure we don't overlook the SCS projects in the discussion. However, I think that the game and fish people need to take every effort that they can to bring these things to the knowledge of the various sportsmens' groups. This is a positive program that the fish people need to get behind and one of them, of course, involves the National Wild Rivers Act. Certainly there are certain streams which can be put under the Act. I would like to see the wildlife people get behind these programs. In fact, let's all get behind them and do it together and, in turn, we will be able to protect some of the streams.

MR. RICHARD W. BROACH: (Arkansas Game and Fish Commission): I did want to set the record straight on the statement that the Corps of Engineers be required to prepare and submit a report under Section 102 prior to the initiation of any court action.

In connection with our defense fund, the Corps of Engineers prepared two specimens and I had the opportunity to examine and evaluate both. These, in my estimation, as a biologist, were satisfactory. Therefore, the environmental statement being prepared pursuant to the recent court action in Arkansas is not the first statement that the Corps of Engineers has prepared.

PROGRESS TOWARD A DECISION-MAKING MODEL FOR PUBLIC MANAGEMENT OF FRESH-WATER WETLANDS

JOSEPH S. LARSON

Department of Forestry and Wildlife Management, University of Massachusetts, Amherst

Legislative protection of wetlands has been enacted for coastal wetlands in Massachusetts, Rhode Island, Connecticut and New Jersey. Vermont has created a State Environmental Board and a series of District Commissions to regulate land use. Maryland has conducted a detailed study of wetlands, but Massachusetts is the only state where legislative restrictions have been placed on fresh-water wetlands.

State legislation protecting coastal wetlands generally recognizes a breadth of natural resource values to be protected in the public interest, including wildlife and marine fisheries. Delineation of the landward limits of coastal wetlands is aided by the relatively clear-cut vegetative boundaries resulting from periodic tidal action. Neither conditions apply as clearly with regard to fresh-water wetland legislation or to the boundaries of inland wetlands. Moreover, the public benefits to be derived from protection of inland wetlands are not as evident to the public or to legislators as are the benefits associated with coastal wetlands. The role of coastal marshes in the marine fish industry, recreation, and as protective storm barriers are

values to coastal communities for which there are as yet no general parallels for inland marshes and communities.

Pioneer inland legislation in Massachusetts dates from the 1966 'Hatch Act" which protects inland wetlands bordering water courses where public water supply or flood control would be endangered by wetland filling or draining. No other values are recognized under this legislation. The 1968 "Inland Wetlands Act" permits the state to restrict alteration of wetlands for protection of a broad range of resource values, but two and one-half years elapsed before the first attempt to implement this legislation. The main roadblock to implementation has been one of delineating the exact wetland boundary. The land is retained in private ownership and the restrictions placed only on the wetland portion of one or more parcels. The state takes the position that action can only be based on maps, acceptable to assessors and the registrars of deeds, on which the boundaries of the restrictions are clearly set forth. The law does not define an inland wetland, so considerable time has been consumed in developing an informal working definition which hopefully will stand a court test and in finding an inexpensive but accurate means of mapping wetland boundaries.

Because inland wetlands in general lack one or two substantial and patently obvious benefits to the citizens of a community, the rational for the inland legislation has been based on an array of generally accepted benefits: flood control, protection of ground-water systems, wildlife, esthetics and others. However, if a community makes application to place a solid land-fill in one of several candidate wetland areas, the specific criteria are lacking for selecting the one which has the least adverse impact on this array of values. The thrust of our study is to marshal the knowledge and to construct a multi-variate decision-making model for public management of fresh-water wetlands. Such a model should have application to the northeastern United States and be of value in much of glaciated North America.

I wish to acknowledge Dr. Ward S. Motts, Geology; Profs. Julius Gy. Fabos and Walter P. Cudnohufsky, Landscape Architecture; Dr. John H. Foster, Agricultural Economics; and Prof. William P. MacConnell, Forestry, and their students as colleagues in this study. This work is supported by funds provided by the U. S. Department of the Interior, Office of Water Resources, as authorized under the Water Resources Research Act of 1964 (P.L. 88-379).

INVENTORY

Definition of an inland wetland varies with viewpoint. Staff of the U.S. Soil Conservation Service recognize two types of soils, poorly

drained and very poorly drained soils as inland wetlands. This is the most broad interpretation proposed to us and it has the merit of being one which can be quite well defined by standard agronomic measurements. A second definition is that based on 1:7,200 panchromatic aerial photography taken with the leaves off the tree canopy. Raytheon's Autometric Division has produced such a wetland inventory of several towns just outside Boston, and if we accept that definition we arrive at an inland wetland acreage 40 to 50 percent smaller than that suggested by the S.C.S. A third inventory, and one for which we have coverage for the entire state, is cover maps based on 1:20,000 panchromatic photography taken with the leaves on (MacConnell and Garvin, 1956). Acceptance of this definition means another 50 percent reduction in wetland acreage since wooded wetlands are not included (They can be inferred by observing wetland symbols which underlie forest types on the cover/topographic map manuscripts.). Depending on the definition selected, inland wetlands in Massachusetts may comprise from 134,000 to 490,000 acres. One clear task before us is to identify the consequences of accepting one of these definitions and to suggest a compromise which will both protect the wetland resource and be acceptable as the basis for restrictive legislation. We believe that a definition based on examination of a coordinated array of wetland values is the approach most likely to succeed.

We are measuring the rates and patterns of wetland changes over the past 20 years and developing predictors for future rates of change. This is being accomplished by contrasting wetlands as inventoried by the aerial cover mapping in 1951-52 with new photography being taken this year. The sample area is the entire Commonwealth of Massachusetts, one which covers a broad array of physiographic and cultural regions. Already we see from pilot samples a loss of about 13 percent of the inland wetlands since 1951 in a region near Boston and in some towns the loss may be as high as 40 to 50 percent.

Of special interest is the delineation of wooded wetlands. These have been generally overlooked in the Northeast and their acreage may equal that of all other open wetland types combined. This wetland type represents a future challenge to land managers in this region (Larson, 1971).

HYDROGEOLOGY

The relationship of wetlands to groundwater systems is one frequently used to justify restriction of wetland development, but, this relationship has not been closely examined. Some general statements can be made, but when a land management agency must make decisions concerning specific wetlands, details are generally lacking.

Our study indicates that about 39 percent of the open fresh-water wetlands occur over outwash deposits, 29 percent over till, 16 percent on glacial lake bottom deposits, 13 percent on alluvium and 3 percent on other deposits such as sand dunes, marine and estuarine deposits. It is known that copious groundwater supplies occur mainly in deposits of alluvial stream terraces and outwash plains. What is not clear is the precise relationship between the surficial wetland, defined by vegetative and surface water indicators, and sub-surface groundwater regimes. To shed some light on this question, we are supporting water budget studies on wetlands underlain by till and outwash. Preliminary field studies of glacial lake deposits indicate that some are important sources of ground-water, especially where lake clays cap more porous deposits. It is likely that certain of these will prove to be important in the future of local water supply management.

We have indications of a correlation between glacial lake deposits, wooded wetlands and potential groundwater supplies. In some instances we see evidence that the dry uplands surrounding some of these wooded glacial clay deposits are acting as recharge areas for aquifers under the confining clays. Where this is the case both uplands and wetlands may have to be managed as a complete recharge-discharge unit.

WILDLIFE

In few cases will wildlife values be considered the single basis for deciding the future of a given wetland. Where this is the case, outright purchase in the form of national wildlife refuges, state wildlife management areas or private refuges can occur, even near the center of Megalopolis. The Massachusetts Division of Fisheries and Game and others have filed legislation this year to authorize up to 11 million dollars in wetland acquisition. But in the final analysis, wildlife values will usually contribute to, but not exclusively govern, the fate of specific inland wetlands. This is in contrast with the estuarine wetland picture where nutrients and wetlands play key roles in the life cycles of fin and shell fish.

The national wetland inventory of 1954 recognized 11 freshwater wetland types all of which occur in the Northeast (Shaw and Fredine, 1956). The limitations of aerial photo interpretation are such that not all of these can be consistently recognized on 1:20,000 photography. Field examination indicates that there are many finer categories within these types. We are working on a more detailed classification within the recognized types. These finer classifications should form the basis for more meaningful wildlife evaluations than do the existing broad types.

We are also examining the influence of vegetative succession on wetlands. Some current wetlands trace the source of their open character to man's activity. Some fresh meadows or shrub swamps may exist due to grazing or wood cutting. To the extent this is true, these wetlands may be ephemeral or transitional. Selection of these for preservation would require periodic intervention by man to retain the desired, but somewhat artificial flora/fauna composition.

In addition, we are seeking evidence of relationships between differences in dissolved nutrient supply, surficial geology and vegetative composition of wetlands.

VISUAL-SOCIAL VALUES

The approach of our landscape architects to the wetland problem has been to identify a conceptual heirarchy of three levels. To grasp this approach, conceive of viewing wetlands as seen by the aerial photographer on the maps of a regional planner.

From this perspective, it is apparent that many wetlands are connected to hydro-geologic systems which are essentially multi-functional. (Those which do not appear related to a system are in a separate category of interest from several viewpoints.) These systems, with their wetland component affect large land areas and can be instrumental in guiding land use and development. These systems differ in visual characteristics in a manner similar to physiographic systems. The cultural land use pattern, diversity and quality of land use adjacent to wetlands influences the visual quality and the access to wetlands and their parent hydro-geologic systems.

Now consider the perspective of a viewer overlooking an expanse of landscape from a small hilltop or highway overlook. Within this context the major determinants of wetland visual quality appear to be local topographic configuration and diversity, from, contrast and the local cultural land-use pattern. The land-use immediately adjacent to wetlands controls visual quality and accessability to specific marshes.

Now consider the wetland as viewed from within. Degree of spatial enclosure, diversity and interspersion of vegetation, ephemeral effects and natural patterns of change appear to be major determinants of visual quality within the wetland. Man-made changes affect the relative permenance of a given wetland type and possibly those wetlands where change is accomplished mainly by natural forces are more valuable in their multi-functional role.

Development of this visual hierarchy provides a framework for testing the visual impact of wetlands on the public. This testing is now in progress. It also is a framework whose form and concepts have meaning to the hydrologist and wildlife manager. One of the exciting

benefits from our team research has been the joint discovery that natural systems and concepts such as diversity have common meanings and form a common working base for people of diverse professional training.

ECONOMICS

The main thrust of our economics group is to develop a comparison between the benefits from preserving wetlands versus the benefits which might accrue to society from alternative uses of these areas. This is the opportunity cost of maintaining wetlands in a natural state. Our other teams bear a heavy responsibility to feed the economists data on values derived from maintaining wetlands. Where possible, hard dollar figures will be used, but our intent is not to restrict our considerations to dollar values alone.

Early in the study it became apparent that there is a general indifference towards wetlands among people in general and wetland owners in particular. The higher the tax liability on a wetland the greater the chances of its alteration. There also appears to be a direct and positive correlation between the extent of zoning and/or conservation restrictions and the market value of a wetland. Since filling wetlands for an alternative use involves contractors, we are studying the fixed and variable cost of altering wetlands. In some instances a pattern of contractor ownership of wetlands appears to emerge whereby a contractor buys a wetland as an investment. It becomes a place to dispose of surplus fill from other jobs and a place where he can keep his work crews busy between jobs. The wetland then becomes a business investment.

We are evaluating the pioneer "Hatch Act" legislation since it appears that about 1200 applications have been made since 1966 and over 90 percent have been approved. Most of these seem to be quite minor cases. Major cases clearly involving flood control or health/water supply considerations appear to have been afforded protection. There are instances where values not covered by the act have been lost and the actions of several large state agencies are not covered by the legislation at all. These limitations and the delay in implementing the "Inland Wetlands Act" lead our economists to suggest that better assessment of benefits and costs ought to be applied when putting public policies into legislative form.

To provide a basis for translating costs and benefits of preserving wetlands into monetary terms, we expect to contrast market values with tangible and intangible values identified by the other subprojects. On the market value or cost side, we propose to use the market price of wetlands since this provides a good measure of the

grantees' expectations of returns from the altered wetland. Data so far indicate that the price per acre of wetlands on the open market may be negligible in remote rural areas and in a range of $1,500 to $70,000 per acre in expanding urban areas.

SUMMARY

In summary, we feel that the unique aspect this study offers is a coordinated team approach to an array of variables in wetland management decisions. An important factor we have not covered is the role of wetlands as physical moderators of surface flood waters. This is a potentially highly important area waiting for a motivated environmental engineer who is not professionally tied to waste disposal system engineering.

The planning and conduct of our work has involved close collaboration between the various disciplines involved in the study. In joint work sessions we have contrasted professional approaches to the research, developed hypotheses and a common framework for research. This gives me hope that disciplines need not be separate entities on university campuses. The graduate students, perhaps more readily than their faculty, have established a rapport and coordination in field and lab work which should carry into the real world where discipline distinctions fade to obscurity.

We are not sure of the form which our final results will take. We are becoming more confident, though, that an integrated management approach is attainable. Our original proposal aimed at goals which we were not entirely sure we could attain, but, we are driven by daily evidence that inland wetlands will continue to be mismanaged on a somewhat impulsive basis unless an integration of important variables can be put in a decision-making framework for managers.

LITERATURE CITED

Larson, J. S.
1971. Managing woodland and wildlife habitat in and near cities. *In*: Trees and Forests in an Urbanizing Environment. Extension Service, University of Massachusetts (in press).

MacConnell, W. P. and L. E. Garvin
1956. Cover mapping a state from aerial photographs. Photogrammetric Engineering. 22: 702-707.

Shaw, S. P. and C. G. Fredine
1956. Wetlands of the United States. Circular 39. U. S. Fish and Wildlife Service, Washington, D. C. 67 p.

HUMAN BEHAVIOR AND WILDLIFE MANAGEMENT: NEEDED RESEARCH

JOHN C. HENDEE AND DALE R. POTTER

USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Seattle, Washington

Most game managers profess that wildlife management is also people management, with the human element possibly dominant. This is perhaps best stated by King (1948): "Biologists once dreamed of solving wildlife problems while the galleries cheered. Wiser now, they see need for human engineering as well as better research." However, wildlife research programs reflect little concern with human behavior aspects of wildlife management and are almost exclusively oriented toward biological problems. This paper identifies some human behavior issues needing research to support efforts to cope with the numerous people problems surrounding wildlife management.

Highly scientific research on human behavior aspects of wildlife appeared scarce in our literature review. We found nearly 600 popular articles or published conference talks on people-wildlife topics but relatively few publications based on solid research data. But, we found only 190 scientific journal articles, 32 doctoral dissertations, 39 master's theses, and 36 federal or state research bulletins devoted to human behavior aspects of wildlife. The highly regarded *Journal of Wildlife Management*, from 1960 to 1970, had only 6 contributions on people-wildlife topics out of 698 total articles.[1] Thus, despite extensive magazine and conference comment on human behavior aspects of wildlife, rigorous social-wildlife research is scarce.

More research is needed on human behavior aspects of wildlife, but a concerted effort will be required to overcome pressures that have led to the current situation. Some problems needing attention are: How can competent behavioral research skills be attracted to wildlife-people problems? For example, social research skills are highly specialized, and biologically trained wildlife scientists cannot competently conduct most of the necessary studies. On the other hand, most social science fields have no inherent interest in wildlife problems and must be wooed to the challenge, not only with money, but by articulate definition of challenging problems for study. Given that important and challenging people problems are identified, what is their relative importance compared to the biological-ecological issues that now attract most of the wildlife research attention? Who will

[1]Out of 698 total articles from 1960 through 1969, six were on human behavior, 108 on administration and management, 580 on biological topics, and four articles falling under "other" subjects.

sponsor or financially support such research? How can wildlife managers be better trained to incorporate behavioral research findings into policy?

ISSUES FOR RESEARCH

In the following pages we identify several broad problem areas and specific questions to which research on human behavior aspects of wildlife should be directed. The areas include: hunting satisfaction, non-consumptive use of wildlife, the hunter population, access and hunting opportunity, wildlife economics, and political-legal issues. The important areas of law enforcement and hunter safety are legitimate topics for study but have not been included due to space limitations. The paper also excludes any specific reference to fishing although much of the content would apply as readily to fisheries as to other wildlife.

Hunting Satisfaction

The basic products of wildlife management are human satisfactions, and the over-riding goals should be to produce desired and worthwhile human experiences. Knowledge about the satisfactions, benefits, motives and preferences of wildlife users, and how they vary under different conditions, is, therefore, extremely important to help guide wildlife managers. In our opinion, questions surrounding the human satisfactions derived from wildlife are among the highest priority issues for research since they will help define the ultimate wildlife management product, human experiences with distinctions of quality versus quantity (Webb 1968).

Some studies allude to the harvest of human values from hunting (in addition to game), but the findings are generally incidental to other issues and a definitive study of hunting satisfaction has not been conducted. For example, studies have reported that hunters are satisfied or that most plan to return the following year, from which a generally acceptable level of satisfaction is inferred (Nobe and Gilbert, 1970; Kirkpatrick, 1965; Garrett, 1970; Pearse and Bowden, 1966; Bell *et al.* 1955). Reasons for dissatisfaction are generally related to the lack of game, sometimes to poor facilities or services, or to crowded field conditions. But such studies do not get at the crucial question which is, what do people get out of hunting besides game? Other studies suggest a substantial list of hunting motives, benefits, and satisfactions including recreation, economic incentive, companionship, esthetic appreciation, health, intellectual satisfaction, character development, religious and psychological release, pleasure, etc. (Davis, 1967; Stokes, 1966; Peterle, 1967; Ashcroft, 1967). Some unproven

theories suggest that the values and appeal of hunting include development of self-reliance, initiative, instinctive satisfactions, ecological awareness, cultural values, ethical training, expression of antisocial impulses, the thrill of chance, etc. (Shephard, 1959; Leopold, 1966; Anthony, 1957; Leonard, 1965; Hendee, 1969).

The foregoing benefits distinguish hunting from killing and provide a rationale for what some critics claim to be an uncivilized blood sport (Krutch, 1957). Such benefits indicate that hunting satisfaction (intangible benefits harvested) may not be directly related to hunting success (game killed) but depend on a minimum probability of success to enhance the intangible benefits that make up hunting satisfaction.

Research is needed to answer questions such as: What is the relationship between hunting satisfaction and success? How does satisfaction vary under different conditions? What are the relative dimensions of hunting satisfaction, and how do they vary among different types of hunters (e.g., experienced *vs.* inexperienced)and different kinds of hunting (e.g., elk hunters *vs.* duck hunters)? How can game management policy be modified to enhance meaningful dimensions of hunting satisfaction? How can management provide diverse conditions so hunters can seek their own preferred mix of intangible values surrounding the hunting experience? Research suggests that job satisfaction depends on achievement relative to expectations and aspirations (Greist, 1968). Does such a model apply to hunting satisfaction? If so, what impact will declining standards of hunting success have on the expectations and satisfaction of future populations of hunters and what should managers do about it?

Another pertinent intellectual challenge concerns philosophical and ethical aspects of hunting for sport. Particularly since this sport involves the harvest of living natural resources, the philosophical and ethical rationale for such activity is extremely important—an implicit point among hunting critics (Krutch, 1957; Gilbert, 1967). Furthermore, there are more hunters than game to go around by previous standards of success and quality, and a well articulated philosophy of how, why, and to whom wildlife benefits are to be distributed is basic to successful wildlife management policy. Thoughtful introspection about human satisfaction from wildlife is needed and can be useful, stimulating, and provocative as well as providing a source of hypotheses as targets for investigation.

Non-Consumptive Use of Wildlife

Non-consumptive wildlife use relative to hunting deserves more attention as it is sure to increase due to: a shrinking accessible land

base for hunters, reduced game habitat due to agricultural practices and urbanization, and decreasing proportion of hunters among all outdoor recreationists, particularly from urban areas. The small absolute increase in annual number of hunters (U.S. Department of Interior, 1956, 1961, 1966) does not match population growth (Peterle, 1967), and a decrease in overall man-days of hunting is predicted due to crowding and population density (Cicchetti *et al.* 1969). Wildlife can be shot only once by hunters but can be endlessly observed or photographed, and such appreciative uses are sure to compete with consumptive uses in the years ahead (Hendee, 1969; Gilbert, 1967). The wildlife management profession cannot afford to be alienated from either type of use.

Evidence of growing appreciative use of wildlife is steadily mounting. Visitors flock to wildlife-rich areas such as Yellowstone where wildlife often attracts more attention than thermal activity. The Cache elk herd in Utah was reported as the feature attraction by 98 percent of 65,000 winter sleigh riders visiting the area (Ashcroft 1967). The opportunity to see wildlife was found to be an important secondary attraction for car campers in Minnesota (Lime and Cushwa, 1969). More than 15,000 people from Nome to Miami take part in the annual Audubon Christmas bird count (Ryan 1971), 11 million people (birders) watch or photograph birds for recreation, and nearly 120 million recreation nature walks occur annually (Bureau of Outdoor Recreation, 1967). More studies are needed describing the extent and conditions under which these non-consumptive uses of wildlife take place, to whom they appeal, and how further opportunities might be developed.

Other questions surrounding appreciative uses of wildlife will be more difficult to answer. For example, what motives underlie these non-consumptive uses and what are the ties with American culture, as with hunting, which are obviously linked to our heritage? To what extent is such use increasing, both in absolute terms and relative to hunting? What shifts in use are taking place and for what reasons? What non-consumptive benefits are harvested by hunters?

The function and role of wildlife in American society are changing with non-consumptive uses growing in importance. Wildlife managers are challenged to capitalize on these appreciative uses to extend support for the total wildlife effort and to contribute wildlife satisfactions to the 85 percent non-hunters in the population. Wildlife in the urban scene is a source of pleasure and ecological reality to millions while contributing to the diversity and quality of urban life (Davey 1967, Stearns 1967).

Vicarious enjoyment of wildlife is offered through scores of books,

magazines, T.V. programs, and movies. The specific appeal and impact of these media as an extension of wildlife benefits to the non-hunting masses should be explored. For example, Jacques Cousteau entertains millions with prime-time T.V. specials about oceanographic research. A host of wildlife management success stories might offer similar drama, popular appeal, and vicarious benefits, e.g., introduced species such as the ringneck pheasant, chukar, and Hungarian partridge, salmon in the Great Lakes, and golden trout in Wyoming. Such efforts should be based on competent study of the reception and potential information and education benefits of such an effort.

The Hunter Population

We found about a dozen studies describing the characteristics of hunters.[2] They report in general that hunters average medium incomes, moderate educations, 35-40 years old; more than 90 percent are male and of middle occupational social class. Specific demographic parameters may imply important policy implications to sensitive interpreters. But, many of these studies were handicapped by poor questionnaire returns, or sampling bias, limited analytical rigor, and formats which restrict comparisons between studies.

Even with the best methodology, the potential contributions of purely descriptive hunter studies are limited and leave more important questions unanswered. For example, hunter populations might better be conceived according to a dynamic model with continuing entry and exit, recruitment, advancement, and retirement taking place and related to substitutable activity in other segments of society. Some important questions are: How do characteristics of hunters compare with those of other recreationists? What are the characteristics of hunters entering or leaving the hunting population, and what are their motives? What alternative activities or sources of satisfaction serve as tradeoffs for hunting? Such information provides clues about future populations of hunters, changes taking place, and future policy implications. At least one recent study (Klessig, 1970) reflects concern with such issues.

A growing number of studies are concerned with hunter preferences—an important topic that can provide valuable feedback and reflects the concern and interest of wildlife managers with the desires of their clients. But, such studies can be misleading, and a philosophical criterion is needed to properly evaluate preferences as a guide to management (Hendee and Harris, 1970). For example, depending on

[2] Bevins *et al.*, 1968; Davis, 1962; Davis, 1967; Folkman, 1963; Garrett, 1970; Kirkpatrick, 1965; Lobdell, 1967; Nobe and Gilbert, 1970; Peterle, 1967; Sendak and Bond, 1970; Vilkitis, 1968.

the dynamic characteristics of the hunter population, preferences will change over time. Questionnaire returns are often so low that one often doesn't know how one-half the population feels. Interview studies also have inherent biases. The search for preferences implies a quest for "the greatest good for the greatest number" which is often aborted to mean "the greatest number." This often results in reduced diversity and quality of hunting opportunities in an effort to serve the masses. Before preference studies can legitimately serve wildlife management, some philosophical ground rules are needed to guide the use of such information and guard against innocent abuse of it. User preferences are not necessarily mandates and must be used with seasoned judgement and an awareness of statistical shortcomings.

Access and Hunting Opportunity

Hunting access and opportunity involve: (1) roads as a means of access to and location for hunting, and (2) privilege access, to hunt on public or private property.

Several studies indicate that hunter distribution and kill are directly proportional to access, most occurring within 1.5 miles of roads.[3] Such concentrated hunting activity and harassment may condition game to avoid heavily roaded areas, perhaps reducing hunter success and satisfaction. How do road systems affect utilization of the game resource? Longhurst, Leopold, and Dasmann (1952) found that hunters in less accessible areas had better success, but their impact was not enough to control herd numbers. Peterson (1969) cites 14 studies in 11 western states reporting underharvested big-game herds. It is interesting and significant that so many big-game hunters road hunt while passing up greater probabilities of success away from roads in the back country.

On the other hand, extensive road networks may not allow animals adequate relief from harassment. Trails have a number of advantages in that they have been found to distribute hunters about the same as roads (James *et al.,* 1964) but do not expose game to as much harassment.

Maintaining access privileges, allowing sportsmen to hunt on private land, is a continuing challenge to game managers (Barclay, 1966). Farmer-sportsmen relations are tenuous, and without the active participation and leadership of game departments, sportsman-landowner relationships may deteriorate, leading to reduced hunting opportunities on private land (Hunter, 1953). Previous studies indi-

[3]Alaska Department of Fish & Game, 1961; Bergerud *et al.*, 1968; DeGarmo, 1952; Giles and Gwynn, 1962; Hanson and McCulloch, 1955; James *et al.*, 1964; Johnson, 1943; New Hampshire Department of Fish and Game, 1957; Stenlund *et al.*, 1952; Trippensee, 1935.

cate that landowners closing their property are more concerned with regulating hunter behavior leading to property damage than with stopping hunting entirely (Whitesell, 1952; Waldbauer, 1966). Maintaining public access to private lands is a challenging public relations task that hunters depend on game departments to provide. Research can help with studies defining the supply of private land, the conditions under which it will be available or withdrawn (McIntosh, 1966), the experimental testing of new access programs such as "pay to hunt," and study of factors associated with access such as safety, vandalism, and littering. But, the key to continued access to private land is proper hunter behavior and intensive, imaginative public relations by game managers seeking public access and improved wildlife habitat and yield from private lands (Durell, 1969).

Wildlife Economics

Several studies document the substantial economic revenues generated by hunters (David, 1962 and 1967; Nobe and Gilbert, 1970; Kirkpatrick, 1965; Wallace, 1956; Fine and Werner, 1960; United States Department of Interior, 1956, 1961, 1966). The expenditures revealed suggest substantial transfers of income from urban to less affluent rural areas by resident hunters and introduction of new money to state economies by out-of-state hunter expenditures. This descriptive information may be important to decision makers and chambers of commerce seeking to justify public investments by indicating the relative stature of hunting compared to other income generating activities.

However, gross expenditure studies leave more important questions unanswered. Fish and wildlife compete with other resource uses thus imposing costs in terms of uses foregone. Until studies indicate what people are willing to pay to hunt or fish, the dollar value of such opportunities cannot be determined and rational trade-offs between competing land uses are impossible. Simulation studies offer approximations of answers such as the cost of overcoming distance or hypothetical expenditures as indicators of people's willingness to pay (Brown *et al.* 1964; Garrett *et al.*, 1970). Such studies are expensive and technically complex, but they facilitate data needed to establish capitalized rents expressing the value of resources for hunting and fishing for comparison with other competing land uses (Crutchfield, 1962, 1964).

Studying the economic aspects of wildlife, properly defined as demand and valuation, requires extensive training in economics. Recreation demand and valuation theory, methods, and techniques are being developed by economists to handle complexities of such prob-

lems, and application of these to wildlife related recreation should be supported But, non-economist wildlife researchers are unlikely to contribute in this specialized area, and their efforts might better be applied to other problems such as hunting product identity, feasibility studies of hunting fees, success and failure of private shooting preserves and hunting clubs (Street, 1969), substitutability of different amounts and levels of hunting quality, survey of industries dependent on hunting and wildlife expenditures, effects of alternative rationing concepts such as permits, reservations, etc., distributive effects of pricing, substitutability of peak and off-peak demand (Bowden and Pearse, 1968; McConnell, 1966; Christiansen *et al.*, 1969a and 1969b; Schermerhorn and Starkey, 1966).

Political-Legal Issues

The search for useful information on human behavior aspects of wildlife management should not be restricted to clientele but should include other organizational and institutional factors. This calls for study and critical appraisal of clientele relationships and political-administrative structures—sensitive issues needing evaluation based on factual data and objective criteria. This will involve such sensitive topics as federal-state jurisdictions, administrative responsibility and cooperative arrangements, ownership of game, licensing prerogatives and fees, conflicting uses, shifting clientele and support, and wildlife management, education, and professionalism (Owens, 1965). Research on such problems uses the "softest" of social science skills but can contribute much to understanding the forces at work and their effects. For example, objective case studies and surveys using conceptual models and theory to identify and interpret critical relationships can be enlightening and useful.

Many political-administrative questions emerge from commission studies such as the Outdoor Recreation Resources Review Commission and the Public Land Law Review Commission (Cain, 1965; Schneider, 1970; Swift, 1970). A major challenge will be to formulate the necessarily broad problems defined in commission reports into research questions and propositions to which operational data and conceptual models can be applied. A few questions that seem pertinent to us are: What effect has administrative dispersion of the wildlife research effort had on selection of problems to be studied? How and to what extent does dependence on hunting license revenues influence wildlife policy and expenditures contrary to directions that would be followed under general revenue support? (Gilbert, 1967). What political forces shape the allocation of money to various wildlife endeavors, both within and among states? Do current problems in wildlife manage-

ment imply the need for change in professional training and educational programs and in what directions? Among what organized groups does political support for wildlife rest—what are the desirable and undesirable consequences of this support—what changes are imminent or desirable in the future? What values are nurtured in the wildlife management profession, and what are the influences of such values on decision making?

IMPLEMENTING RESEARCH

Implementing a research program on human behavior aspects of wildlife will require a fresh approach as current efforts have not produced the necessary quantity or quality of investigation. Many of the suggested areas for research should be pursued in a centralized effort due to the problem of attracting the necessary, skilled scientists. This is particularly true for such topics as hunting satisfaction, political aspects, systems analysis, and demand and valuation issues in wildlife economics. Obviously, many questions of local importance such as access, hunting opportunity, and market surveys must be a decentralized effort by states and their universities. But, to guide their efforts and upgrade the quality of research methods, problem selection, and study formulation, a centralized effort is required.

It seemed apparent to us in reviewing the work to date that wildlife management education must broaden its horizons to include more social science. Greater exposure to these fields would acquaint the managers with the potential use of behavioral research on wildlife problems and provide a basis for evaluating such contributions. A first reflection of broadened professional education might be a change in the appalling scarcity of articles in wildlife journals on human behavior aspects of wildlife.

There is also the scarcity of money. Our opinion is that shifts in available money are warranted from biological-ecological research to human behavior study—considering the problems and priorities confronting the wildlife field and the current imbalance. It doesn't make sense to spend virtually all available research money on game and habitat problems at the expense of inquiry needed to extend the benefits of wildlife to a broader segment of society through nonconsumptive uses, needed to identify the intangible values hunters harvest in addition to dwindling game per capita, needed to solve problems of access to shrinking hunting opportunities, etc. But, it is not realistic to expect change in the status quo to be generated at local levels. Money from a central source is needed to prime the research pumps at local levels. This is in addition to establishment of research

teams and provision of grants to support substantial studies with broad collective benefits.

We leave other questions unanswered. They are best left for discussion and decisions within the wildlife profession. We direct your attention to such issues as: What group might provide leadership for the changes we suggest? For example, what role should various federal agencies, the National Wildlife Federation, and the Wildlife Management Institute play in initiating research? How can current imbalances be changed, given their existence is recognized? What relative priorities do you attach to the problem areas identified?

LITERATURE CITED

Alaska Department of Fish and Game
1961. Caribou management investigations. Annu. Progr. Rep., Fed. Aid Proj. W-6-R-2. 128 p.

Anthony, Harold E.
1957. The sportsman or the predator: Part II. but it's instinctive. Saturday Rev. Lit. p. 9-10, 40. Aug. 17.

Ashcroft, William H.
1967. The socio-economics of recreational use of the Cache elk herd. M.S. thesis, Utah State Univ. 77 p. illus.

Barclay, John Scribner
1966. Significant factors in influencing the availability of privately owned rural land to the hunter. M.S. thesis, Pa. State Univ. 112 p. illus.

Bell, James G., Laurence R. Jahn, and Lloyd Gunther
1955. Horicon's managed goose hunt—1954. Wis. Conserv. Bull. 20(3): 12-14, illus.

Bergerud, Arthur T., Frank Manuel, and Heman Whalen
1968. The harvest reduction of a moose population in Newfoundland. J. Wildlife Manage. 32(4): 722-728.

Bevins, Malcolm I., Robert S. Bond, Thomas J. Corcoran, Kenneth D. McIntosh, and Richard J. McNeil
1968. Characteristics of hunters and fishermen in six northeastern states. Vt. Agr. Exp. Sta. Bull. 656. Also Northeast. Reg. res. publ. 76 p. illus.

Bowden, G., and P. H. Pearse
1968. Nonresident big-game hunting and the guiding industry in British Columbia. Study Rep. 2. Fish & Wildlife Br., Dep. Rec. & Conserv., Victoria, B. C. 72 p. illus.

Brown, W. G., A. Singh, and E. N. Castle
1964. An economic evaluation of the Oregon salmon and steelhead sport fishery. Ore. Agr. Exp. Sta. Tech. Bull. 78.

Bureau of Outdoor Recreation
1967. The 1965 survey of outdoor recreation activities. U. S. Dep. Int. 201 p. (Unpublished report.)

Cain, Stanley A.
1965. What is the place of fish and wildlife in outdoor recreation programs. Proc. 45th Annu. Conf. West. Ass. State Game & Fish Comm. 45: 4-9.

Christiansen, John R., William S. Folkman, J. Loraine Adams, and Pamela Hawkes
1969a. Forest fire prevention knowledge and attitudes of residents of Utah County, Utah, with comparisons to Butte County, California. Soc. Sci. Res. Bull. No. 5. Brigham Young Univ. and Pac. Southwest Forest & Range Exp. Sta. 26 p. illus.

Christiansen, John R., Sydney D. Stainforth, Aaron Johnson, Jr., and Rollin Cooper
1969b. An economic survey of privately owned shooting preserves in Wisconsin. Coll. Agr. & Life Sci., Univ. Wis. Res. Rep. 47. 11 p. illus.

Cicchetti, Charles J., Joseph J. Seneca, and Paul Davidson
1969. The demand and supply of outdoor recreation, an economic analysis. Bur. Econ. Res. Rutgers—The State Univ. New Brunswick, N. J. 301 p. illus.

Crutchfield, James R.
1962. Values of fishery resource. Land Econ. 38: 145-154.

1964. Fish and wildlife values in relation to other resources. Proc. 44th Annu. Conf. West. Ass. State Game & Fish Comm. 44: 48-56.

Davey, Stuart P.
1967. The role of wildlife in an urban environment. Trans. 32nd N. Amer. Wildlife & Natur. Resour. Conf. 32: 50-60.
Davis, William C.
1962. Values of hunting and fishing in Arizona, 1960. Spec. Stud. No. 21. Bur. Bus. & Publ. Res., Univ. Ariz. 62 p. illus.
———.
1967. Values of hunting and fishing in Arizona in 1965. Coll. Bus. & Public Admin., Univ. Ariz. 91 p. illus.
DeGarmo, W. R.
1952. The 1951 deer season. W. Va. Conserv. 15(11): 4-7.
Durell, James S.
1969. Hunter-landowner relationships. Trans. 34th N. Amer. Wildlife & Natur. Resour. Conf. 34: 179-185. illus.
Fine, I. V., and E. E. Werner
1960. Economic significance of hunters in Wisconsin. Univ. Wis. Bur. Bus. Res. & Serv. 1(6): 16 p. illus.
Folkman, William S.
1963. Levels and sources of forest fire prevention knowledge of California hunters. U.S.D.A. Forest Serv. Res. Pap. PSW-11. Pac. Southwest Forest & Range Exp. Sta., Berkeley. 22 p. illus.
Garrett, James R.
1970. Characteristics of Nevada hunters. Agr. Exp. Sta. Bull. B.22. Univ. Nev., Reno. 66 p. illus.
Garrett, J. R., G. J. Pom, and D. J. Arosteguy
1970. Economics of big game resource use in Nevada. Agr. Exp. Sta., Univ. Nev., Reno. B-25. 22 p. illus.
Gilbert, Bil
1967. Hunting is a dirty business. Saturday Evening Post. p. 16-17. Oct. 21. Reprinted Feb.-Mar. 1969 in the Wild Cascades.
Giles, R. H., Jr. and J. V. Gwynn
1962. The Allegheney County, Virginia, Head. Va. J. Sci. 13(1): 1-16.
Greist, David A.
1968. A method for determining elements of satisfaction in outdoor recreation. M.S. thesis, Colo. State Univ., Fort Collins. 83 p. illus.
Hanson, William R., and Clay Y. McCulloch
1955. Factors influencing mule deer on Arizona brushlands. Trans. N. Amer. Wildlife Conf. 20: 568-588.
Hendee, John C.
1969. Appreciative versus consumptive uses of wildlife refuges: Studies of who gets what and trends in use. Trans. 34th N. Amer. Wildlife & Natur. Resour. Conf. 34: 252-264.
Hendee, John C., and Robert W. Harris
1970. Foresters' perception of wilderness-user attitudes and preferences. J. Forest. 68(12): 759-762. illus.
Hunter, W. A.
1953. Landowner-sportsman relations. Proc. 33rd West. Ass. State Game & Fish Comm. 33: 265-269.
James, George A., Frank M. Johnson, and Frank B. Barick
1964. Relations between hunter access and deer kill in North Carolina. Trans. 29th N. Amer. Wildlife & Natur. Resourc. Conf. 29: 454-463.
Johnson, Fred W.
1943. Hunter distribution—studies and methods. Trans. 8th N. Amer. Wildlife Conf. 8: 392-407.
King, Frank H.
1948. The management of man. Wis. Conserv. Bull. 13(9): 9-11.
Kirkpatrick Thomas O.
1965. The economic and social values of hunting and fishing in New Mexico. Bur. Bus. Res. Univ. New Mex. 94 p. illus.
Klessig, Lowell L.
1970. Hunting in Wisconsin: Initiation, desertion, activity and attitudes as influenced by social status. M.S. thesis, Univ. Wis., Madison. 152 p. illus.
Krutch, Joseph Wood
1957. The sportsman or the predator? Part 1. A damnable pleasure. Saturday Rev. Lit. 40: 8-10, 39, 40.
Leonard, Justin W.
1965. Moral, ethical, and fiscal aspects of wildlife management. Trans. 30 N. Amer. Wildlife & Natur. Resour. Conf. 30: 422-425.
Leopold, Aldo
1966. A Sand County almanac, with other essays on conservation from Round River. Oxford Press, New York. 269 p. illus.
Lime, David W., and Charles T. Cushaw
1969. Wildlife esthetics and auto campers in the Superior National Forest. U.S.D.A. Forest Serv. Res. Pap. NC-32. N. Central Forest & Range Exp. Sta., St. Paul, Minn. 8 p. illus.

Lobdell, Charles Henry
1967. Socio-economic characteristics of Maine sportsmen. M. S. thesis, Univ. Maine. 95 p. illus.
Longhurst, William M., A Starker Leopold, and Raymond F. Dasmann
1952. A survey of California deer herds, their ranges and management problems. State of Calif. Dep. Fish & Game, Bull. No. 6. 136 p. illus.
McConnell, Chester A.
1966. A survey of private commercial shooting preserves in Tennessee. Proc. 20th Annu. Conf. Southeast. Ass. Game & Fish Comm. 20: 161-180. illus.
McIntosh, Kenneth D.
1966. Privately-owned hunting lands in West Virginia: Supply, quality and access arrangements. Ph.D. diss., Univ. Wis. 324 p.
New Hampshire Fish and Game Department.
1957. Hunter-success relationships. Job Completion Rep. Fed. Aid Proj. W-12-R-9. 16 p.
Nobe, Kenneth C., and Alphonse H. Gilbert
1970. A survey of sportsmen expenditures for hunting and fishing in Colorado, 1968. Colo. Div. Game, Fish & Parks, Tech. Pub. No. GFP-R-T24. 83 p. illus.
Owens, John Robert
1965. A wildlife agency and its possessive public. Inter.-Univ. Case Program #87. The Bobbs-Merrill Co., Indianapolis, Ind. 52 p. illus.
Pearse, Peter H., and Bowden, Gary
1966. Big game hunting in East Kootenay. Univ. B. C., Vancouver. 39 p. illus.
Peterle, Tony J.
1967. Characteristics of some Ohio hunters. J. Wildlife Manage. 31(2): 375-389. illus.
Peterson, William J.
1969. A literature review on deer harvest. Spec. Rep. No. 22. Colo. Div. Game, Fish, and Parks; and Coop. Wildlife Res. Unit. 15 p. illus.
Ryan, Pat
1971. . . . and a partidge in a palm tree. Sports Illus. Jan. 11, 34(2) p. 44.
Schermerhorn, Richard W., and William K. Starkey
1966. An economic feasibility study—shooting preserves in Maryland. Agr. Exp. Sta. Univ. Md. Misc. Pub. No. 584. 34 p. illus.
Schneider. Phillip W.
1970. Fish and wildlife as related to other resources and values. P. 58-74 in "What's Ahead for Our Public Lands?" by Hamilton K. Pyles. Natural Resources Council of America, Washington, D. C. 343 p.
Sendak, Paul E., and Robert S. Bond
1970. A consumer analysis of licensed hunters and fishermen in Massachusetts. Planning and Res. Develop. Ser. No. 14, Bull. No. 583, Holdsworth Natural Resources Center, Agr. Exp. Sta., Univ. of Mass., Amherst. 43 p. illus.
Shephard, Paul Jr.
1959. A theory on the value of hunting. Trans. 24th N. Amer. Wildlife Conf. 24: 504-512.
Stearns, Forest W.
1967. Wildlife habitat in urban and suburban environments. Proc. 32nd N. Amer. Wildlife and Nat. Resources Conf. 32: 61-69.
Stenlund, Milton H., Marius A. Morse, Donald W. Burcalow, John L. Zorichak, and Bernard A. Nelson
1952. Whitetailed deer bag checks, Gegoka Management Unit, Superior National Forest. J. Wildlife Manage. 16(1): 58-63.
Stokes, Gerald Lamar
1966. Outdoor activity and personality. M.S. thesis, Univ. Ga., Athens. 56 p. illus.
Street, Donald R.
1969. The fee fishing lakes as a business in Pennsylvania. Pa. State Univ. Agr. Exp. Sta. Bull. No. 755. 24 p. illus.
Swift. Lloyd W.
1970. Review of the report on fish and wildlife resources on public lands. P. 190-201 in "What's Ahead for Our Public Lands?" by Hamilton K. Pyles. Nat. Res. Council of America, Washington, D. C. 343 p.
Trippensee, R. E.
1935. Cooperative deer hunting. Control of wildlife harvest imperative to good management. Amer. Wildlife 24(6): 87, 92-93.
U. S. Department of Interior
1956. National survey of fishing and hunting 1955. Fish & Wildlife Serv., Cir. 44. 50 p. illus.
U. S. Department of Interior
1961. 1960 National survey of fishing and hunting. Fish & Wildlife Ser., Cir. 120. 73 p. illus.
U. S. Department of Interior
1966. 1965 National survey of fishing and hunting. Fish & Wildlife Ser., Bur. Sport Fish. & Wildlife Res. Pub. 27. 76 p. illus.

Vilkitis, James R.
1968. Characteristics of big game violators and extent of their activity in Idaho. M.S. thesis, Univ. Idaho, Moscow. 202 p. illus.
Waldbauer, Eugene Charles
1966. A study of posting on private lands in New York State. Ph.D. diss., Cornell Univ., Ithaca, N. Y. 278 p. (Univ. Microfilm No. 66-11,057).
Wallace, Robert F.
1956. An evaluation of wildlife resources in the State of Washington. State Coll. Wash., Pullman, Bur. Econ. and Bus. Res. Econ. & Bus. Stud. Bull. No. 28. 63 p. illus.
Webb, William L.
1968. Public use of forest wildlife: quantity and quality considerations. J. Forest. 66(2): 106-110.
Whitesell, Dale E.
1952. An analysis of the farmer-hunter problem in Ohio. Trans. 17th N. Amer. Wildlife Conf. 17: 533-539. illus.

DISCUSSION

CHAIRMAN WALLACE: Thank you, gentlemen, for this very excellent paper.

Dr. Hendee, you mentioned a whole series of research projects which you thought were important. What kind of priorities do you place on these various topics which you covered?

DR. HENDEE: As I indicated, hunting satisfaction is important because we need to know more about the human values that are harvested while hunting that might be enhanced by policy modification or change—something that we can do right away. In other words, we need to know more about what people get out of hunting besides game, so we can enhance satisfaction from use of the resources.

A second priority would be non-consumptive uses of wildlife. There is a vast and unexploited clientele that the wildlife profession has not tapped and which is of growing importance. This, in turn, will offer the opportunity to distribute wildlife benefits to a large mass of people that might not otherwise obtain benefits from wildlife.

I think economic issues would come next because we are faced with conflicts over land use everywhere and, must rationally make trade-offs between hunting and other important uses.

Political-legal issues come next, as we have a continuing need to re-evaluate the administrative structures under which we operate and how they might be modified to more efficiently generate wildlife benefits to the public.

MR. JAMES MORRISON: I have a question which is particularly relevant to our situation today. In view of the tight money situation how you can justify an expanded expenditure, particularly when you say most of the money comes from the user rather than the non-user?

DR. HENDEE: We acknowledge the shortage of money, but on the other hand, we stand on our judgment that wtih the current scarcity of human behavior research on wildlife problems, even if new money is not forthcoming, we think that a shift from biological and ecological areas to human behavior areas is warranted.

CHAIRMAN WALLACE: You suggested a central agency carrying out these kinds of studies. Do you have in mind this would be something like the Federal Government, for example?

DR. HENDEE: Yes. Research in human behavior aspects is not something where the results of research would apply only to a specific local area. At least they are not initially. Major research carried out on human behavior aspects would have broad collective implications. Because of this, it would seem that a federal effort spreading benefits from the research programs to all of the local areas would be called for.

The non-consumptive area, I think, is beginning to be justified by sheer competition for wildlife with participation in hunting decreasing relative to population growth and a growing increase in non-consumptive use. It would be folly for the wildlife profession to ignore this. These non-consumptive users unexploited clientele that the wildlife management profession is involved with and may establish

some way of bringing general revenues, through the right program. We have to recognize our responsibilities in this area.

MR. MORRISON: You are identifying a real problem area and I think it is worthwhile repeating what Tom Kimball said over television a couple of weeks ago on the "Today" show—that the decision to hunt or not to hunt is not a wildlife management decision—that it is a personal decision—that it is akin to one's selection of religion or politics; that if we are going to make this distinction, then we have to get into this area as opposed to strictly looking at our own population dynamics, et cetera. I don't know where the money is going to come from but Tom has identified the ground we have to put our effort into.

DR. RICHARD VAN DRIEL (Washington): There is one question here that bothers me, at least in some respects, and that is, whether the amount of resource involved is going to help us in relation to our game management, our recreational management, or, on the other hand, is it to satisfy a sociological problem? Or, on the other hand, is it purely a psychological effect that we are worrying about? It appears to me that the extensive reports that our game department has made, and I have looked back here in the index and I cannot see any referral to their studies of the actual behavioral problems we have had in our state, certainly hasn't helped bring in the funds that are required to produce the wonderful program that we have in our state. It seems to me this is more a sociological problem that seems to be bugging us rather than wildlife management and recreational management.

As I tried to follow your report, it appeared to me that everything seems to pertain to the sociological and psychological problem rather than to find out how to fund for better wildlife management and fishery management or even recreational management. It seems you are trying to satisfy the social problems of your constituents rather than the recreational aspects.

DR. HENDEE: You are quite correct in interpreting that it is concerned with the sociological and psychological aspects of hunting because it is these intangible values that people go out there to hunt for, or otherwise there would not be a justification to go. For example, elk hunting, with a chance of getting at an elk being fairly low and yet many people go year after year.

There are various intangible values that people get from participating in outdoor recreation and in hunting and our concern is that some of these be measured so that we can maximize the production of these values rather than just the production of game, because it is not just the game that people go out there for—it is other benefits.

We have to identify these benefits and see how wildlife management policies can enhance them.

MR. GERALD WOLLAM (Oregon): My work has been with parks and other recreational activities largely. I want to describe in background a steelhead fisherman that goes out with a fly and fishes until he has hooked a good sized steelhead. He plays it for five, ten or twenty minutes and he finally brings it to shore. So, he disdains using a net. He slides the steelhead onto a bar. Then he picks that steelhead up, after wetting his hands, moves him out into the water and removes the fly. He then caresses him on the stomach and then turns him loose.

Now, what is the psychological influence that causes that man to go fishing? After all it wasn't to get a steelhead to take home, was it? Yet, that man will go fishing year after year and, further, if you ask him why he doesn't use a net, he says that he doesn't like them.

What I am trying to indicate is that there are psychological effects to recreation that the sportsman pays for.

What I am trying to say here is that we do not have proper game management because we do not have it financed through the proper sources. There are so many benefits to this that our Game Commission is considering creating a visual point for viewing elk, deer, ducks and other wildlife by people who never take any game. This is the psychological effect which I believe is so important.

ECONOMIC EVALUATION OF MICHIGAN'S SALMON-TROUT FISHERY

GALE C. JAMSEN AND PAUL V. ELLEFSON
Department of Natural Resources, Lansing, Michigan

INTRODUCTION

Since its inception, Michigan's Great Lake salmon and trout program has received nationwide attention (Carter, 1968). In an attempt to better understand the program, Michigan's Department of Natural Resources began surveys of sport fishermen in 1967. Since then more detailed studies of the program's impact have been initiated. All of these studies were designed to provide managers with vital information needed to guide the future course of the program. Following is a broad summary of a few of the Department's findings to date. The results of more detailed analyses will be available in the near future.

Great Lakes Sport Fishing

Between the late 1800's and the early 1940's the fish resources of the Great Lakes supported a sizeable commercial fishery with lake trout (*Salvelinus namaycush*) being the species of most importance. Records indicate that the total commercial lake trout catch hovered around the 10 million pound mark during the end of this period. Sport fishing was also important during the 1930's and 40's. Again it was the lake trout which supported interest in sport fishing.

Fish stocks began to change markedly in the Great Lakes after 1940 (Smith, 1968). A number of factors caused these changes with the most important being the selective predation of the sea lamprey (*Petromyzon marinus*). By 1950 the lamprey had virtually eliminated trout populations from Lakes Michigan and Huron and by 1960 it had greatly reduced trout populations in Lake Superior. During this period of instability, the alewife (*Alosa pseudoharengus*) exploded into prominence and became the dominant species in Lakes Michigan and Huron.

A two-pronged program of restoring the Great Lakes began in the early 1950's. First, an attack coordinated by the Great Lakes Fishery Commission was marshalled against the lamprey. This involved development and application of a selective poison to spawning streams used by the lamprey. Although treatment continues, the lamprey can be considered as controlled in the upper Great Lakes.

The second part of the restoration program was restocking the Great Lakes with trout and salmon. Lake trout plantings were made

in Lake Superior throughout the 1960's while similar plantings began in 1965 in Lake Michigan. To speed up the restoration of high valued predator species in the Great Lakes, Michigan's Department of Natural Resources introduced coho salmon (*Oncorhynchus kisutch*) and chinook salmon (*Oncorhynchus tshawytscha*) in Lakes Michigan and Superior in 1966. Salmon were subsequently introduced in Lake Huron in 1968. In addition, large steelhead trout (*Salmo gairdneri*) plants were made in the past four years.

Michigan's Salmon and Trout Fishery Today

The impact of public and private efforts aimed at restoring the Great Lakes fishery was brought into sharper focus in 1969. In that year 180 thousand fishermen generated a total of 1.8 million angler days of sport fishing. Furthermore, these fishermen caught nearly one million salmon and trout (Jamsen *et al.*, 1970).

The Lake Michigan watershed was the focal point of fishing activity in 1969 (Table 1). Of the total statewide salmon and trout

TABLE 1. MICHIGAN SALMON AND TROUT SPORT FISHING BY TYPE OF FISHING AND LOCATION, 1969

Location	Type of Fishing		Total
	Great Lake	Tributary Stream	
	Angler Days		
Lake Michigan	596,000	621,000	1,217,000
Lake Superior	281,000	71,000	352,000
Lake Huron	113,000	108,000	221,000
TOTAL	990,000	800,000	1,790,000

fishing effort expended, more than 1.2 million angler days (68 percent) took place on or near Lake Michigan. An additional 20 percent of the total effort occurred in the Lake Superior area and the remaining 12 percent was registered by fishermen who fished on Lake Huron and its watershed.

Fishing effort during 1969 was almost evenly distributed between that which occurred on the Great Lakes proper and that which occurred on their tributary streams (Table 1). Of the total statewide effort for salmon and trout, 990 thousand angler days (55 percent) were generated by fishermen whose efforts occurred on a Great Lake. Fishing activity on tributary streams accounted for the remaining 800 thousand angler days. The major exception to the rather even distribution of lake and stream fishing activity occurred in the Lake Superior area. This exception is explained by the large role that lake trout play in the Lake Superior sport fishery.

Most of the 1969 catch of salmon and trout also came from Lake Michigan and its tributaries (Table 2). Of the total Great Lake

TABLE 2. MICHIGAN SALMON AND TROUT SPORT CATCH BY WATERSHED AND SPECIES, 1969

Lake and Watershed	Steelhead Trout	Coho Salmon	Chinook Salmon	Lake Trout
Michigan	167,000	269,000	109,000	93,000
Superior	37,000	60,000	7,000	172,000
Huron	20,000	34,000	1,000	1,000
TOTAL	224,000	363,000	117,000	266,000

salmon and trout catch, Lake Michigan accounted for 75 percent of the steelhead trout, 74 percent of the coho salmon, 93 percent of the chinook salmon, and 35 percent of the lake trout. Lake Michigan's dominant role for all but lake trout is explained by both the relatively large number of fish planted in Lake Michigan and the fertility of Lake Michigan relative to Lake Superior.

Lake Superior's contribution to the Great Lake sport fishery stems primarily from its lake trout population. Only in a few locations can the salmon sport fishery of the lake be considered of any consequence. The latter condition exists because few salmon have been planted in Lake Superior, and of those planted the survival rate has been relatively poor.

The Lake Huron sport fishery has yet to be fully developed. Mature coho salmon were available to Lake Huron fishermen for the first time in 1969. Although of limited importance at present, Lake Huron offers great potential as a resource from which a sport fishery can be developed.

All signs point to an even larger salmon and trout sport fishery in 1970 (Jamsen and Ellefson, 1970). This optimistic forecast is made in light of the substantial increases in fish plantings that have occurred during the past five years and the wider geographic distribution of these plantings.

ECONOMIC EVALUATION OF MICHIGAN'S 1970 SALMON AND TTOUT SPORT FISHERY: PRELIMINARY RESULTS

Michigan is now in the process of evaluating its salmon and trout program. The evalution involves a careful review of the present and expected costs of the program plus a rather thorough review of the benefits or returns that are being realized from monies invested.

One of the more perplexing problems that must be faced in evaluating a recreational program, such as Michigan's salmon and trout program, is that of determining the worth of the program's output in monetary terms. This problem stems from an inability to define exactly what it is that the program is producing. Typically, the benefits of recreational programs have been labeled as "intangible"

or "not subject to measurement." Although recreational benefits are difficult to measure (Pearse and Bowden, 1969), widespread recognition to their importance does exist. The question is one of how to accurately determine such benefits so that they can be included properly in the arena of private and public decision makng.

The procedure used for valuing the benefits of Michigan's salmon and trout program has been applied to fisheries resources in the past (Dyer, 1968; Brown *et al.*, 1964). The basic premise of the approach is that the willingness of the fishermen to forego money and time is indeed a measure of the value of the natural resources that are being

Figure 1.—Geographic location of five distance zones in Michigan.

used to produce the sport fishing opportunity that he consumes.

The method chosen for valuing Michigan's salmon and trout resources is that of analyzing recreation demand curves. The method uses travel costs as an indicator of the willingness of the fishermen to pay for salmon and trout resources (Clawson, 1959). Such costs are used to define the relationship between price of a day's fishing to the fishermen and the per capita attendance. This relationship is a conventional demand curve with a negative slope, *i.e.*, as the price of fishing increases we expect a decline in the number of days fished. By applying a range of added prices to the demand curve, it is possible to define a second demand curve which represents the demand situation for the salmon and trout resources per se. The value of the fishery is then measured by simply determining the area under the curve, *i.e.*, summing the number of days fished at each price. This sum is an appropriate measure (consumer surplus) of the economic value of the salmon and trout resources that are being used to produce sport fishing opportunities.

The first four months of Michigan's 1970 salmon and trout fishery has been subjected to the demand curve analysis mentioned above (Ellefson and Jamsen, 1971). The procedure followed three major steps. First, the demand curve for the entire sport fishing experience was determined. This represents the demand situation for the entire sport fishing package, *i.e.*, anticipation and planning, travel to and from the site, activity at the site, and the recollection that occurs once the fisherman returns home. Second from the demand curve for the entire recreation experience, a demand curve for the salmon and trout resources per se was determined. And third, based on the latter demand curve, the total value or worth to the fishermen was determined. Data used in the analysis are obtained from a survey of 1970 fishermen.

Demand Curve for Entire Sport Fishing Experience

The state of Michigan was divided into five distance zones based on the average distance that anglers drive in getting to salmon and trout fishing sites (Figure 1). Fishermen originating in Zone I were found to travel the greatest distance, and accordingly, spent the most money per day fished (Table 3). In contrast, fishermen from Michigan's Upper Peninsula (Zone V) traveled the least and as expected incurred the lowest cost for each day fished.

The demand curve for the entire salmon and trout fishing experience is presented in Figure 2. It relates the average variable cost per angler day of each zone (Table 3) to the number of angler days fished per 1,000 population of each zone.

TABLE 3. DEMAND SITUATION FOR MICHIGAN'S SALMON AND TROUT SPORT FISHERY, JANUARY-APRIL, 1970

Distance Zone	Mean Distance Traveled	Average Variable Cost Per Angler Day	Zone Population	Sample Angler Days	Total Angler Days Per 1000 Population[1]
	(miles)	(dollars)	(1,000's)		
I	204	16.76	4,590	123	4.02
II	149	10.15	1,665	122	10.99
III	92	11.85	1,032	202	29.36
IV	38	6.14	982	619	94.55
V	28	6.08	299	164	82.27

[1] Total angler days = (Sample angler days) × (Expansion factor).

Demand Curve for the Salmon and Trout Resource

Based on the demand curve for the entire recreation experience, a demand curve for the salmon and trout resources was determined. Presented in Table 4 is the estimated number of angler days that would be taken by the fishermen of each zone if they were faced with various increases in the cost of a day's fishing.

The resulting demand curve for the salmon and trout resource is presented in Figure 3. It illustrates the relationship between the

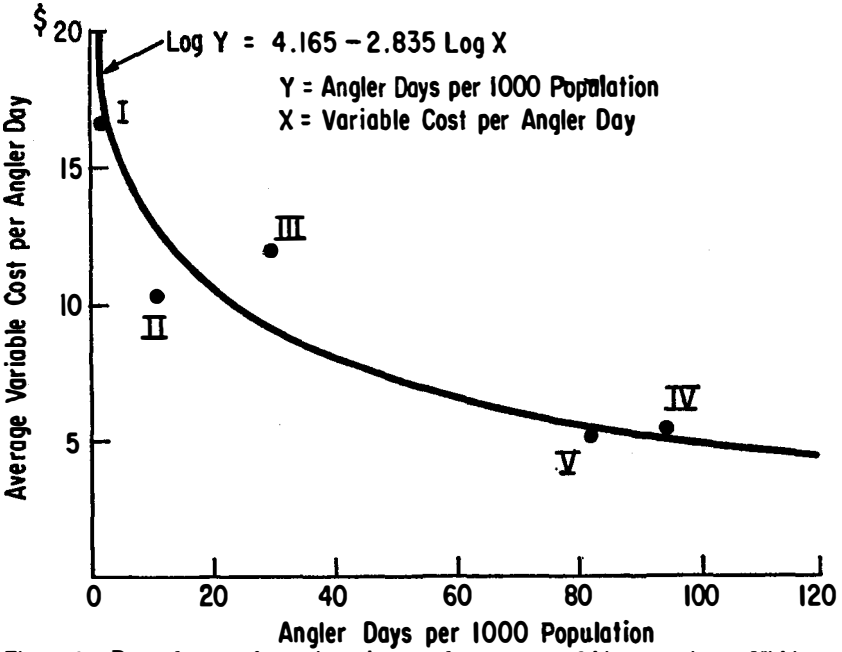


Figure 2.—Demand curve for entire salmon and trout sport fishing experience, Michigan, January-April, 1970.

TABLE 4. DEMAND SITUATION FOR MICHIGAN'S SALMON AND TROUT SPORT FISHERY RESOURCE, JANUARY-APRIL, 1970

Distance zones	Number of Angler Days at Added Cost of:					
	$0	$5	$10	$15	$20	$25
I	18,500	10,850	6,037	4,590	4,590	4,590
II	18,300	10,983	4,894	2,611	1,665	1,665
III	30,300	5,036	2,411	1,344	1,032	1,032
IV	92,800	15,485	5,414	2,519	1,380	982
V	24,600	4,788	1,666	773	423	299
TOTAL	184,500	47,142	20,422	11,837	9,090	8,568

assumed increases in daily fishing costs and the total number of days fished by Michigan fishermen.

Valuing the Fishing Resource

The value of the first four months of Michigan's salmon and trout fishery is interpreted as the sum or the area under the demand curve for the resources (Figure 3). This area totals approximately $711,000. At an interest rate of 5.5 percent, the capitalized value of the first four months of Michigan's salmon and trout sport fishery is nearly $13 million.

Speculating as to the worth of the entire 1970 salmon and trout

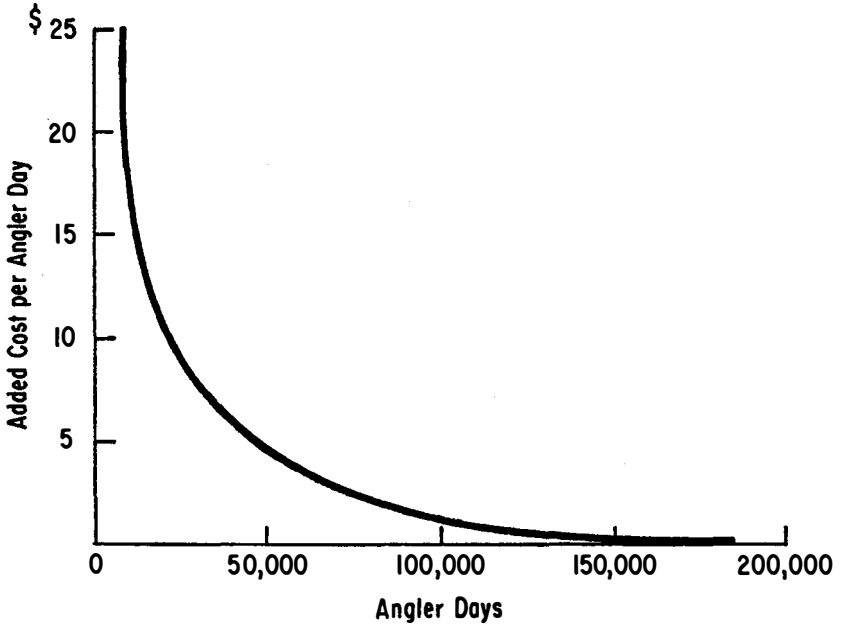


Figure 3.—Demand curve for Michigan's salmon and trout sport fishing resource, January-April, 1970.

fishery requires that certain assumptions be made. First, it is expected that the program will produce between 1.5 and 2 million angler days during 1970. Second, the net value of an angler day as determined for the first four months of the fishery ($3.50) is reflective of that which will be found for the entire season. If these assumptions prove to be realistic, the net value of the 1970 salmon and trout fishery will lie within the range of $5 million to $7 million.

The dollar value of the fishery must be used with extreme care. Preferably, it should be an aid in making decisions about the fishery resource and not the sole basis for making judgments about its future. Caution is warranted for two reasons. First, the value is a conservative estimate of the fisheries' worth in that it does not include the value of the fishermen's time. Second, it further underestimates the worth of the fishery because it does not reflect other program (secondary) benefits such as the net impact the fishery has on local communities (added income, new jobs, etc.).

SUMMARY

Michigan's salmon and trout program has been spectacular in terms of the total amount of sport fishing activity generated. Before the intoduction of salmon in 1966, Great Lakes sport fishing was severely limited. By 1969 the fishery was producing about two million days of sport fishing fun for an estimated 180,000 anglers. In that year the catch of salmon (coho and chinook), steelhead trout, and lake trout was estimated to be about one million. Half of the catch was salmon. Preliminary results indicate the net value of the salmon and trout resources to be between $5 and $7 million. Continuing analyses will determine a more precise economic value for the entire 1970 salmon and trout fishing season.

LITERATURE CITED

Brown, William G., Ajmer Singh and Emery N. Castle
1964. An economic evaluation of the Oregon salmon and steelhead sport fishery. Oregon Agr. Exp. Sta. Tech. Bull. 78. 47 pp.

Carter, Luther J.
1968. Lake Michigan: Salmon help to redress the balance. Science 161 (3841): 551-555.

Clawson, Marion
1959. Methods of measuring the demand for and value of outdoor recreation. Resources for the Future, Inc., Reprint No. 10. Washington, D. C.

Dyer, Archie Allen
1968. The value of a trout stream fishery. M.S. thesis, Utah State University. Logan. 49 pp.

Ellefson, Paul V. and Gale C. Jamsen
1971. Economic appraisal of Michigan's 1970 sport fishery, January 1-April 24. Michigan Dept. Nat. Res., Research and Development Div. Rept. 227.

Jamsen, G. C., J. R. Ryckman and F. W. Jamsen
1970. Michigan's 1969 salmon and trout sport fishery. Michigan Dept. Nat. Res., Research and Development Div. Rept. 203. 10 pp.

———— and Paul V. Ellefson
1970. Michigan's 1970 sport fishery, January 1-April 24. Michigan Dept. Nat. Res., Research and Development Div. Rept. 211. 4 pp.

Pearse, Peter H. and Gary K. Bowden
1969. Economic evaluation of recreational resources: problems and prospects. Trans. N. A. Wild. and Nat. Res. Conf., 34: 283-293.
Smith, Stanford H.
1968. Species succession and fishery exploitation in the Great Lakes. J. Fish. Res. Bd. Canada, 25(4): 667-693.

DISCUSSION

MR. FRANK BRYAN (Michigan): Why did you not identify some of the crowded conditions on the river?

MR. JAMSEN: We certainly do have problems with our salmon fisheries and I don't want to give you the impression that we do not have problems. There is stream crowding in certain locations and there has been an attempt here to spread the salmon out so that we do not get large concentrations of fishermen. Further, some of the property owners on the river banks are quite unhappy with us. But I think, on the whole, the program has been quite successful and anything you do like this is going to cause some problems. Our people are working hard at trying to alleviate the difficult ones.

FROM THE FLOOR: To what do you attribute your lack of survival in other lakes? You mentioned you felt that the stocking effort had been more successful in Lake Michigan.

MR. JAMSEN: Lake Huron salmon were first planted in 1968 and so mature salmon were first available in 1969. Then, we had a run this fall. Probably survival in Lake Huron will be close to that in Lake Michigan.

There is another problem—our neighbor Ontario. They have an active commercial fishery and there is no restriction on harvesting salmon. Therefore, some of our biologists feel that this is one reason the number of fish available to sports fishermen is reduced. It appears also that there is a lack of adequate food in Lake Superior.

Another problem seems to be the cold water. Where a mature coho salmon in Lake Michigan reaches the average of 10 pounds, a mature coho in Lake Superior is only 5 or 6 pounds.

THE ROLE OF FIRE IN MANAGING RED FIR FORESTS

BRUCE M. KILGORE

Office of Natural Science Studies, National Park Service, Sequoia and Kings Canyon National Parks, Three Rivers, California

Fire has long been a major factor in the ecology of forests in North America (Ahlgren and Ahlgren, 1960). Its role in the red fir forest of the Sierra Nevada, however, has received little study. Investigations in mixed conifer forests in Sequoia, Kings Canyon, and Yosemite National Parks by Biswell (1961), Hartesveldt (1964), and Reynolds (1959) lead to the conclusion that fires have been less numerous during the past 50 years than they were in primitive forests. Estimates of frequency in such primitive forests range from a fire every year or two to one every 21 years (Wagener, 1961), with a generally agreed upon average of something like 8 to 10 years between fires for individual trees. A conservative estimate would be that each tree was burned every 10 to 20 years. This is confirmed by the fire scars which some of the trees bear. As such, fires were an integral and

important environmental factor in the evolution and maintenance of many plant communities in the Sierra Nevada before effective and widespread fire suppression activities came into being.

Since the early 1900's, attempts have been made to suppress fires—both man-caused and lighting-caused—particularly in the mixed conifer forest type. In an effort to develop a management program aimed at restoring natural environmental conditions to national parks, the National Park Service has initiated studies of the role of fire in various forest types. Since fire hazard is less in a red fir forest than in a mixed conifer forest, red fir was considered a useful type within which to begin study of the ecological impact of prescribed fire on fir thickets.

STUDY AREA

The basin drained by Rattlesnake Creek, a small tributary of the Middle Fork of the Kings River, was chosen for study and experimental management. The headwaters of this creek are above 10,000 feet, while the elevation of its junction with the main stream is 5,000 feet. Within this basin, the 800 acres selected for study and managment range in elevation from 8,400 feet to 9,800 feet. The topography in the Rattlesnake Creek basin varies from fairly level creekside land in certain sections to steeper slopes on the west, north, and east.

The dominant vegetative cover is red fir (*Abies magnifica*). This is mixed with lodgepole pine (*Pinus contorta*) along the stream and in moist sites. Jeffrey pine (*Pinus jeffreyii*) is found in the lower part of the unit, while western white pine (*Pinus monticola*) and whitebark pine (*Pinus albicaulis*) are found on ridges and in the higher elevation segments of the study area.

No permanent weather records are available for this elevation in the Middle Fork of the Kings River region or even for comparable elevations anywhere on the west side of the Sierra. Standard temperature, humidity, and precipitation readings were taken, however, whenever men were in the area during the course of this project. Minimum temperatures found in August and September in the Rattlesnake Creek basin during 1968 and 1969 ranged from 27 to 58 F. and averaged 41 F. Maximum temperatures for the same period ranged from 52 to 80 F. and averaged 71 F. Only a trace of rain fell during these months. Based on Corps of Engineers storage gauge data, total precipitation at 9,900 feet elevation in Rattlesnake Creek has varied from 27 to 90 inches in the past eight years, with a mean of 48 inches—much of this falling as snow.

HISTORY OF MAN'S IMPACT ON THE AREA

Nearly all of what is now Kings Canyon National Park, including the Rattlesnake Creek drainage, may have been grazed to some extent by sheep in the late 1800's, but the amount of grazing in this high, isolated region was likely to have been negligible. It is thus probable that Western man had some, but relatively little, impact on the Rattlesnake Creek region.

The ecological importance of early efforts at fire suppression between 1900 and 1940 in this back country region must also be seriously questioned. National Park Service records in the past 20 years show 13 fires, each less than one-fourth acre in size, in the eight square miles surrounding Rattlesnake Creek; how much impact the resulting suppression activities may have had is debatable. A 1963 lightning fire was studied on the ground in 1968; the fire burned one-fourth acre, and some effort was expended in building line and cutting through down logs. The openness of the surrounding country and relative lack of ground fuels, however, make it appear the fire would have done little more than consume part of the scattered down logs and ground fuels and then gone out, even if it had not been suppressed.

METHODS

Within the 800-acre management area on Rattlesnake Creek, twelve 100 foot-by-100 foot macroplots were laid out for intensive study. These plots were selected as being representative of some of the heaviest fuel types and most dense red fir reproduction areas within the drainage. As such they seemed to reflect most nearly the conditions characteristic of lower elevation, higher fuel hazard zones where white fir thickets are found.

Before and after burning, the following records were gathered for each plot:

(1) species, diameter, and height class of trees more than 12 inches diameter at breast height (dbh);
(2) numbers of red fir and lodgepole pine saplings per acre in four height classes ("sapling" is used here for any tree less than 30 feet in height);
(3) extent and approximate height of red fir sapling thickets ("thicket," as used here, means a growth of young trees—usually of a shade tolerant species—which is dense enough to make walking through the area difficult);
(4) coverage and frequency values for herbaceous and shrub species;

(5) flash fuel and duff weights;
(6) length and diameter of down trees;
(7) chemical light meter indices for light reaching the forest floor.

Before going into the field, locations of five 50-foot transects were systematically determined for each plot to sample the understory cover and ground cover. Ten 2 foot-by-3 foot microplot samples were taken along each transect. The sampling procedure followed was basically that of Daubenmire (1959), modified to use a 1 to 5 coverage scale. Coverage values were recorded for individual herbaceous, grass, and shrub species, for total ground cover, and for understory cover up to six feet—contributed by both small and large living trees and shrubs plus dead branches. The transects were resampled in 1969 and 1970, one and two years after burning.

The preburn and postburn appearance of vegetation on the plots was recorded by black-and-white and color photography at a series of permanent photo points. An index to the overall density of vegetation was obtained with a 24-hour integrating light meter based on the chemical light properties of anthracene in benzene (Marquis and Yelenosky, 1962). Five points on each of the 14 plots—or 70 points—were analyzed simultaneously by this method. The assumption here is that light received at the forest floor is an inverse function of the percent of canopy cover.

To determine the impact of fire on the range of dead flash fuel and duff weights, samples of these two types of fuel were taken before and after burning. At each of 13 sites, a 2 foot-by-3 foot sampling frame was used and two sub-samples were taken. All branches, loose twigs, needles, and cones found within the frame made up the flash fuel sub-sample, while the partially decayed organic material found in one square-foot unit made up the duff sub-sample. Because of the large weight involved and the uneven distribution, down logs—in various stages of decay—were measured separately. Lengths and diameters of such logs were measured, volumes were calculated, and this volume was converted to an estimated weight per acre using sample field dry weights of decaying down log materials.

Water samples were taken from above and below the burn for water quality analysis, and deer pellet groups were sampled in different vegetative types as an index to deer use.

During August, 1968, Park Service resource managers burned all of the 800-acre management unit except for the 12 study plots. In September, 1968, six of the study plots were burned under known conditions of temperature, humidity, wind, and fuel stick moisture. Heavy concentrations of ground fuels were touched off by a drip torch

in as many places around and through the plot as seemed feasible and safe for the Park Service rangers involved. Down punky logs and standing dead snags near the center of the plots were often prime fuel targets for initial ignition. After the fire began in the center, points near the edge were ignited, thus using essentially an area ignition technique. Six plots were retained as control areas.

RESULTS

Red fir is the dominate species in canopy height, density, and frequency in this area. Trees more than 12 inches dbh averaged 35 per acre. Its principal associate was lodgepole pine, which averaged 18 per acre. The burning program caused relatively little change in numbers of these larger trees. Six of the total of 80 trees more than 12 inches dbh on the burned plots were killed, while 8 of 12 snags were largely reduced to ashes. The thin-barked lodgepole pine was far more susceptible to burning than red fir. Many lodgepole would catch fire at the base, burn completely through, and fall without the upper canopy being burned. The only sizeable red fir trees killed were found on plot 13 where a surface fire became intense as it burned a number of large down trees and dense thickets of reproduction.

As shown in Figure 1, control plot numbers of fir saplings for 300 microplots remained almost the same between 1968 and 1969. Numbers of small red fir on treated plots, however, decreased more than 60 percent following burning. Trees less than three feet tall made up about 70 percent of the fir saplings on both control and burn plots. Numbers of fir saplings averaged 12,000 per acre on burn plots and 16,000 per acre on control plots in 1968. Following burning, numbers decreased to 5,500 per acre on burn plots in 1969 and 4,900 in 1970, while remaining at 16,000 on control plots.

The understory foliage of trees and shrubs occurring between one foot and six feet covered about 50 percent of these plots. Two years following burning, understory cover had decreased to less than 28 percent (Figure 2). Accompanying this decrease in cover on burn plots was an increase in amount of sunlight reaching the forest floor. On control plots, between 26 and 27 percent of full sunlight was recorded in both 1968 and 1969. Burn plots, however, showed an increase from 18 to 28 percent in amount of sunlight received at the forest floor—presumably a direct function of a decrease in overall vegetative density above the measurement stations.

Ages were determined for a sample of 20 red fir less than six feet tall, growing in dense thickets. These small trees ranged from 17 to 60 years old and averaged 43.8 years. Since snow depths at 9,900 feet in

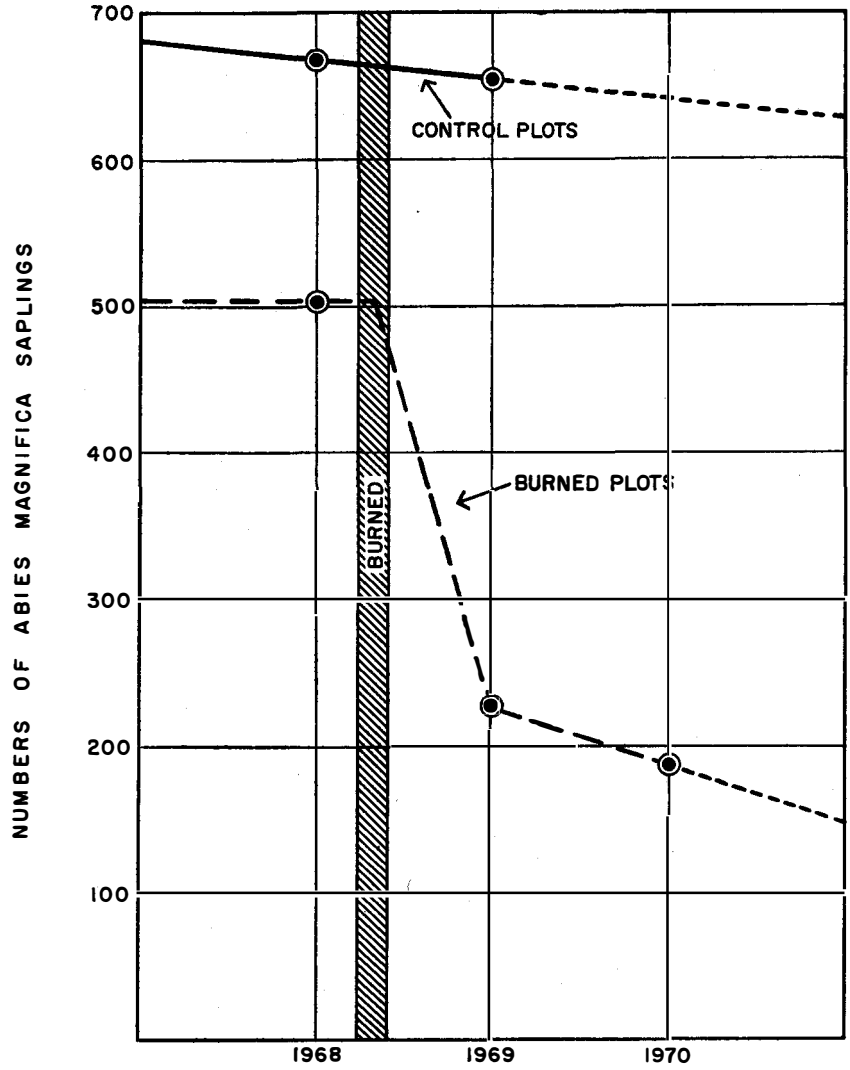


Figure 1.—Changes in numbers of *Abies magnifica* saplings on 300 two-foot by three-foot microplots before and after burning.

Rattlesnake Creek Basin average 111 inches between February and May (Department of Water Resources, 1965-1969), the dense thickets of red fir less than nine feet tall are probably an example of the phenomenon described by Oosting and Billings (1943) wherein most red fir saplings never grow to a height exceeding the average depth of

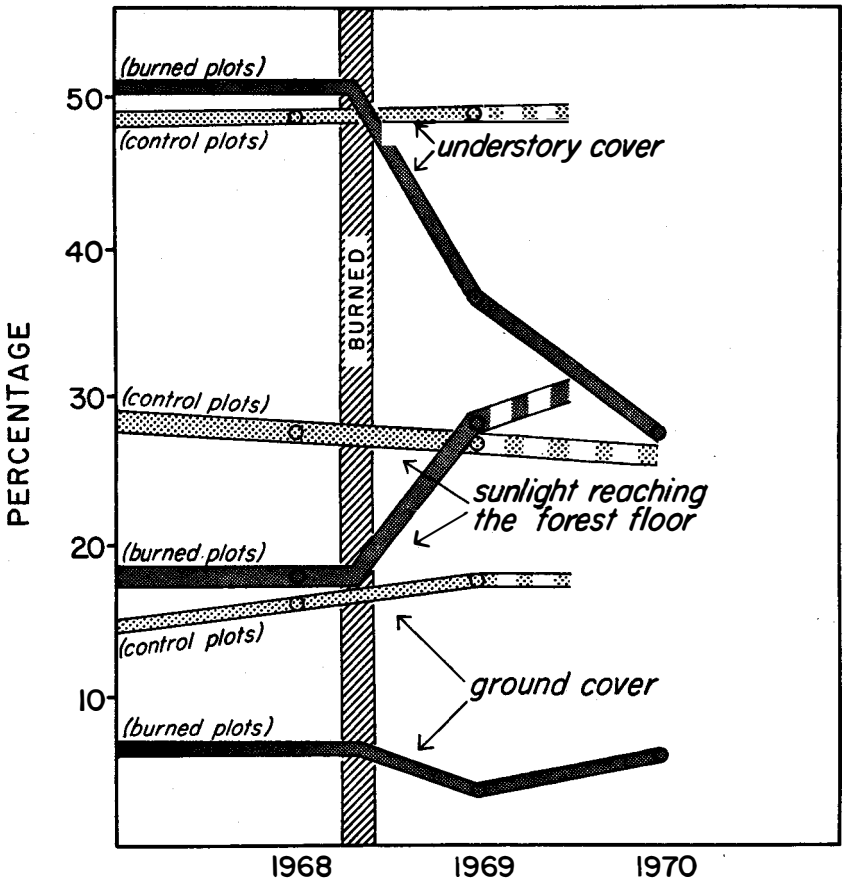


Figure 2.—Changes in understory cover, ground cover, and sunlight reaching the forest floor before and after burning.

winter snow. This is true because unless the terminal shoot can grow vigorously in a single season from below the pack to a foot above the pack, snow blast and low temperature just above the snow kill back the terminal shoots.

Large numbers of "seedling" red fir (less than two inches high) were found in 1968, averaging from 17,000 to 21,000 per acre. By 1969, through natural mortality factors, seedling numbers had dropped to 1,200 per acre on control plots. Numbers on burn plots were further reduced to 500 per acre, apparently the result of both direct kill during burning and less favorable growing conditions created by fire. In contrast, no seedling lodgepole pine were found

before burning in 1968. In 1969, 33 newly germinated seedlings were found on the same transects within burn plots (about 80 per acre), with only five (or 12 per acre) on control plot transects. Based on the location of the 33 burn plot seedlings, it seemed clear that burning had created conditions favorable for seedling establishment of this species. Eight of these seedlings (19 per acre) were still present in 1970, two years after the fire, while none remained on control plots.

Two shrubs, seven grasses, and approximately 40 species of forbs were found on one or more of the study plots during the three years. Although there were essentially no shrubs on the plots before burning, numbers and frequency of *Ribes cereum* seedlings increased on the plots after burning. Adjacent to the study plots, in a heavily burned montane chaparral area on the south-facing slope, a special survey found more than 11,000 seedlings per acre of *Ceanothus cordulatus* and lesser numbers of *Ribes* sp., *Artostaphylos patula,* and *Prunus emarginata.*

Herbaceous plant cover remained stable at about 16 percent on control plots. The burn plots had 6.5 percent herbaceous ground cover in 1968 which decreased to 3.8 percent the first year after burning, but returned to 6.0 percent in 1970 (Figure 2). Individual species coverage values were too low to be meaningful. Frequency values, however, seemed to show an increase in *Phacelia hydrophylloides* after burning, and a decrease in frequency of *Pedicularis semibarbata, Hieracium albiflorum,* and *Viola purpurea.* Five species which increased only slightly in frequency and coverage on burn plots were more strongly favored by conditions after burning in scattered areas throughout the total management unit. These were *Descuriana richardsonii, Gayophytum diffusum, Mentzelia dispersa, Epilobium* sp., and *Cryptantha affinis.* One plot showed a noticeable increase in both frequency and coverage of several mosses and of *Senecio triangularis.* This may have resulted from some of the same conditions described by Hoffman (1966) who found that the moss *Funaria hygrometrica* exhibited a strong affinity for burned areas and concluded that the moss was probably responding to favorable nutrient concentrations in the charred soil surfaces, favorable moisture relations, favorable light and temperature conditions, and perhaps lack of competition with other species. The remaining 30 species of herbaceous plants and grasses found on the plots did not show an appreciable response to the burning program.

Figure 3 compares the oven-dried ground fuel weights in 1968 and 1969 on two control plots and two burn plots. Weights for the six-square-foot samples ranged from 48 to 255 ounces before burning. After burning, control plot weights remained almost the same, while

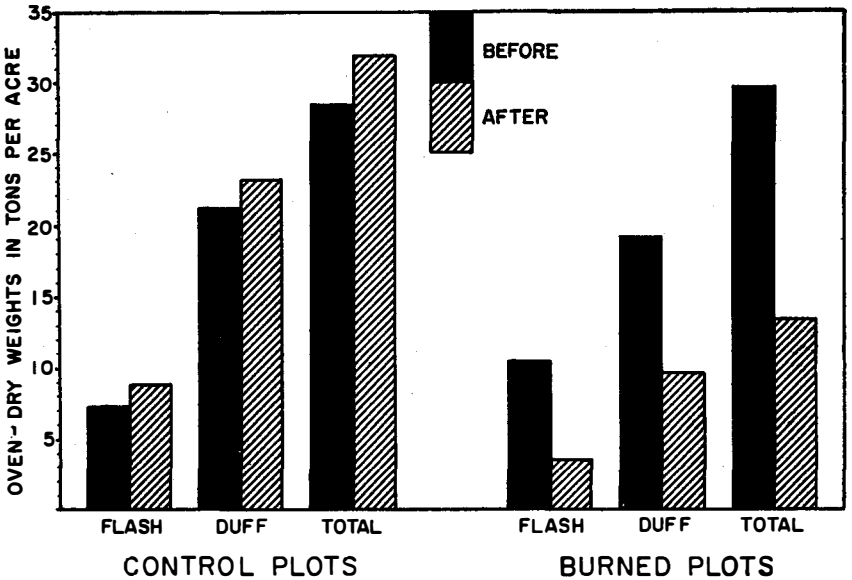


Figure 3.—Flash fuel and duff weights before and after burning.

burned plot weights had decreased considerably. Preburn measurements indicated that the total flash fuel and duff was approximately 30 tons per acre. Following burning, this was reduced by more than 50 percent. Fire also reduced volume of down logs by 30 to 50 percent on most plots. The estimated log fuel weights decreased from 7 to 4 tons per acre.

In order to monitor any impact which burning might have on the quality of water in Rattlesnake Creek, measurements of pH and dissolved oxygen were made upstream and downstream from the burning both before and after the fire. No changes in either characteristic were found after the first rain following burning. Water samples were also collected at these same sites and submitted to the California Department of Water Resources laboratory for chemical analysis. Analyses of turbidity, settleable solids, hardness, alkalinity, sodium, chloride, magnesium, conductivity, and specific conductance did not indicate a measurable change in water quality following burning.

A survey of deer use of the several vegetative types in the Rattlesnake Creek Basin was made in 1968 and 1969 by biologists from the California Department of Fish and Game. Their unpublished results indicate no substantial change in numbers of deer during this brief period. However, numbers of shrubs sprouting and

numbers of seedling shrubs established following burning should contribute to range improvement in the next few years and may eventually have an impact on deer numbers.

While detailed study of bird populations in the area before and after burning was not possible, general observations at Rattlesnake Creek plus previous work in the mixed conifer type (Kilgore, 1971) make it appear that little change would be expected in bird numbers as a result of the burning program unless the upper canopy was altered substantially. No such change took place in the study area.

DISCUSSION AND CONCLUSIONS

In summary, the impact of fire on certain biotic and abiotic elements of a red fir forest ecosystem was studied by measuring these elements before and after prescribed burning. Fire reduced the litter, duff, and humus by about 50 percent. Fire hazards were reduced accordingly. Few older red fir were affected, but many fir saplings and seedlings were killed resulting in both decreased coverage of fir thickets and more sunlight reaching the forest floor. Many mature lodgepole pine were readily killed by fire, while germination of lodgepole seedlings was stimulated. Numbers of seedlings of nine shrubs and herbaceous species increased substantially, and three shade-tolerant species decreased in frequency. No changes in deer or bird numbers were noted. Water quality of the creek was not altered by the burning.

Prescribed fire had a relatively mild impact on the climax forest of this high elevation ecosystem. Such burning was considerably different from fire at lower elevations in the drier, heavier fuel conditions of the mixed conifer type. There was little problem with fire crowning; some individual trees did flare up, but generally the fire did not move from one tree to another at such times. A lightning fire which started in 1968 in a similar forest type on the south side of the Middle Fork of the Kings River Canyon in early July was not suppressed. Throughout August and September it continued to burn, primarily through scattered down logs, litter, and duff, with only occasional burning of standing trees. In two months, it covered less than ten acres.

Based on this study and such evidence from natural fires in red fir forests, fire suppression seems to be of questionable value in this near-climax vegetation type unless there is danger to human life and property. If natural environmental conditions are to be maintained in national parks and wilderness areas, it would seem desirable to allow most lighting fires in red fir forests to burn without suppression.

ACKNOWLEDGMENTS

This study is a contribution from the National Park Service's Office of Natural Science Studies under RSP SKC-N-25a. R. Riegelhuth, Management Biologist at Sequoia and Kings Canyon National Parks, helped select and lay out study plots and offered useful suggestions throughout the project. Superintendent J. S. McLaughlin and Chief Ranger P. H. Schuft made possible the assistance rendered by rangers and naturalists, including field help by M. J. Zardus and J. A. Rockwell. Special thanks are due to: California Department of Fish and Game for surveys of deer use by G. C. Ashcraft and advice on sampling water quality by R. R. Ehlers; California Department of Water Resources and V. B. McIntyre for laboratory determinations of water quality; University of California Herbaria at Berkeley and Davis and Helen K. Sharsmith and B. Crampton for identification of plant specimens; U. S. Forest Service for advice of C. E. Conrad and H. E. Schimke of the Pacific Southwest Experiment Station; Department of Chemistry, Fresno State College, and Helen Gigliotti, for assistance in spectrophotometric analysis; and P. J. Zinke; P. W. Rundel, and H. Weaver.

LITERATURE CITED

Ahlgren, I. F. and C. E. Ahlgren
1960. Ecological effects of forest fires. The Botanical Review 26: 483-533.
Biswell, H. H.
1961. The big trees and fire. Nat'l. Parks Mag. 35 (April): 11-14.
Daubenmire, R.
1959. A canopy-coverage method of vegetational analysis. Northwest Science 33(1): 43-64.
Department of Water Resources, State of California
1965-1969. Water conditions in California. Fall Reports. Bulletins No. 120-65, 120-66, 120-67, 120-68, and 120-69. Sacramento.
Hartesveldt, R. J.
1964. Fire ecology of the giant sequoia: controlled fires may be one solution to survival of the species. Nat. Hist. Mag. 73: 12-19.
Hoffman, G. R.
1966. Ecological studies of *Funaria hygrometrica* Hedw. in Eastern Washington and Northern Idaho. Ecol. Monogr. 36(2): 157-180.
Kilgore, B. M.
1971. Response of breeding bird populations to habitat changes in a giant sequoia forest. Amer. Midland Naturalist, 85(1): 135-152.
Marquis, D. A. and G. Yelenosky
1962. A chemical light meter for forest research. U. S. Forest Service, N. E. For. Expt. Station. Paper No. 165. 25 p.
Oosting, H. J. and W. D. Billings
1943. The red fir forest of the Sierra Nevada: *Abietum magnificae*. Ecol. Monogr. 13(3): 259-274.
Reynolds, R.
1959. Effect upon the forest of natural fire and aboriginal burning in the Sierra Nevada. Unpubl. Thesis, Geography Dept., Univ. Calif., Berkeley. 262 p.
Wagener, W. W.
1961. Past fire incidence in Sierra Nevada forests. Jour. Forestry 59: 739-748.

DISCUSSION

FROM THE FLOOR: Is soil erosion increased significantly after these fires?

DR. KILGORE: We found no evidence of that. Our controlled measurements are few but we have been there two years now and have gone over these 800 acres very extensively and we found no real problem.

DR. CLARENCE COTTAM (Texas): I would like to say that that was a fine paper. However, have you done any work in relation to sequoias?

DR. KILGORE: We have a short preliminary paper out on the impact of fire on germination of sequoia seedlings. We do have many sequoia and some brush seedlings coming into the area, where none were found before the fire.

MR. ROBERT LOWE: Do you find any time of year better for doing work in relation to such trees as the red fir, or do you just do it in the summer?

MR. KILGORE: For practical reasons, our studies took place during the summer. There is snow in the area until late May or early June. Therefore, to do any burning of the ground cover, we have to work during the summer. As soon as snow arrives in the fall, burning is finished for the season.

I should also mention that 65 percent of the 800,000 acres that make up Sequoia-Kings Canyon National Parks is now designated as a natural fire zone in which lightning fires are allowed to burn. This is high elevation area—generally above 8,000 feet—and does not include any sequoias.

CHAIRMAN WALLACE: Ladies and gentlemen, this has been a most excellent series of papers. I would like to have you give recognition to our speakers for the fine job they have done.

TECHNICAL SESSION

Wednesday Morning—March 10

Chairman: GEORGE C. HALAZON
Extension Specialist, Kansas State University, Manhattan

Discussion Leader: JOHN MADSON
Assistant Director, Conservation Department, Olin Incorporated, East Alton, Illinois

CONSERVATION COMMUNICATIONS

AN ECOLOGICAL RATIONALE FOR THE NATURAL OR ARTIFICIAL REGULATION OF NATIVE UNGULATES IN PARKS

GLEN F. COLE

Office of Natural Science Studies, National Park Service, U.S. Department of the Interior, Yellowstone National Park, Wyoming

INTRODUCTION

Yellowstone, Glacier, Rocky Mountain, and Grand Teton National Parks are designated as natural areas. The primary objective in such areas is to preserve representative natural environments and native biota as integrated wholes (i.e., ecosystems) for their scenic, educational, cultural, and scientific values. Evolved policies for these natural areas restrict management to protecting against, removing, or compensating for human influences that cause departures from natural conditions. Management that manipulates park biota (*i.e.*, artificial regulation) is to be based on the findings and evaluations from appropriate research.

In retrospect, the rationale for artificially regulating wild ungulates in the subject parks was not always consistent with the objectives or present management policies of natural areas. This was

partly due to a paucity of ecological data on ungulate populations that were naturally regulated (i.e., without human influences) and general assumptions that were not critically evaluated. In substance, these assumptions were: (1) that ungulate populations need to be artificially regulated to compensate for insufficient native predators, prevent progressive habitat deterioration, and/or maintain interspecies equilibriums (mean numerical stability) between large herbivores; (2) that "low" rates of increase in ungulate populations or periodic "high" overwinter mortality were unnatural phenomena; and (3) that the artificial regulation of ungulates would retain the esthetic or scientific values of biological systems to a greater extent than doing nothing.

The results from research on both naturally and artificially regulated ungulate populations within the subject parks, as well as other literature, will be used to evaluate the above assumptions and present an ecological basis for relying on natural or artificial processes. The various studies within parks involved moose (*Alces alces*), bison (*Bison bison*), mule deer (*Odocoileus hemionus*), elk (*Cervus canadensis*) and other associated faunal species. Some of these ungulate species were associated with what are usually considered large predators: grizzly bears (*Ursus arctos*), mountain lions (*Felis concolor*), and small numbers of gray wolves (*Canis lupus*) (Cole, 1969a). All were associated with the coyote (*Canis latrans*) and a variety of scavenger species. Except where other references are cited, the author's interpretations for ungulates in general are drawn from research progress reports or publications by Houston (1968, 1969, 1971a), Meagher (1970, 1971), Martinka (1969), Stevens (1970, 1971), and Cole (1969b, 1971a, 1971b). Interpretations were aided by considerations of ecological principles as presented by Elton (1927), Nicholson (1933), Allee *et al.* (1949), Andrewartha and Birch (1954), MacArthur (1958), and Slobodkin (1961).

NATURAL REGULATION

Naturally regulated ungulate populations were depressed to lower numbers by density-influenced intraspecific competition and the partially density-independent effects of periodic severe weather. Intraspecific competition increased energy stresses in populations that were at high densities in relation to their available winter food. This directly or indirectly (by predisposing) caused the mortality of subadults or adults with the lowest energy reserves and sometimes lowered the subsequent year's natality (realized reproduction).

Unusually severe weather periodically caused higher than usual

mortality in ungulate populations by increasing intraspecific competition, energy stresses, or the efficiency of predators. This mortality was also predominantly animals with low energy reserves, but individuals that would have probably survived the usual harsh weather were included. The additional mortality from the effects of unusually severe weather was considered density-independent to distinguish it from the more consistent density-influenced mortality from intraspecific competition.

Winters with less severe weather and/or intraspecific competition allowed ungulate populations to compensate for mortality that was predominantly animals with low energy reserves and return to higher numbers. Compensations occurred from density-influenced natality and/or survival or what Errington (1946) calls compensatory trends. Emigrations also helped to relieve intraspecific competition.

Ungulates that were predisposed to death by intraspecific competition or weather influences provided food for native predator and scavenger species. Predators and scavengers, as an interacting unit, tended to hasten the deaths of ungulates with the lowest energy reserves. Scavenging forced more efficient predators to make additional kills. Exceptions to the usual hastening relationships occurred when unusually severe weather increased the efficiency of grizzly predation by temporarily increasing the vulnerability of elk. Under these conditions, grizzly predation with scavenging served to dampen and extend the interval between elk population fluctuations (Cole, 1971b).

An appropriate summary may be: Over a series of years, naturally regulated ungulate populations were self-regulating units. They regulated their own mortality and compensating natality in relation to available winter food and their population size. Predation on either wintering or newborn ungulates seemed a nonessential adjunct to the natural regulation process because it did not prevent populations from being self-regulated by competition for food.

NATALITY AND MORTALITY

Low realized natality, with the recruitment of young in a replacement relationship to low adult mortality, appeared to represent the "best system" for a naturally regulated ungulate population to maintain relatively stable numbers in a frequently harsh environment. The latent potential for high natality allowed populations to compensate for periodic higher than usual mortality that was partly due to severe weather. This mortality, as well as the more consistent density-influenced deaths of animals with low energy reserves, was

predestined to occur in naturally regulated ungulate populations. Such mortality would not represent a loss of biologically essential population members and it, as well as low realized natality, are not unnatural phenomena.

HABITAT AND FOOD RELATIONSHIPS

Interpretations of ungulate relationships to their habitats or food sources required considerations of natural selection processes, the ecological completeness of habitats, plant succession, food sources that did or did not limit population numbers, and human actions that changed habitat and food conditions.

The fossil record (Frick, 1937; Péwé and Hopkins, 1965), suggests that the ancestors of present day ungulate populations arrived in central North America 10 to 20 thousand years before primitive man, and approximately 30 thousand years before modern man. Deductions, from the principle that consistently harmful relationships do not survive the natural selection process (Darwin, 1859) and the concept of density-dependence (Howard and Fiske, 1911, and others), led to a hypothesis that populations of native ungulates cannot, without overriding successional influences or habitat limitations imposed by man, progressively reduce food sources that limit their own densities.

In the absence of substantial environmental changes, interspecific competition maintained populations of different ungulate species in some equilibrium with each other and their respective food or habitat niches where they had a competitive advantage. Changes in food or habitat conditions that favored certain ungulate species over others occurred from fires or floods that temporarily reversed plant succession, or the long-term trends of primary plant succession since the retreat of the last glaciers. Plant succession from pioneer substrates, in combination with interspecific competition, probably caused general trends in biological succession as shown by Figure 1.

Ecologically complete habitats (ECH) for wintering ungulates were complexes of physiographic sites such as bottomlands, upland swales, and different slope exposures and interspersions of different vegetation types and plant successional stages. Such habitats provided contingencies for ungulates to obtain food and maintain relatively stable populations in variable and periodically harsh environments. Particular habitat units were ecologically essential to maintain high population densities, but interspersions of different units as an ECH had carrying capacity relationships where the "whole was greater than the sum of its parts."

Ungulates that free-ranged over ECH fully utilized the most

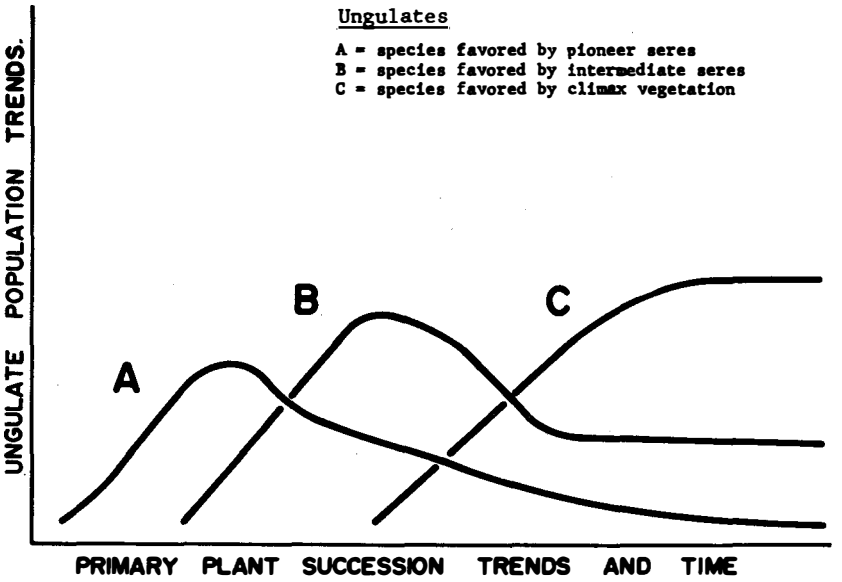


Figure 1.—Theoretical biological succession which results from primary plant succession and accompanying interspecific competition.

available food sources, such as limited ridgetops or other sites that were relatively free of snow each winter. Such use maintained stabilized biotic disclimaxes or conditions that Daubenmire (1968) and Houston (1971a) describe for zootic climaxes. Trees that bordered or occurred within openings which furnished relatively greater quantities of forage to wintering ungulates were variously "high-lined" as a zootic climax. These and other zootic climaxes on sites that remained relatively free of snow were suggested to be natural by comparing present conditions with 1871 to early 1900 photos. Less available (due to partial or complete snow cover), but quantitatively greater food sources on other habitat areas were variably utilized by ungulates as a result of weather influences, animal preferences, or foraging actions (pawing snow or prior use).

The sites and food sources that native ungulates maintained in a zootic climax stage on ECH appeared to be too limited (less than 5 percent by area or about 1 percent of total food in three studies) to have "law of minimum" (Taylor, 1934) relationships to population numbers. This led to the conclusion that the less available but quantitatively greater food sources on ECH, in combination with successional processes (Figure 1), determined ungulate population numbers over time. The variable "rest rotation" use of food sources

and habitat units by free-ranging ungulates over a series of years obscured "law of minimum" relationships.

In the absence of human restrictions on their free-ranging use of ECH, native ungulates did not seem to be able to cause retrogressive or secondary succession and, except for limited zootic climax sites, halt primary successional trends. These interpretations applied to populations with or without significant natural predation or human exploitation. The biotic effects of free-ranging ungulates in hastening the replacement of seral vegetation, when stands reached late stages or remnant status, were considered an inevitable natural relationship.

Native ungulates did cause secondary plant succession and accelerate primary succession when they were artificially concentrated or prevented from using habitat units that were essential to maintain natural equilibriums. Ungulate species that caused secondary succession lowered their own habitat carrying capacity and sometimes increased interspecific competition. Biotic effects that accelerated primary succession hastened inevitable changes in biological systems that favored certain species more than others.

The information reviewed thus far permits some evaluation of previous assumptions that park ungulate populations need to be artificially regulated to substitute for native predators, prevent progressive habitat deterioration, or maintain interspecies equilibriums. These assumptions infer that predation by either beasts or man is universally essential to "control" ungulate populations or their biotic effects and prevent one species from displacing another. This inference is not supported by the various studies in the Rocky Mountain parks.

The above assumptions probably resulted from overestimating the regulatory effects of native predators and interpreting all successional changes, biotic effects, or interspecific competition that involved ungulates as departures from natural conditions. These interpretations could have also been influenced by situations where ungulates did cause departures from natural conditions because they were artifically concentrated or restricted from using habitat units that were essential to natural equilibriums.

ARTIFICIAL REGULATION EFFECTS

The artificial regulation of ungulate populations mainly differed from natural processes to the extent that human exploitation substituted for natural mortality, caused uncompensated mortality, or conditioned animals to avoid humans. The extent that human exploitation reduced the density-influenced mortality from ungulate populations could be expected to reduce the more consistent food sources

for a native predator and scavenger fauna. Prolonged uncompensated mortality progressively reduced the most vulnerable population segments and maintained ungulate densities in relation to human-determined habitat security levels, instead of forage carrying capacities.

The regulation of ungulate populations by sport hunting, helicopter trapping, or controlled shooting resulted in avoidance behavior toward humans that was not present in naturally regulated populations. Contrasts were greatest in species that formed relatively large social groups with leader-follower relationships (elk, bison, pronghorn antelope (*Antilocapra americana*)). Conditioned avoidance behavior from prolonged hunting along park boundaries restricted the free-ranging of ungulates to the extent that the animals initiated both secondary plant succession and accelerated primary succession.

ECOLOGICAL RATIONALE

This section applies to native ungulates that were year-long inhabitants or had ecologically complete winter habitats within the subject parks. Other ungulates that regularly ranged outside these parks were managed under the rationale that sustained hunter harvests could substitute for most predestined natural mortality and maintain higher than natural natality rates.

The ecological rationale or justification for artifically regulating native ungulates within the Rocky Mountain parks is considered to be as follows: A human influence that causes unnatural trends in biological succession by restricting ungulates from free-ranging over an ECH (1) cannot be removed, (2) can be rectified by artificially regulating ungulate numbers, and (3) that such regulation will not cause greater departures from natural relationships in an interspecies system than accepting a new equilibrium. The rationale for relying on natural processes to regulate native ungulate populations in parks is that the animals are not causing unnatural trends in biological succession, or the antithesis of the rationale for artificial regulation (1-3).

A fundamental consideration in applying these rationale is that the presence of humans must be distinguished from their significant ecological effects (Houston, 1971b). The latter mainly occurs when humans divert sufficient amounts of energy or substances to or from a native biota to change species numbers or ecosystem roles. The permanence of human effects should be assessed from an awareness that ecosystems can "repair themselves" after severe natural catastrophies. Other considerations are that primary plant succession changes toward or into the next sere cannot be reversed by elimina-

ting biotic effects. Also, regulating one ungulate species may allow other herbivores to have the same end effects.

Accepting a new equilibrium that occurred with accelerated primary succession may result in fewer departures from natural relationships in interspecies systems than artificially regulating a dominant herbivore on a sustained basis. The ecological role an absent or poorly represented predator species once had may be partially reinstated by other species in the secondary consumer niche.

DISCUSSION

The foregoing rationale was largely suggested from quantitative field studies of ungulate habits, population dynamics, and ecological relationships. These first began in 1962. Tests of appropriate hypotheses are still being carried out on a continuing basis to permit critical evaluations over time. The paper's intended purpose is to show that the objectives of preserving or restoring the esthetic and scientific values of representative natural ecosystems or their community units require broad ecological considerations. It also shows that a rationale which relates to National Park Service objectives will be considerably different from those where native ungulates are intentionally managed as a harvestable crop. Research which tests the appropriateness of the Rocky Mountain rationale to large herbivores in other parks is encouraged.

ACKNOWLEDGMENTS

Dr. Don C. Quimby, Montana State University, and Park Service research biologists Douglas B. Houston, Mary M. Meagher, Clifford J. Martinka, and David R. Stevens reviewed the manuscript and made many helpful suggestions. The paper is a contribution from the National Park Service's Office of Natural Science Studies under RSP YELL-N-38.

LITERATURE CITED

Allee, W. C., Alfred E. Emerson, Orlando Park, Thomas Park, and Karl P. Schmidt.
1949. Principles of animal ecology. W. B. Saunders Co., Philadelphia. 937 p.

Andrewartha, Herbert G. and L. C. Birch
1954. The distribution and abundance of animals. Univ. of Chicago Press. 782 p.

Cole, Glen F.
1969a. Grey wolf. Yellowstone Nat. Park Res. Note, Nat. Park Serv., Yellowstone Nat. Park, Wyo. 5 p.

———.
1969b. Elk of Grand Teton and Southern Yellowstone National Parks. Office of Natr. Sci. Stud. research report GRTE-N-1, Nat. Park Serv., Yellowstone Nat. Park, Wyo. 192 p. (*also* Fauna of Nat. Parks, in press)

———.
1971a. Animal ecology studies in Yellowstone National Park. Office of Natr. Sci. Stud. annual report YELL-N-38, 1970. Nat. Park Serv., Yellowstone Nat. Park, Wyo.

———.
1971b. Grizzly-elk relationships in Yellowstone National Park. Pres. at N.W. Sec. of Wildl. Soc. Conf. Montana State Univ., Bozeman, March.
Darwin, Charles
1859. The origin of species by means of natural selection. Encycl. Brit., Inc., Chicago. 251 p.
Daubenmire, Rexford
1968. Plant communities, a textbook of plant synecology. Harper and Rowe, New York. 300 p.
Elton, Charles
1927. Animal ecology. The MacMillan Co., New York. 209 p.
Errington, Paul L.
1946. Predation and vertebrate populations. Quart. Rev. Biol. 21:144-177, 221-245.
Frick, Childs
1937. Horned ruminants of North America. Amer. Mus. Natur. Hist. Bull. 69, 669 p.
Houston, Douglas B.
1968. Shiras moose in Jackson Hole, Wyoming. Grand Teton Nat. Hist. Assoc. Tech. Bull. 1. 110 p.
———.
1969. Moose ecology studies, Grand Teton National Park. Office of Natr. Sci. Stud. annual report GRTE-N-3a, 1968. Nat. Park Serv., Grand Teton Nat. Park.
———.
1971a. Elk ecology studies, Yellowstone National Park. Office of Natr. Sci. Stud. annual report YELL-N-29a, 1970. Nat. Park Serv., Yellowstone Nat. Park.
———.
1971b. Ecosystems of national parks. Science 172:648-651.
Howard, L. O. and W. F. Fiske
1911. The importation into the United State of the parasites of the gypsy moth and the brown-tail moth. U.S. Bur. Entom. Bull. No. 91. 344 p.
MacArthur, Robert H.
1958. Population ecology of some warblers of northeastern coniferous forests. Ecology 39:599-619.
Martinka, Clifford J.
1969. Ungulate winter ecology studies, Glacier National Park. Office of Natr. Sci. Stud. progress report GLAC-N-17, Nat. Park Serv., Glacier Nat. Park, Mont. 71 p. (mimeo).
Meagher, Mary
1970. The bison of Yellowstone National Park: past and present. Ph.D. Thesis, Univ. of California at Berkeley, 172 p. (*also* Fauna of the Nat. Parks, in press)
———.
1971. Snow as a factor influencing bison distribution and numbers in Pelican Valley, Yellowstone National Park. Pres. at Snow and Ice Symposium, Iowa State Univ., Ames, February 11-12.
Nicholson, A. J.
1933. The balance of animal populations. J. Anim. Ecol. 2: 132-178.
Péwé, T. L. and David M. Hopkins
1965. Mammal remains of pre-Wisconsin age in Alaska. *In* D. M. Hopkins (ed.) 1967. The Bering Land Bridge. Stanford Univ. Press, Stanford, Calif.
Slobodkin, Lawrence B.
1961. Growth and regulation of animal populations. Holt, Rinehart and Winston, Inc., New York. 184 p.
Stevens, David R.
1970. Ungulate ecology studies in Rocky Mountain National Park. Office of Natr. Sci. Stud. progress report ROMO-N-13. Nat. Park Serv., Rocky Mtn. Nat. Park, Colo. 74 p. (mimeo)
———.
1971. Plant succession as related to ungulate grazing in the ponderosa pine winter range in Rocky Mountain National Park. Pres. at N.W. Sec. of the Wildl. Soc. Conf., Bozeman, Mont., March 26-27.
Taylor, Walter P.
1934. Significance of extreme or intermittent conditions in distribution of species and management of natural resources with a restatement of Liebig's law of minimum. Ecology 15:374-379.

THE OWAA YOUTH PROGRAM

JAMES A. O. CROWE[1]

Outdoors Editor, The Detroit *News, Detroit, Michigan*

It is impossible to overestimate the influence of the 1,600 members of the Outdoor Writers Association of America on the public opinion of the United States and Canada. Suffice it to say that uncountable millions of people are constantly exposed to the output of all those newspaper outdoor editors and writers, magazine writers and editors, outdoor cinematographers, still photographers and radio and television broadcasters.

These vast resources for action have been unleashed in the association's youth program. The purpose of the program is to encourage the development of a conservation conscience in the youth of the United States and Canada.

The program had its genesis in June, 1968, when this writer was asked to conduct a training seminar at an association annual meeting detailing the experience of the Detroit *News* in sponsoring the Young Hunters' Safety Program and the Kids Fishing Derby. The discussion following the presentation indicated a strong interest in spreading such programs continentwide through the association. Thus was the OWAA Youth Program begun, and this writer was appointed chairman of the committee.

The first order of business was to set up a series of sub-committees, the chairmen of which had full autonomy in their individual areas.

These sub-committees covered such areas as education, finance, motion pictures, youth conservation clubs, correspondence course, public relations, handbook and awards program.

The first major task of the committee was to produce a handbook for members with which they would have the basic information needed to sponsor a youth conservation program in their own sphere. The top experts in their fields, within the membership, were recruited to write chapters for the handbook. The opening chapter, written by Dr. Dan Corbin of Purdue University, is a short course in the basic technics of education. Other chapters concern themselves with youth programs in forestry, gun safety, fishing, hunting, "Reaching the Under Twelves," camping, and the like.

The generosity of the National Shooting Sports Foundation and the American Fishing Tackle Manufacturers Association underwrote the cost of publishing 3,000 of these books for free distribution to members requesting them. A limited number of copies are available for distribution without charge to non-members who can convince

[1] In the absence of the author, this paper was read by Mr. Howard Gray, Chairman of the Board, Outdoor Writers Association of America.

OWAA headquarters in Columbia, Missouri, that they have a legitimate use for them.

While the handbook sub-committee was busy at its work, the other sub-committees were hard at it, too, particularly the finance committee. This sub-committee had the job of finding the finances not only for the book but also for an incentive awards program which was announced at the same time that the book was published in mid-1970.

The awards sub-committee has come up with a very attractive program, whose purpose is to encourage members to get into the business of putting on youth conservation programs. At the June, 1971 annual conference of the association, a huge array of very attractive prizes is scheduled to be awarded to members judged, in several categories, to have put on the most effective programs to get the message of conservation across to young people. Prizes include color television sets, outboard motors, boats, the use of an expensive recreation vehicle for a year and cash prizes totaling at least $2,000.

While all this was going on, another sub-committee has been going through the pains of devising a major motion picture production, designed for free distribution throughout the continent to further spread the gospel of conservation among the young people. As this is written, this sub-committee has set up a separate awards program, this one offering a South American trip for the best story line for the picture, authored by a member.

Even this does not conclude the activities of the youth committee. Other sub-committees are studying the feasibility of devising a conservation correspondence course for young people, developing methods to encourage schools and colleges to incorporate conservation into their curricula and to launch a continent-wide system of junior conservation clubs.

It is not yet possible to call the OWAA youth program a success or a failure. We will know better by next June whether the members have followed through their early enthusiasm by actually sponsoring youth programs. We will have a better reading on the program's success when the motion picture is released. Our effectiveness will be better measured if we produce a correspondence course, infiltrate the schools and devise junior conservation clubs, among other things.

It can be said, however, that all early signs are that the youth program as a whole will be effective and is well on the way to making a major contribution toward developing a conservation conscience in the youth of the North American Continent.

DISCUSSION

DISCUSSION LEADER JOHN MADSON: Thank you, Howard. I might add that we of the OWAA have high hopes for this program, and there is a possibility that it might not have shown as much promise ten years ago as it does today. But we have

good and confident reasons to believe that many young people are looking for something to tie to in this area of conservation education and training. This certainly could fill a desperate need today.

Howard Gray was at the helm when much of this program was being developed.

COMMUNICATING COMPLETE WILDLIFE VALUES OF KENAI[1]

HAROLD W. STEINHOFF

Colorado State University, Fort Collins, Colorado

The alliteration commenced in the caption can be continued by commenting that cogent communication must be both *comprehensible* and *comprehensive*. This paper will be a waste of your time and mine if I cannot tell you clearly about the wildlife values of Kenai. And you justifiably will feel cheated if I do not try to tell you all of the values.

Examples will come from a 1968 study of the wildlife values and related recreational values of the Kenai National Moose Range, Alaska. A 45 percent sample of recreational users of the Range, the managers of the area, local citizen leaders, and oil company representatives were questionnaired and interviewed. Data on expenditures, duration of visits to the Range, benefits, costs, and attitudes were gained from these groups. The results are used to illustrate the set of values described in this paper.

VALUES MUST BE COMPREHENSIBLE

Who must comprehend the values? Obviously the public, including congressmen and legislators, whose vote ultimately will determine broad resource use policies of any wildlife area. For communication we must have a mutually-understood vocabulary. I have tried in this paper to use terms understandable to a non-economist, because few of us truly understand economic terminology. For precise and efficient understanding in any specialized field, one needs the specialized vocabulary. But often these terms are so unfamiliar that a technically acceptable definition does not lead to true understanding. My aim is to use well-understood terms in a way which will be reasonably correct and efficient, if not completely so to an economist.

Definitions

Benefit—values received. In the case of wildlife the "purchaser," or user, buys an *experience*, measured crudely in visitor days. He buys a commodity which is not exchangeable for other commodit-

ies or money as if it were a diamond ring. No true market exists where he can pay one single price for the experience. No adjustment of price to value in a natural supply-and-demand system can exist. His experience is personal, so the value he receives is related to his knowledge and perception. The wildlife user is thus partly the producer as well as the consumer of the experience. The value he receives is non-negotiable, although some may share their experience via talks, but the user still retains the entire experience! The values received are mostly pleasurable feelings, including memories, but they may be partly tangible, in the form of venison or salmon steaks. Because they cannot be measured directly the benefits are assessed in special ways.

Cost—values yielded. The wildlife user incurs expenses for licenses and fees, equipment, travel, and subsistence required to consume the experience. He also bears the loss of income he might otherwise have made, termed the "opportunity cost of time".

Profit—benefits minus cost. The cost of a wildlife experience can be measured rather logically and surely, but the benefits usually are without direct monetary measure because the user almost always gets more than he pays for. If a Kenai resident pays 100 dollars to hunt moose, and an identical non-resident pays 1000 dollars for the same experience, then the resident gets 900 dollars worth of value for which he didn't pay. This surplus is termed a *consumer's surplus* and may be considered equal to the profit. Methods of ascertaining the value of the consumer's surplus are based on a technique described by Clawson (1959).

Gross Income—the total benefit received.

Land Value—the worth of a defined unit of land. In the case of the Kenai National Moose Range, the land value for wildlife is the price for which the 1,730,000 acres would sell on the real estate market for the use of wildlife alone. The actual value is computed by determining the total profit, or consumer's surplus, from wildlife uses and capitalizing this at some logical rate, say 4 percent. This land value (or capitalized value, or real estate sale value) is the amount which a corporation would need to invest, at 4 percent interest, to gain the annual return equal to the total profit from wildlife use. This is also termed the "opportunity cost of money" invested in the Range.

An important view to keep in mind is that we must think of these as values *to someone*. One must have precisely in mind who the "someone" is before the value is correctly understood. In most cases we are expressing the values to the user of the wildlife experience. But these

values accrue to society as well, so the sum of values to individuals is the value to society.

VALUES MUST BE COMPREHENSIVE

No "THE" value of wildlife exists. Many kinds of wildlife values are recognized. King (1947) has defined them in mutually exclusive categories as Recreational, Esthetic, Educational, Biological, Social, and Commercial. This is a comprehensive categorization, arranged according to the role played by wildlife in serving man's needs and wants. Another type of categorization relates wildlife values to comparable expressions of value of other commodities, such as oil or timber or football tickets. These categories may be described by the terms defined earlier. Obviously the choice of truly comparable values is important if one is to match the value of wildlife experiences on the Kenai to, say, oil.

The result can only be, that, when we try to express wildlife values, we must present a *catalog* of values, and indicate clearly the types of values of other commodities with which they can legitimately be compared.

Incommensurability

One further problem is incommensurability. Devine (1966) has distinguished between incommensurable, *i.e.* cannot be expressed in the common unit such as dollars, and intangible, *i.e.* incapable of quantitative measurement. Although some wildlife values may be truly intangible, most which cannot be expressed in money are incommensurable. When a non-consumptive user of wildlife says he would rather see the beauty of a moose feeding at the edge of Tustumena Lake than to see an oil derrick there, he is simply saying he is willing to forego the profit from oil, and thus is expressing the value of his moose viewing experience quite tangibly. Or when citizens through their Congress, vote to retain Echo Park undammed, they are valuing a natural Echo Park greater than the profit foregone from the dam.

Often the incommensurable values are most easily expressed as a vote, or the percentage of a group which expresses a certain view. For example, 90 percent of the owners of Tustumena Lake (*i.e.* the citizens of the United States) may say they prefer moose or salmon to oil production on the Lake, if there must be a choice. What, then, are the wildlife values and related recreational values, both economic and incommensurable, of the Kenai National Moose Range? Details of the method of deriving these values are found in Steinhoff (1969).

A CATALOG OF VALUES

Recreational Values

Profit—The total profit, or consumer's surplus, of recreational visitors to the Kenai National Moose Range in 1968 was $2,697,000. In effect this is value placed in the pocket of the recreationist as profit and is analogous to net income. A sole owner who charged the varying individual consumers' surpluses as entrance fees (a discriminating monopolist) could presumably recover this amount annually. The net annual income may be capitalized at 4 percent to $67,429,000 (or $39 per acre) as land value (or market value) of the Range for recreation.

A sole owner would more likely charge the same entrance fee to all recreationists and he would naturally seek the fee that would yield the maximum net return. The demand curve computed in Clawson's method permits computation of this value also. The optimum single fee would be $7 per recreation day, and recreationists would buy 131,737 days[1] at this rate, for an annual income of $922,000. The optimum annual fee per family unit would be $100. Some 2550 family units would purchase the use of the range at this figure and would spend 141,692 RD's there. The annual income would be $255,000.

Obviously few would pay the $100 fee if initiated next year, to say nothing of the public outcry at the idea. We assume that once the public became emotionally adjusted to paying for recreation they would be willing to pay this much. Obviously, though, the nation gains the greatest net return, ten times as much, by letting each participant pocket his consumer's surplus for himself. Also, Seckler (1955) has made a strong case for considering the wildlife experience a welfare good, since the wildlife resource is owned by all. He advocated income-neutral rationing. A no-fee policy is the easiest way to do this. If we charge a fee, Seckler argues, we really should pay the low-income individual for the *loss* of harvest of the wildlife experience which he owns and can no longer afford.

Expenditures. Much condemned as the illegitimate child of the assessment family ,critics call unfair the inclusion of food costs in recreational expenditures, because "one must eat anyway." A second complaint is that recreational expenditures do not add "new" money to the economy but simply reallocate what would otherwise be spent elsewhere. But other resources all charge the cost of food to the final product. The value of a log as it comes from the forest includes the cost of the logger's lunch, axe, and house trailer, just as the value of a

[1]A recreation day is a visit by one individual to a recreation area for recreation purposes during any reasonable portion or all of a 24-hour day.

recreational experience when it comes from the forest includes the cost of the moose hunter's lunch, rifle, and camper.

Several economists have pointed out that the second complaint is invalid because every expenditure, of any kind, for anything, is a "reallocation" from something else that might be purchased. So the expenditures method is a legitimate way to assess certain values of wildlife. Expenditures have been called "gross economic value" by some, but are more properly termed a "cost of production and harvest".

Recreational expenditures by visitors to the Kenai National Moose Range in 1968 totalled $7,543,000. They generated $5,656,000 in personal income, on which $1,131,000 were paid in Federal taxes. Contribution to the GNP is 1.2 times personal income, or $6,840,000. These figures are extrapolated from indices developed by Swanson (1969).

Gross Income (or Benefits). The recreationist is both producer and consumer of the recreational experience. His costs are his expenditures and the opportunity cost of time he invests. His profit is the consumer's surplus. The total is comparable to the sales price of other products. The recreational experience is analogous to the log, fresh salmon, barrel of crude oil, or sack of potatoes in the homesteader's truck.

Expenses + Profit = Sales Price

(Recreational Expenditures + Opportunity Cost of Time)
+ Consumer's Surplus = RSP

Sum of RSP'S (Recreational Sales Price)
= Gross Income Volume or Gross Sales Volume

Expenditures	$ 7,543,000	
Opportunity Cost	6,320,000	
Consumer's Surplus	2,697,000	
Gross Income Volume	$16,560,000	(or Gross Sales Volume)

Opinions. Over 50 percent of a sample of 126 U.S. citizens, owners of the Range, who did not use the Range in 1968 said they would vote for a greater appropriation ($150,000 in 1968) for the Range, 40 percent indicated the same as current appropriations, and 7 percent said they would vote for less or none. These proportions were consistent among salary classes as shown by a non-significant chi-square. A vote by owners of a public resource is one important way to express value, and a vote involving appropriations is a very tangible

evidence of it. This may be an example of "option demand"—willingness to pay for the option to use the resource later (Krutilla, 1967).

Fines. Though not intended by either donor or recipient as an economic expression, fines for violation of sport fishing or hunting regulations are a source of income to the state and express the cost of a "recreational" experience to the violator. In 1968, 53 convicted transgressors on the Moose Range paid $1475 in fines, an average of $28 each. The market value of a recreation day is $46, so the miscreant made $18. A rational basis for setting fines might be the least the value of the stolen commodity, the recreational experience involved.

Incommensurable Values. Over 23,000 individuals, in 6090 families, used the Range for wildlife and related recreation in 1968. They spent 358,319 recreation days there. These figures alone represent a considerable, concrete expression of value. Most users rated "quality recreation" as the best use of the Range, "wildlife" as second, "general recreation" third, "other renewable resources" fourth, "non-renewable resources (oil and mining)" fifth, and "business and commercial" last.

Esthetic Values

Our materialistic society seems overwhelmingly to vote for esthetic values. Such values of wildlife are objects and associated environment possessing beauty, affording inspiration, and contributing to the arts (King, 1947). The average visitor scarcely distinguishes re-creation of mind, spirit, and body from the beauty of wildlife and environment which stimulates pleasure and satisfies artistic hunger. Visitors and managers of the area alike rated esthetic values of the Range as very high. Non-residents indicated esthetics as a major reason for their visit to the Range. A sizable portion of the $16 million dollar gross sales volume of recreation on the Range would be assignable to esthetic value, if I knew how to do it.

Diseconomies. Costs or losses to one resource because of another resource are known as "external diseconomies." The extra cost of oil exploration, development, and production on the Kenai National Moose Range in order to maintain esthetic values is an example. Extra costs accrue because of narrow seismic trails, lighter equipment, seismic operation only with snow cover and on frozen ground, careful containment and disposal of wastes during drilling, and restoration of areas by leveling, reseeding grass, and replanting trees after exploration, development, and pipeline construction. Although some of these measures are aimed at direct protection of wildlife (including

commercial fisheries), most are aimed at preserving the esthetic beauty of the natural environment. The total extra cost for all oil operations on the Range in 1968 is estimated at $173,200. In earlier years the cost was greater because exploration and development activity was more intense, sometimes twice as great, or about $350,000.

Viewed nationally, this amount is profit which the public was willing to forego, and this is an expression of value of wildlife and related recreation on the Range. It should be added to the primary market value of wildlife, because it is a part of the expense of production of the wildlife experience.

The diseconomy oil imposes on wildlife and recreation includes loss of 20 square miles of habitat and recreational area due to oil roads pipelines, air strips, and oil well sites (Hakala,[1] personal communication). This totals 0.7% of the Range, a loss of $470,000 in land value, and an annual loss of $18,000 in profit from wildlife. This annual loss will continue as long as the land is occupied for oil production, whereas the diseconomy to oil will become minimal as soon as exploration and development cease.

Educational Values

President Franklin D. Roosevelt declared in his Executive Order establishing the Range that "study in its natural environment of the practical management of a big game species that has considerable local economic value" was a major purpose of establishment of the Kenai National Moose Range. Thus the singular voice of the people spoke forcefully, from the first, of the educational value of the area. Educational values are those which add to man's knowledge, either collectively through research, or individually through personal learning.

Approximately $727,000 has been invested in 52 separate identified research projects on the Range. Moose were a primary interest in 28 studies, and 21 of these were concerned with moose range. Other research featured trumpeter swan, Dall sheep, goat, beaver, general and plant ecology, fisheries, fungi, spruce grouse, erosion control, ice fields, and lake morphometry.

Seventeen groups totalling 578 people visited the Range at least partly for educational reasons in 1968. Owners ranked education as the second greatest value of the Range, ahead of esthetic, social, and commercial values. Users, managers, and owners all rated education in the form of "wildlife observation" and "wildlife research" as a preferred use of the Range in relation to other resources.

[1]Refuge Manager, Kenai National Moose Range, 1969.

Biological Values

King (1947) defined biological values as the worth of services rendered by wild animals. In the broad sense "wildlife" includes all wild animals,—beetles, nematodes, earthworms, and mosquitos, as well as moose, salmon, and ptarmigan. Each organism provides a service to the ecosystem, so each contributes to the value. All the ecology of a moose is integrated in one fact—the presence of the moose. Similarly the economics of the ecosystem of the Range is integrated in one value,—the value of the wildlife experience. The worth of a nematode which produces organic matter on which to grow moose food shows up in the expenditure of the moose hunter.

The ultimately expressed values in dollars in the pocket or gleams in the eye are affected just as much or more by changes in biological complexes as they are by immediate manipulation of moose herds and picnic tables. A change in biological values inherent in the moose-wolf relationship will change the wildlife value of the area subtly but profoundly. Thus any economic system devised, computerized, and de-humanized, must take into account the operative biologic systems. We must use bioeconomic systems.

Some biological values are negative ones (i.e. losses) to some groups. Moose-auto encounters and mosquito bites are examples. Officially recorded moose-auto accidents in 1968 totalled 42 and cost an estimated $42,000. Although these were losses to persons suffering the accident, they might be considered the amount society was willing to forego in order to have moose, thus a positive expression of wildlife value to society.

Social Values

Social values are those "accruing to the community as a result of the presence of wild animals" (King, 1947). These values are demonstrated by what people do, say, and commemorate. Buckley (1957) said that "well over half of the wage-earners in Alaska are dependent to a greater or lesser extent upon wildlife for their livelihood." Approximately one-third of the 1968 population living close to the Moose Range, or approximately 7500 people, are dependent directly on wildlife and related recreation. The dependencies come from commercial fishing, providing goods and services for recreationists, and from food provided by game meat. The entire flavor of the community is much affected by this dependence.

Fifty percent of nearby families use the Range for recreation. Family participation is shown by the average of 7 per party for swimming, 6 for picnicking, 5 for camping, 4 for fishing, 3 for general hunting (including moose), and 2 for sheep and goat hunting.

Wildlife and recreation rival the weather as a topic of social conversation on the Kenai Peninsula. Approximately 13 percent of the column inches of news in the *Cheechako News* (the principal newspaper near the Range) is conservation-related, and about 5 percent applies quite directly to the Kenai National Moose Range.

Names of local features such as lakes and streams indicate things held dear in the minds of namers. They continue to impart a character to the community throughout the following years. Wildlife place names occur at the rate of 3.4 per 100 square miles on the Moose Range, with each feature counted only once. These make up a very high proportion of place names of all kinds.

Socio-economic characteristics of users indicate segments of society which value the wildlife and recreation of the Range highly enough to use it, and those who receive the major benefit. Whether or not these are the kind of people we want to encourage and reward in our society is a matter of personal philosophy and value judgment. The greatest users of the Range, in proportion to their occurrence in the population as a whole, were skilled workmen, followed by professional, business (including sales and administrative), armed services, retired, and lastly other (including laborer, housewife, and student). Persons with over $10,000 annual income were proportionally more frequent visitors, as were those in the 26-55 age bracket for Alaskans, and the 46-65 age bracket for non-residents.

Commercial Values

Salmon produced on the Range contributed $1,122,000 or 25 percent of the commercial salmon income to the commercial fishermen of Cook Inlet in 1968, a "pink salmon year." The Range contributes 31 percent of the income, omitting pink salmon. Some years the proportion may be as high as 40 percent (Bureau of Sport Fisheries and Wildlife, 1963). Its retail value after processing at the cannery was $3 million. No indices exist to allocate the portion of this value actually produced on the Range. On livestock ranges of the western United States the value of a calf is 10 to 20 percent of the value of the marketed steer. If this analogy is valid, the value of the Gross National Product in 1968 of commercial salmon produced on the Kenai National Moose Range was $150,000.

Meat. An estimated 336,000 pounds of meat were harvested on the Range in 1968, about 75 percent moose (250,000 pounds) and most of the rest salmon at Russian River (76,000 pounds). At one dollar per pound, a conservative figure, the value in 1968 was $336,000. How is the value of game meat to be regarded in an economic analysis? Is it extra income to be added to the value of expenditures? Or an expected return on the recreational investment, to be deducted if one is

computing the value of the recreational experience itself? To the extent that the meat was not a conscious goal of the recreational experience, it is a bonus, without cost. Thus its value is a commercial one, additional to the value of the recreational experience. If the meat was part of the purpose for the visit, its value should be deducted from the "recreational" category and tallied as a commercial value of wildlife.

Hides and Furs. Very few moose hides are salvaged or tanned, though some potential value exists in use of this resource. Fur trapping is primarily recreational, and its value has been included with recreational expenditures. Market value of furs harvested in 1968 totaled $4014. The average annual income for 1963-67 was $4669, at 1968 prices. Allocation of this value should follow principles discussed in the previous section, "Meat."

The Businessman. We deal with primary values to the nation at the point of consumption, in this analysis. Secondary benefits of those who sell wildlife goods and services—the multiplier effect—is not measured. However, the businessman's gain is roughly equal to the expenditures of $7.5 million annually. Of this, $2.4 million are current expenses which go largely to the local economy, $1.3 million are transportation expense in Alaska, $0.4 million is transportation elsewhere, $2 million for equipment in Alaska, and $1.4 million for equipment elsewhere. This totals $5.7 million spent in Alaska and $1.8 million spent elsewhere in 1968 by visitors to the Kenai National Moose Range and directly attributable to that experience.

ASSIGNMENT OF VALUES TO AREAS

Resource decisions of the future often will be made on smaller areas, rarely on the whole Range at once. If values are allocated to specified areas in proportion to recreation days generated, the Kenai-Russian River Campground, with less than 0.003 percent of the area generates 31 percent of the value. The Skilak Loop, a heavily used recreation area which has approximately 1 percent of the area generates 27 percent of the value. On the basis of recreation days of each activity, fishing accounts for 22 percent of the value, hunting 18 percent, camping and picnicking 15 percent, relaxation and driving 14 percent, wildlife observation and photography 12 percent, and all other recreational uses lesses amounts. This type of analysis may permit more rational selection of the best alternative use of specific areas where there is conflict, between oil and salmon, for example.

ESTIMATES OF FUTURE VALUES

I estimate that by 1980 the use of the Range will increase 184 percent over 1968, to 1,019,000 recreation days. Expenditures and

consumer's surplus will increase 311 percent to $31 million and $11.6 million respectively. These figures are based on federal and state agency estimates of increases in population and tourist travel by 1980, and on expected construction of the Turnagain Arm Causeway. It also assumes continued development of recreational facilities at least at the present rate, and sufficient to meet the demand. They are believed conservative. The wildlife and related recreational resources of the Kenai National Moose Range are rare commodities. Many of them are unique. They are in short supply, and more cannot be produced at will on the assembly line. To paraphrase Cooley (1967), the acreage of the Moose Range in 1492 had almost no value to the white man because it was unknown and therefore unused and unvalued. Today the 1,730,000 acres have great value. In 1980 they will have proportionally much greater value because of 2.84 times the demand with the same number of acres.

LITERATURE CITED

Buckley, John L.
1957. Wildlife in the economy of Alaska. Biol. Pap. U. Alaska, No. 1, Revised. 33 pp.

Bureau of Sport Fisheries and Wildlife.
(circa 1963). Kenai National Moose Range. A plan for proposed management and development. BSFW, USDI, Wash., D.C. 54 pp.

Clawson, Marion.
1959. Methods of measuring the demand for and value of outdoor recreation. Reprint No. 10, RFF, Inc., Wash., D.C.

Cooley, Richard A.
1967. Alaska, a challenge in conservation. U. of Wisc. Press, Madison.

Hakala, John.
1969. Personal communication. From Refuge Manager, Kenai National Moose Range.

King, R. T.
1947. The future of wildlife in forest land use. Trans. N.A. Wildl. Conf. 12:454-467.

Krutilla, John V.
1967. Conservation reconsidered. Reprint No. 67, RFF, Inc., Wash., D.C.

Steinhoff, Harold W.
1969. Values of wildlife and related recreation on the Kenai National Moose Range. Mimeo rpt. to Div. Wildl. Res., BSFW, USDI, Wash., D.C.

Swanson, Ernest W.
1969. Travel and the national parks. U.S. Natl. Park Serv., Wash., D.C.

DISCUSSION

DISCUSSION LEADER MADSON: This is a very important paper. It indicates a classic example of confrontation between extremely tangible economics and intangible values. Alaska right now is the scene of a number of these confrontations, primarily the pipeline matter, but the situation is not unique to Alaska. It's going on all through the lower states and it behooves conservationists, especially conservation writers and communicators, to learn ways of assessing the values and attributing more tangible values to a lot of the things that we have always tended to dismiss as aesthetic.

Have you noticed a growing interest among economists—not resource-oriented economists as such, but economists in general—any interest in attempting to turn intangible into tangible values, on an economic basis?

DR. STEINHOFF: Since I have become interested, I have read much more of the literature on this. But the increase I have seen is among resource economists rather than among economists in general.

DR. GRAHAM NETTING (Carnegie Museum): As a non-economist, I have tried to follow carefully this very lucid explanation of how to assess values; but I am left without the payoff. What is the total value—either for a moose or an acre? What are the final figures?

DR. STEINHOFF: You can measure values in many ways, and the payoff is a question of what you want to say it is. Most of us would say it's the profit, and the profit is $2,700,000 per year from recreation in the Kenai. The gross sale volume would be the profit plus the cost; and the cost would be the expenditures plus the opportunity cost of time, plus the profit, and this would be about $16,000,000. That would be equivalent to the gross expenditures for recreation on the Kenai, except that they aren't all expenditures, of course, but we can call them that.

MR. RON SHEA: (Oregon Game Commission): In any of your studies, did you follow this up to the point where you might start losing some values because of too heavy use by people? This might possibly come with the bridge or the road you were talking about to Anchorage, or was this considered at all?

DR. STEINHOFF: I don't have any good measures of this. However, I think you would be converting one value to another. You would be converting some of the aesthetic values to a more tangible type of dollar value, and you would certainly lose something. However, we seem to have a whole spectrum of desires in our population, all of the way from those who are happy only when alone in areas surrounded by wilderness to those who are happiest when they are shoulder-to-shoulder campers. So the problem of the resource manager, I think, is how to satisfy the whole spectrum of these values.

MR. MADSON: Thank you very much, Harold. I am sure we will be hearing more on this in the future.

THE ROLE OF MASS MEDIA IN KEEPING THE PUBLIC INFORMED OF ENVIRONMENTAL PROBLEMS—A PANEL

REMARKS OF THE CHAIRMAN

GEORGE C. HALAZON

Modern living has been greatly influenced by mass media. If you doubt that, listen to the vocabulary of a pre-school child or watch at the books he picks. If they don't have slick-colored covers, they are drastically ignored.

The wildlife profession, to a large degree, has ignored the potential of these mass media and, conversely, many of the mass media have ignored the wildlife biologists. An outstanding example of the contrary is the ecological coverage afforded by *Field and Stream.* To discuss this subject with us is Clare Conley of *Field and Stream.*

THE ROLE OF THE PRINTED MEDIA

CLARE CONLEY[1]
Editor, Field and Stream, *New York City, New York*

My subject is the role of printed media in the communication of environmental problems.

First, let me give you a little background about *Field and Stream,* because it is a classic case of a magazine that was designed, in its original concept, to talk not only about hunting and fishing, but to be concerned about the outdoors—where it was going and how long it would last.

Field and Stream was started in 1895, and last year we had our 75th anniversary, celebrating it with a fairly large issue in June. But anywhere along the line in the history of the magazine, you can find articles indicating concern for such things as the grizzly bear as far back as the early 'teens.

One of our earlier editors, Ray Holland, was very active in making the legal determinaton of the Migratory Bird Treaty. He actually pushed the case through the courts and established that the treaty was legal.

So you see that we have always been very concerned about conservation.

[1] Mr. Conley spoke extemporaneously and his comments were recorded.

Now, where does a magazine such as ours and others like it fit in? We have a circulation—guaranteed to our advertisers—of 1,650,000; we print about 1.8 million copies a month, and we have a readership that includes all the people who would read a single copy. Usually this is a multiple of four, so we have somewhere in the area of eight million readers a month.

The amount of conservation material that we carry is greater than that of any other magazine of its size, larger than that of magazines with larger circulation. But the important thing is that *Field and Stream* fills a gap in communications that could be filled in no other way. We reach people who are active in the outdoors. Newspapers, because of their local nature, do not fill this void; radio has been practically inactive in the conservation field; and television has been something of a Johnnie-come-lately. Of course, it's a Johnnie-come-lately industry.

So magazines really are the only medium that can reach the reader with in-depth articles and offer him some understanding of our present problems. To accomplish this, we carry a monthly conservation department—one of two magazines of our size that does. Our conservation editor is Michael Frome.

I was personally pleased to be the editor who hired Mike, because Harold Titus had been with us for many years and there was a void after he passed away and before we hired Mike. Mike is an active conservationist and potent writer. The blending of Mike's talent with *Field and Stream* made a perfect combination.

When he came to work for us about five years ago, we felt that conservation was not being carried with enough force either in politics or writing. For various reasons conservation organizations and other magazines could not reach out and say that black was black and white was white, or who was causing the problems. This is particularly true of politicians. We had nothing to lose and everything to gain by taking a firm stand. That was the original design that we talked about and negotiated when he went to work for us. Because of this Mike has become one of the best-known conservation writers in the United States. He is outspoken to the extent of being called the "Ralph Nader of conservation." He doesn't like it much, but that's what some people call him, particularly those who have been under his fire.

Of course, the magazine also covers conservation in its articles. We carry many articles on conservation subjects. Every issue features at least one conservation problem in addition to those covered by the conservation department. Recently we have carried a three-part article on the Corps of Engineers called, "Dam the Rivers, Full

Speed Ahead." This was a carefully researched article by Mike Frome and gave much insight into the thinking of the Corps, their future plans, and what we can hope to do abut them. Mike has compiled the 15 most unneeded projects. When I talked with him recently he said he had added 15 more.

We have had stories about the Soil Conservation Service, by George Laycock pointing out that the philosophy of channelization was being carried too far—that some of our vital floodplain recreation and wildlife-habitat areas were being drained. We felt that it was time to blow the whistle on this and return to reality.

We have had articles on former Secretary Hickel and the Arctic, and articles about the Alaska pipeline. We had three articles on the logging of Admiralty Island and how this harvesting was being done. We sent editors and photographers up there to cover the story. Some of our advance promotional material reached the hands of the Forest Service, which was able to issue a white paper almost as soon as we reached the news stands, so we had an interesting exchange of ideas in the public media. We did not believe the Admiralty Island should be logged in quite the way it was being done or that maybe it should not be done at all.

One of our more noteworthy features is called, "Rate Your Candidate." We do this every two years at election time as a means of telling the readers what their Congressmen and Senators have been up to for the last few years; particularly those that are up for election. Admittedly, it sometimes looks as though we are telling the readers how to vote, but actually we're showing congressional records as they pertain to the outdoors and conservation.

We've had stories on population growth, which, to my way of thinking, is the ultimate conservation problem. It is one about which readers write to me often, and which five years ago was considered almost an unmentionable subject.

We have had in the past an article called, "Mischief in the Melon Patch," also by George Laycock, which won him an award by the Ohio Outdoor Writers for conservation writing. I mention it because it discussed the subject of politicians at the state level tampering with game departments and the extreme confusion and the damage they cause to the career people in these departments. A classic case in point is going on in Montana right now.

Soon to be published with George's by-line will be a story called "Scalp Lifters," discussing whether we should bounty predators, and one on Mirex and the fire ant problem in the South. Other subject areas that we have covered include pollution and DDT. We had one of the first stories on mercury poisoning. We will be covering offshore

commercial fishing and the damage it is doing to Atlantic salmon and all of the big game fish; the Florida Barge Canal; and of course, public land.

This gives you some concept of the material we're getting across to our readers every month.

Field and Stream more and more is trying to act as an intermediary between the research people and the popular or lay reader.

Gordon Gullion did a story for me last year on the ruffed grouse and its habitat. Recently I purchased another story from Gordon on how to re-build grouse habitat—what sportsmen can do on their own ground to improve grouse hunting. This area of communication we feel is very important.

Other activities of the editors of the magazine, primarily in Washington, D.C. and in the states, consist of conferring with elected and appointed officials. We work a great deal with the Forest Service, Bureau of Land Management, up and down the line in the Department of the Interior. We had a number of meetings with Mr. Hickel, when he was Secretary of the Interior. We were pleased to find that he became the kind of man in that job that he did. We were concerned when he went in, but when he went out we were disappointed. My notes say "Hickel to Nixon, to Morton," which sounds like a triple play, but we feel from our early discusssions that Secretary of the Interior Morton may also be a good man. We're not totally sure of ourselves yet, but it doesn't look as though it's going to be too bad. We had one meeting with President Nixon in the White House to discuss briefiy the problems of the outdoors, and we had one article by-lined by the President in the aniversary issue, the only magazine, to my knowledge, that has carried an article by the President.

Ratings, of course, are an important part of our Washington activity. We make many personal appearances such as this, and in elections we may have participated a little more than we should. I was active in the latter part of the Idaho gubernatorial election las year. But we got the man we wanted. I came under some personal fire for my interest, but there comes a moment when you have to decide where you're going to go or whether you're going to go or not, and this decision was mine. Mike Frome was very active in some of the Virginia and Tennessee elections because of impending problems in those states. As in Idaho it was a matter of whether the resources would be used one way or used the other, and we had very strong feelings in some of these areas. I should say that my Idaho activity was based largely on the fact that I am from Idaho and I have very sympathetic feelings toward that state. I want it to stay the state that it should be and not become an open-pit mine.

We have testified in federal hearings in Washington, D.C. and in the states. I have testified personally in wilderness bill hearings, grazing fee hearings, Alaska pipeline hearings and timber harvest hearings. As a magazine, we feel we are something of the watchdog for the people. We watch the politicans, the bureaus, and the other media. We make readers feel that they have a voice. With the size of the United States today, one voter usually doesn't feel he has any effect at all. But through a magazine, throught the voice which we try to give the reader and we make him feel that he has a chance to do something about what's going on and make him felt.

We've used the line, "The Little People Are Watching," which is a line from a letter written by a reader in Clam Lake, Wisconsin. I have to paraphrase, but it was to the effect that, "Keep giving them Hell and let them know the little people are watching." We liked the line because it was the way we felt about our readers and how we were trying to do what they wanted. With 1,800,000 you can't do what every reader wants every time, but we do the best we can. I might add that we must think ahead because the magazine is published at least six months ahead of release and usually planned a year ahead. Areas of concern in the future deal with forest-management practices-subjects like clear cutting and changing mixed forests of oak and pine to single-species pine farms. I realize I'm talking about private land in many cases here, but these are areas in which we feel the public has a deep concern. We're concerned about oil and its management and how it will be taken from the ground and taken out of Alaska. I, Mike Frome and my managing editor have all been separately to Prudhoe Bay to examine the situation and to see the terrain the pipelines will have to cover.

We're concerned about dams—dams like the regulating dams on the Clearwater—the Lenore, Lower Granite, the Ben Franklin. These are all desperate situations in the Northwest, situations that with a little foresight we should have avoided but didn't. And now we're trying to preserve the last of these rivers that we have. Fifteen years ago the Columbia and Snake were, for the most part, free-flowing rivers, with large runs of salmon and steelhead that went clear up to south of Boise into the Swan Falls area and on up the Weiser River. These runs don't exist anymore because we couldn't stop building dams.

We're concerned about public lands. All of you in the western states are concerned because in the Land Law Commission review report the threat is there in black and white. The game has started. The attack is on to run the lands for the "dominant use." In other words, if it's grazing, grazing will control the area; if it's timber cutting, it's going to be timber cutting that does it. And there are

going to be very few areas managed for recreation. Rrecreation is going to get the short end. I believe this really is one of our major problems of the future.

Offshore fishing for Atlantic salmon and big-game fish is another area all of our coastal states are particularly interested in, the Northeast and the Gulf States particularly. We are going to push for a greater offshore restricted area. Territorial waters for fishing purposes, I believe, should go out as far as Peru and some other countries claim, to two hundred miles offshore.

The United States does not have a large enough fishery to support the world and there is no reason that the world should be allowed to deplete our fisheries. We have to come to some terms. It involves many international treaties but major damage is being done these days and we're grossly ignoring it. Nobody in politics is willing to make any statement on it that I know of.

Finally, I want to say that one of the big areas of concern that we have—and I personally have, too—is the anti-hunting sentiment that's beginning to come from the new environmental action groups. It's developing into a militant force, but a force very poorly informed. As a case in point, *American Sportsman* recently has announced that it will carry a great deal less hunting material. This is a well-known television show that had established itself as entertainment for the outdoorsman—hunter, fisher, camper. Why are they cutting back on hunting? The reason is simply that they did a piece on bear hunting which got quite a bid of mail. The sponsor said that they would back out and sponsor no more shows.

Management at ABC said no more hunting—or very little—and that's what's happening. The anti-hunters are making themselves felt.

There was a show in January called *Say Goodbye,* which was presented by NBC, sponsored by Quaker Oats, produced by Wolper Productions, that is an almost classic case of the innocence of a network and of an advertiser in regard to the outdoors. I didn't see the show and, when I began to get so many complaints about it, I asked Quaker Oats to put it on for me in New York, which they very kindly did. Incidently my rapport with Quaker Oats has been good. I do not feel that they were responsible other than being innocent.

I was astounded at the beginning to see a deer and cougar sequence in which a cougar was set up to attack a deer. Now, all of you who work outdoors know very well that it's next to impossible to put that sort of thing on film. That means that it had to be setup; I am surprised that the Humane Society would let this kind of thing get by. Why should you allow a cougar to attack a deer and at the same

time have laws against such things as bull baiting and pitting a grizzly bear against dogs and that sort of thing? We know that's not humane. I'm not for it. But why, just because it's going on a film, is it acceptable?

The prairie dog seqeunce, I think, was gross. They made a very good point saying the prairie dogs were endangered because of poisoning. That's quite true. We've had the same thing in the magazine, and I couldn't agree more. Then to emphasize their point, purely for dramatic shock effect, they have a cowboy hop off a horse with his trusty .30-30, which you know and I know is not a prairie dog rifle, and three of these little animals are blown to bits right before your eyes. Now what's the use of that? Are you going to talk about saving prairie dogs or are you going to blow them up for TV entertainment?

Finally they came to the polar bear sequence, which was the most contrived, concocted nonsense I've ever seen. But the problem is that it does damage, so let me explain it to those who haven't seen it.

They started out with a helicopter sequence, sighting a bear and filming it down from the helicopter. Finally the helicopter settled. There's a cut. Two men run across the ice and really shoot a big, male polar bear. Fine, except that the helicopter made it seem to look as if the hunters had arrived by helicopter, which in the United States and Canada is illegal.

More cuts, more helicopters flying. Then we come to a sequence where, at the end, there is a bear in the distance, and a couple of cubs. A gun goes off in the foreground, the bear rises up and is thrashing on the ground. The camera shoots the bear thrashing on the ground and the two poor cubs off at the side—I've had people say they cried when they saw this. I would too, if it were real.

These were all contrived to look as if the hunter was knocking off the game—almost irrationally, with no heart or sportsmanship or anything.

Well, the film of the sow with the two cubs was research film from Alaska. It was a tranquilizer shot. The bear and the cubs are still together. Nothing was killed. But the bear did appear to be killed, through clever film editing.

So I ask, where is the responsibility of television in this anti-hunting business? If you want to know where the anti-hunt feeling is getting its voice, it's through the innocence of television—that and the fact that television is capitalizing on shock effect. Incidently, somebody said to me that they weren't trying to fool the public, that *Say Goodbye* did not mean to indicate that there was shooting from

planes or that hunting was bad, and that as a matter of fact, there was no shooting from planes in that movie. But even so, Congressman Saylor of Pennsylvania came out with a press release saying that *Say Goodbye* dramatically pointed out the currently unpunishable slaughter of wildlife practiced by some lower forms of *Homo sapiens.*

Now Congress is trying to pass a law that you can't shoot from an airplane, which most states, including Alaska, have anyway.

I want to wind up on this statement of my concern for the future of hunting by quoting from Dr. Leslie Glasgow, who was assistant secretary of the Interior for a while.

He said in a speech just a little over a year ago, "Public hunting, as we know it today in the United States, will be further curtailed in the near future and it will be under severe restrictions within twenty-five years. And it may eventually be outlawed entirely unless professional wildlife managers and their conservationist allies mount a public education program to counteract the Chicken Littles who are running around crying that the sky is falling down, all because of hunting. The anti-hunting movement must be stopped.

"The wildlife scientist knows that the hunter and harvest is not the danger. The real danger is environmental destruction."

With that I'd like to thank you for having me here to give you my ideas about magazines.

REMARKS OF THE CHAIRMAN

GEORGE C. HALAZON

We are sorry that we must announce that we are going to have to deviate from the program, since one of the speakers has not appeared. For the sake of later discussion and continuity, we would like to mention, for those of you who may have been aware of the old educational television but do not know the Public Corporation for Broadcasting that this is the new wording. Part of the Public Broadcasting Corporation is a section for special emphasis on the environment—the Environment Center. Our second scheduled speaker represented this center and was to give us some information on it.

There are a large number of educational television stations scattered throughout the nation. They are a recent innovation, and their viewing audience admittedly is still quite small, but it is extremely selective. More and more people are turning to these stations for information on special topics.

The special role of this television medium is not to provide

programs that necessarily will attract the largest number of viewers, but to provide those that will cover and provide information on neglected or minority viewpoints.

With that, we will move on to the next speaker. Mr. Conley mentioned briefly *Say Goodbye.* Our next speaker bears the label of NBC, but as you will find out shortly, divorces himself completely from *Say Goodbye.*

Most of you have heard of the rumpus that was generated by that particular TV program. Most of you also have heard of the TV special, *Man's Thumb on Nature's Balance.* We discussed it with some of the organizations that were violently opposed, and justifiably so, to *Say Goodbye.* We also found that they were strongly in support of *Man' Thumb in Nature's Balance.* We asked them whether they had let the producers know of their feelings. They admitted in the negative but hastened to add that they will rectify that before this session is over.

To speak to us now, on the role of television, is Mr. Northshield.

THE ROLE OF COMMERCIAL TELEVISION

ROBERT NORTHSHIELD

NBC News, New York City, New York

I find it necessary, at the start, to make a correction. That is to correct the impression that I am qualified to talk on the role of commercial television in keeping the public informed on environmental problems. It seems to me that television itself is an environmental problem, and yet I am qualified to discuss only a part of that.

I've been tipped off that there's a certain amount of unhappiness, poorly concealed and sincerely held, about some recent television programs. That, as you can imagine, creates a problem in my environment. . . . especially this specific little ecosystem that is this conference. So let me, early on, tell you that I didn't have anything to do with *Say Goodbye,* that I probably wouldn't have liked it if I *had* seen it but, most important, I *didn't* see it. So I know only indirectly what all the shouting is about.

Here I must beg your indulgence while I get a little technical. Within the National Broadcasting Company there are a half dozen separate divisions. Two of them are NBC News, of which I am a part, and NBC Television, of which I am not. All programs that get broadcast on television are put on by the Television Division. One of the principal sources of those programs is the News Division. That is,

NBC News *produces* programs but NBC Television puts them on the air. Obviously, NBC Television gets most of its programs from other sources than the News division. Obviously, too, NBC News has nothing to say about those programs that it *doesn't* produce. Such is the case of *Bonanza, The Flip Wilson Show* or even *Say Goodbye.*

As a part . . . a kind of senior part . . . of NBC News, I have been involved in television journalism for a long time . . . eighteen years at all three networks. My aims, my ambitions, my intentions are no different than they were when I worked on newspapers back in the days before I went straight. Journalism, in any of its varied forms, is still simply the reporting of news. And news, by my definition, is quite simply the chronicling of change.

Now one of the most significant *changes* in recent years is the eruptive interest by the public in things environmental. Everyone is suddenly involved in the problems of ecology, of pollution, of desecration, of destruction. I think that's just great. But I think it has happened for the wrong reasons.

I think that a great many, probably most, of the people are terribly interested in the environmental questions because they think these are *simple* questions.

After more than a decade of trying to figure out how they feel about the racial problems of the country, how they feel about the complexities of a filthy war, how they feel about mistrust and hatred between themselves if they are either parents of offspring, how they feel about drugs and pornography and changing life styles . . . after all these challenging, ennervating arguments with themselves, it looked simple to get concerned about clean air, clean water, beautiful trees and gentle animals.

Most important, aside from its apparent simplicity, the environmental issue served to bring together people of all ages. It seemed to be an easy bridge across the generation gap.

Unfortunately, this is the age of television, too. It's the time when issues are dealt with massively and as simply as possible. Television grabbed at the issue at the same time its viewers did. So we have a great many simplistic, popular, not necessarily complete or accurate reports on what's new on the issue of our environment and its problematical future.

So now, finally, I get back to the title of this screed. The role of commercial television, specifically that part of it with which I am concerned, *is* simple. As journalists, we must tell what is going on and, in the tradition of journalism that goes back to the time when cavemen painted news on rocky walls (Spiro Agnew notwithstanding), we must tell what the effects are likely to be.

Further, we must point out that it isn't simple.

In 1953, on the very first television program I ever worked on, we did a little film essay on the balance of nature. Most of the meager number of viewers heard about ecology and food chains and nitrogen cycles for the first time. It was a difficult piece to write and make sensible.

It still is and must be.

Since then, I have done dozens of programs and parts of programs on the general subject of natural history and ecology. I think pieces we did on *The Huntley-Brikley Report* helped tremendously in saving the alligator, in stopping the Everglades jetport, in stopping the Cross-Florida canal, for instance. I don't know what effect documentaries like *Who Killed Lake Erie?* and *Pollution is a Question of People* (both produced by Fred Freed, not by me) will have. But it won't hurt.

Every one of these efforts . . . and the dozens of others done by the news divisions of each of the networks . . . every one of these is complicated, responsible and, in our view, necessary.

That is the role of commercial television in this field: to inform, to elucidate, to predict and to warn that saving the world is not only essential: it's complicated and expensive.

One personal footnote: the last program I did was a documentary called *Man's Thumb on Nature's Balance.* It said, bassically, that sometimes it is necessary for men to add the weight of their skill and morality to that of nature to conserve the planet and its inhabitants. It could be said that we argued that hitting seals on the head is good for them.

The response to the program was overwhelmingly negative, even abusive. The viewers, apparantly, were looking again for simple answers. The fact that they didn't get them must not deter journalists. We must continue to be objective and militant, I believe, and we must continue to tell what's going on.

Let me remind you that I didn't see that other program. But if it was as bad as so many of you have told me, it only clarifies that sense of mission we should share: we have a world to save and it won't be easy or cheap. But we have to keep telling the people.

PANEL DISCUSSION

DISCUSSION LEADER MADSON: Thank you Mr. Conley and Mr. Northshield. I am sure that there are a number of questions to be asked and comments to be made.

MR. JOHN SCHMIDT (South Dakota State University): I have a suggestion that we change the title of the first talk from "The Role of the Printed Media" to either "The Role of *Field and Stream*" or to "The Role of Clare Conley and Mike Frome."

MR. JACK REMINGTON (Portland, Oregon): I would like to ask Mr. Conley about

advertising. He mentioned it only in respect to television and I would like to ask about his policy toward advertising in *Field and Stream*. For example, what is your policy toward advertisers or types of advertising that is perhaps anti-conservation or anti-environment?

MR. CONLEY: If I read you correctly, there are several areas which you could be questioning. One would perhaps be advertising for tiger hunting in India, I don't know whether we are still carrying that or not. I hope we don't have any more.

There are certain regulations that we have to observe, and there is a matter of the legality of what we can turn down. In some cases, they can force us to take advertising.

The other area you might be talking about would be vehicular use of open spaces. I don't know which one is your favorite, but we have had articles by Bob Behme who is my vericles editor. In response to the latest issue, we had many letters asking how we could take advertising that would show a four-wheeled drive off-road vehicle going across the open country or desert because it does do environmental damage. We have made a long statement of what we think is right and wrong in this area. We believe that there are places for off-road travel—beaches, areas set aside by the Bureau of Land Management, Forest Service, or whatever the managing agent might be.

We also believe that there are certain areas that should not have vehicles and I believe that we are coming to a shakedown on this at the national level and in the various states. Most are setting aside places where you can use snowmobiles and off-road vehicles and places where you can't. I believe that the controversy is straightening itself out.

As far as advertising for such equipment goes, we have no choice but to take it. If we are to have a publication to fight with, we have to pay for it somehow, because subscription does not come close to paying for a magazine. Most magazines these days work at a loss on subscription. *Field and Stream* does not, but most do; and if we don't have advertising, we can't exist.

So, while we may take from the people that are building these vehicles and feel that perhaps they abuse some areas at certain times, we have to. It's a matter of existence. We feel that we are better off to exist and fight than to turn down advertising on various moralistic grounds.

MR. ART KENNEDY (Bureau of Land Management, Alaska): Mr. Northshield, I would like to have your viewpoint on the possibility of establishing a board of some sort that would act as a screening or advisory body to rate television documentaries and maybe even motion pictures dealing with the environment for their authenticity and factual content. Is this a possibility as you see it?

MR. NORTHSHIELD: *No.* (Laughter)

I didn't mean to be rude. Obviously, you're entitled to more of an answer. I think that that sort of thing gets proposed not only on this subject, but on all subjects. This happens to be the popular and controversial subject this year for television documentaries. Certainly, most of us have lived through the time when the same thing was proposed for documentaries dealing with urban problems—which is a euphemism for racial problems—and earlier with regional problems. The southern stations felt that the documentaries we did were much too northern. I don't think your suggestion is practical because the essence of journalism is that it must be a little ahead in telling what's new or what's next. Therefore, it is, by its very nature, controversial.

To get into rating and judging, is simply impossible because it means that you have to wait for the rating before you can tell the news. This is obviously impossible.

I would further suggest that the one place where it is now in use is in movies, where I know, a modicum of bare bosom is shown in each picture, just so it can get an "R" rating. This is better at the box office than a "GP." I don't know if you people have felt as tricked as I have recently, in going to a string of "R" movies, which all turned out to be *Song of Norway*, or something.

In other words, in the one place that I can think of where it has been tried just

doesn't work. The producers learn to manipulate ratings, and I would think that in television, we are just as manipulative as motion picture producers.

MR. MADSON: For whatever it's worth, Mr. Northshield, I don't believe I have remembered that the professional conservationists and biologists were greatly impressed by your show, *Man's Thumb on Nature's Balance*. They thought that it was a very reasonable, well-balanced presentation of a highly controversial subject. (Applause)

MR. NORTHSHIELD: Thank you, John, and thank you all for that. There are two points I would like to make about that, beyond saying simply "thank you." When we went up to the Pribilofs to make the film, Bill Peck was head of what was then called the Bureau of Commercial Fisheries operation there. He told me that they were apprehensive about our arrival, because we didn't know what we were going to find or what we were going to report. But we did this story as we do, or I hope we do, all our stories. It turned out to please you people. It displeased a much larger group of people who are looking for simple answers. It was, I think, a little ahead of its time, and of course, you are.

The other point that I really feel compelled to say is that NBC may have been derelict in putting on *Say Goodbye,"* but they are also the same outfit that gave me the hour in which to do *Man's Thumb*, and to do it without intervention, censorship, or judgment. I was trusted to be a professional journalist and was allowed to say what I felt was the right thing to say.

And I hope they're listening. It's a swell company, and I would sure like to do some more stuff there. (Laughter and applause)

MR. DWIGHT SMITH (Colorado State University): My question is directed to Mr. Northshield. I apologize for coming in late, particularly if you have already answered my question; but you mentioned, as I came in, in relation to *Man's Thumb on Nature's Balance*, and that public response was negative and even abusive, in some cases, to it; but that we must have a sense of mission, in which I agree heartily with the applause that you just received.

My question is about the problems of sponsorship for these types of programs. Does this limit you, in any way, in the type of program that you can produce, when it is unpopular with a large segment of the viewing and listening public?

MR. NORTHSHIELD: That particular program went on the air as sustaining, which is to say non-commercial. It cost about $150,000 to produce, and that was a dead loss. Not a penny came back from that. That's the kind of times we are in now. Two years ago, we would have had a sponsor. It had nothing to do with the content, because sponsors, in regard to news programs and NBC, are not permitted to see a show until it goes on the air. They are given some idea of what it's about—about two paragraphs. I think it is just that we are currently in more of a recession than most people and are a little more panicked about it than most people are, but not to the extent that we won't put on sustaining programs. We still do. The last three that I have done were sustaining.

I don't think that sponsorship is a very big issue. The News Division does fewer documentaries in this kind of an economy than they did back when we could sell absolutely anything. We just put NBC News on and somebody would buy it, usually the Gulf Oil Company—and whatever happened to them? (Laughter)

Your other point was a perverse one and that's what we're good at. The fact that the program was controversial was terrific, as far as we are concerned. Not that we try to get people excited and hating us, but it does get people talking—whether it's us or CBS or ABC. I think news people are genuinely interested in getting the public exercised about problems.

I answered each letter we receive every calmly, sensibly, and sincerely and somewhat plottingly; and a number of the people wrote back and said, "Gee, it was nice of you to write that way, after the way I assaulted you." That, I must say, is really rewarding and maybe they should have paid more attention to the program and not be more reactive to my letter than to the television show.

But at any rate, that kind of interchange between viewers and producers is all to the good for producers and probably to the good for viewers. So the idea that that kind of program might be unpopular would not stop us from doing it.

MR. MADSON: Your comment, Bob reminded me of that old editor of mine who once said, "The best editorial approach in an editoral page is not one of outrage and force, but one of hurt and bewilderment." Next question, please?

MISS PATRICIA CARPIO: Mr. Conley, would you consider taking advertising from conservation groups? I make this plea in view of the fact that in your October issue, you had eleven or twelve full-paged color snowmobile ads; and if conservation groups were to contact you, would you consider giving them as much space if they could come up with the appropriate funds?

MR. CONLEY: Naturally, we would take advertising from any source we could get. If you will give me your name and address, I will have a salesman call on you right away. (Laughter)

We have carried material from the Zero Population group. I have very strong feelings about this and we have more coming. In the issue we are just getting together now, we have another story on population. And whether you advertise or not, I am for this idea, so I don't think that it is really necessary.

Besides, our rates are so high that I don't think that one of your groups could do well buying space with us.

MISS CARPIO: Well, maybe a combination of conservation groups then, together?

MR. CONLEY: Oh, I would be happy to carry it, really.

MISS CARPIO: And also, I would like to just make one comment on your being very upset about this program on television. You know as well as I do, and others, that there is quite a bit of illegal hunting and some from the air. I know of it personally in Alaska. Those that are honorable sportsmen, I don't think need to be so concerned about this public reaction; but the action shown is, too many times typical of some unsophisticated, unsportsmanlike hunting that takes place. And if the hunting associations could bear down on these individuals that aren't going by the laws, I think this would be in the interest of the sportsman and the non-hunter. Thank you.

MR. CONLEY: Thank you, I know there is illegal activity going on. There is illegal activity in every field, even in population control.

But the point you bring up is one that I think laymen frequently hit us with, and that is, that since something illegal is going on, all sportsmen are therefore bad. This was extended into the back page of *Audubon Magazine* in the latest issue. A good friend of mine, Less Line the editor, who was very kind to *Field and Stream* in his editorial by saying we were the only one exempt from what he was going to say, went on to really castigate hunters and hunting; and at one point said that the ethics of hunting no longer existed. Well, you and I know that that is not true, but he was mad because of some sheep poaching that had been exposed in California and I don't blame him. They may be *Field and Stream* readers, but they surely are not *Field and Stream* people, those who were involved and indicted in this.

So don't think because something illegal is going on, that all 40 million fishermen and 20 million hunters, are bad. They are not.

MR. CLEM STEARNS: Before I announce to all of you who I am, I want to qualify myself as an expert journalist, a newspaper man, a film editor, born in a newspaper family, whose father was sued for libel, run out of town and so on—I quality. I know how to handle news. Now, whatever you people say this morning, I can write five different stories on it and still never misquote you.

I am the public relations coordinator for Pacific Northwest Power Company, the largest power company in the hemisphere not doing business on the Snake River.

I have taken up almost all of my time. I am going to let Clare off, because today, I see he recognizes that the profit motive is not as bad as last year in Coeur d'Alene, at the Outdoor Writers Association, he seemed to indicate, so I will let you off the hook, Clare. I go to Bob at NBC.

MR. NORTHSHIELD: I'm leaving. (Laughter)

MR. STEARNS: I have been quoted fairly on NBC by my good friend Oliver from Los Angeles—quoted fairly, with the Sierra Club on one side and me on the other. But last year on the 22nd of January, you aired a program called *The American*

Wilderness. I had to pick a utility executive to represent us. I picked Robert A. Short from Portland General, a former newspaper and radio man.

After the interview, I told Bob Short and his newsman, "You are going to be made a fool when that program is aired," and he was. You see, by very careful editing, he appeared out of context for a minute, and then my good friend from the Sierra Club, Brock Evans, appeared for a sentence. Short got hundreds of letters from all over the country criticising him, mostly from the East, but including the daughter of a Portland General Electric Company division manager, who said, "Daddy, how come you have that terrible man working for you?"

Then, just a little later, a beautiful picture on the North Cascade Fire—*Nature Conspired* Lorne Green and his beautiful voice—"Nature conspired with lightning, with inversions, so that airplanes can fly"—and never once was it mentioned that careless man had set fires in the same area or that there were no access roads in some other areas where tremendous fires had burned.

My question, then, to you, sir, is, not who, not how, because I understand that, but why were those programs edited that way?

MR. NORTHSHIELD: I can't answer that. I don't know why they were edited that way, but my supposition is the same as yours, that is, that the producer, through research or reading or whatever determinations, had arrived here or in Idaho or wherever it is, with a pre-conception; that is, what he was going to get from Mr. Short, he knew before he got it from Mr. Short.

Now, any of us who has ever worked on a newspaper—and this, I would assume includes you—knows that this is an easy thing to fall victim to. As I say, I am, in effect, accusing this guy, who is a friend of mine, of having done something, and I don't know that that is what he did.

I would further think that to probe the motivations of an editor is an exercise in utter frustration, as you know. There is no way of knowing why single sequences are eliminated, why stories are played on the right side of the page instead of the left, except in terms of what the individual journalist or, in this case, producer, determined to be the most significant. Now, if he was prejudiced or criminal or unfair, that's a problem. That guy, I know, happens not to be.

I must say that I remember the show, because it was on just a couple of nights before mine and I thought it was insane to run *Say Goodbye, The American Wilderness*, and my show, all at the same time. I mean, the American viewer was up to his ears in being nice to little animals, and it didn't help me any, because mine was the last.

But, I must say that I was unimpressed by the problem. I recognize it, now that you tell me about it, but when I saw the show, I thought that Mr. Short did fine and I think your company did fine. I don't think that the Sierra Club won or lost that argument. I think it simply showed that there were at least two sides and in a traditional way. They were those same two sides that we have heard since the New Deal.

MR. STEARNS: The only thing I want to say is I will not write a letter to NBC nor to any newspaper, to Clare Conley's magazine, or anybody, to the newspapers who castigate me occasionally. While calling me very candid and forthright, they still ink their type with acid and go ahead and blast me. I refuse to answer, however, because you still have a network and you still have the press.

MR. NORTHSHIELD: Yes, but look, you have Mr. Short. (Laughter and applause)

MISS TINA NATHY (Nevada): I would like to ask both of you, as people in both media, whether you have thought of doing any articles on new life styles, in the way of saving natural resources, like communal living, or the importance of the Women's Liberation Movement, and cutting down on some of the consumers; or if you have ever done an article or program on the amount of stuff that goes into producing beer, for instance, the amount of resources and power used in producing beer cans; or is this too touchy an issue for you?

MR. NORTHSHIELD: You are going to sneer, because I have been sneered at before; but most of the new life style, in my limited way, I advocate.

Most of what the practitioners of the new life style, or the new culture—and

they will die before they will admit this—learned about it from watching television and I don't mean *I Love Lucy*. I mean the Walter Cronkite Show or the NBC Nightly News or whatever they call the thing on ABC. The almost immediate communication of change has been made most evident by television coverage. I really believe that the Women's Lib argument is greeted with an enormous national yawn—not by me, please.

I lit a girl's cigarette the other day and she hit me. But that's New York.

Anyway, in all seriousness, I think I could, if necessary, prove to you, that the specific thing you mentioned have been seen on television repeatedly, and with great effect. This is the perfect grist for the television journalism mill.

Keith Hay from the American Petroleum Institute can tell you that the television coverage of the Santa Barbara disaster—and we called it a disaster before anybody else—had a tremendous national impact because it was on a national television show. And out of that, came the whole thing about littering and beer cans and the cost of making them and the ideas of recycling and so on. Now, I don't mean that we invented it, but I do think that we made a great dent in public awareness, and it cost me my friendship with Mr. Hay, which wasn't worth much to start with anyway. (Laughter)

MR. CONLEY: Could I have equal time on that question? Since it was directed at both of us, I will try to get your question in parts, because it was about recycling, for example. We have carried some on that subject. We have taken a beer can apart and said that the metal came from here and the steel came from here and the paint from here and the varnish someplace else. However, recycling certainly is very much in our plans. This is a very practical answer to a lot of problems, particularly metropolitan problems.

Littering is more of a rural problem. They litter New York until you can hardly walk, but it is really more damaging when it's in the open. Recycling may be a good answer there.

I write editorials in the magazine most of the time. An idea that went through my head was to advocate the concept that if you wanted to buy a six-pack of beer, you had to turn six cans in to get it, which is not a bad idea. It would make people pick them up. It is fairly simple and I see that one of the companies has come out with an offer of one-half cent per can this week. I don't know that that is going to be enough of an incentive. It is going to take a lot of cans to get enough money to go to the show.

About Women's Lib and commual living—we have not done much. Life styles, yes. As far as wilderness camping, wilderness travel, living outdoors, we have done that sort of thing.

I don't know that Women's Lib is really a subject I should get into. I am not against their liberation. I have tried to liberate as many women as I could. (Laughter)

Actually, I don't think it's a subject for me, but I do think that life styles, in the sense of living outdoors, is and has been a subject right along with us. Does that answer sufficiently?

MISS NATHY: No.

MR. CONLEY: That will teach me to ask.

MISS NATHY: I feel that first of all, whether you shoot or don't shoot, is really a minor question. What is a problem is that each person lives in his little suburban house and has a family and this is basically destroying your other way of life, eventually, because you keep moving out to suburbia, because you have to have so many appliances. These are the things that I am talking about, which we need to change women's attitudes, or the communal life style of sharing, which I think is more basic.

MR. CONLEY: What you are getting back to in the life-style idea then is our standard of living, or the comforts that we have accustomed ourselves to. I followed this kind of thinking through myself, but where do you end? Where do you say, "Well, instead of buying a large car, I will buy a small car," and "Instead of having a house that has two bedrooms, shall I have four?" Your

demands on power go right back to where your power comes from. Where do we start to recycle ourselves to a less demanding method of living? I fail to see how this will come about quickly, and I don't see an answer. The American public is spoiled. I know I am and maybe you will admit that you are spoiled, too, to some of these comforts—to being warm in the winter instead of cold. They all make demands on our environment and on our natural resources.

Where we do find problems is in what we consider wasteful demands—where land is destroyed forever; where land is not kept up and managed properly. These things, we fight to prevent. We have to tell people that they must no longer take five sacks from the grocery story rather than putting everything in one that they carry back and forth all the time. Yes, I can do it, but it is a matter of public education, and I don't know that we are going to get that very soon. I don't want to make it discouraging, and I know that what you are saying has some truth, but I don't know that we are going to get the answers very quickly.

MR. NORTHSHIELD: My point, by the way, is quite different. My contention is that we do do a good deal of that and the fact that you don't know about it or don't believe me when I tell you is something that I can't do anything about. But what I can do is to continue to do it. And, you know—tune in.

MR. KEITH HAY (API, Washington, D.C.): I would like to address my remarks to Chad—that's another of several names that people call him by.

There are a lot of resource people here, with a lot of local problems. Some of these problems are of national significance; and a good point, Chad, is the alligator poaching that happened down in the Okefenokee. Certainly, the thing that you did on Huntley-Brinkley was a tremendous good for that cause, and I am certain it didn't hurt the legislative travels of the Endangered Species Act.

Now, there are probably other local problems of this nature that these people know about. How can they get to you or people like you, to do news or documentaries on them?

MR. NORTHSHIELD: I guess, Keith, nobody knows better than you the difficulty I have answering that question, because Keith and I did a number of things together when he was in the Bureau of Sport Fisheries and Wildlife; and it certainly was beneficial to us and perhaps to him and to the government. But that was a personal relationship that paid off for both of us.

I don't know. On the local level, probably each of you knows how to do it. I think that the local stations have to be encouraged to talk to the networks, more than they do. That, by the way, is a serious breakdown, particularly in news operations. The local stations think that their stories are local, but there is no such thing any longer as a "local issue." Everything is a national issue because everything is connected to some other national issue.

I would suggest specifically that certainly most of the organizations have adequate public information or public relations and conservation education people. You can write to me. It usually doesn't work, but this is because there are far more problems than there are hours of air time.

I don't mean to say that we don't have a responsibility to seek out these stories. We certainly do, and to the extent tha we can, we do it. It's really a very bad problem when such things as situations in which AEC or nuclear contractors have done things that have resulted in accidents and these go un-noticed. This redounds very much against us. We should know about things like that. We should have know about Santa Barbara before it happened—at least, that it might happen.

In 1947, I worked for a Chicago newspaper and we were competing incredibly with the St. Louis *Post Dispatch*. It was that powerful a paper that they almost owned down-state Illinois and they kept warning about a mine disaster that was going to occur in Centralia, and it did. And 111 people were killed. And the Chicago guys said, "Well, we couldn't have prevented it even if we had known it." Now, this attitude hasn't changed much, I am afraid—that is, you will find that too many of us, the guys in my business, say, "Gee, we can't cover everything" and we are going to miss a lot of stuff.

I am afraid that I am rambling and giving no information about how you can

get to us. But I would think that a general approach through news directors at the local level, with the suggestion—a very strong suggestion—that they please pass it along to their network sources, would probably be the best way to handle it.

MR. MADSON: I would like to ask Mr. Conley, if, in the last two or three years, you have had any indication of a pickup of circulation among people who are reading your magazine not for the sporting material, which is the traditional content, but to read *Field and Stream* for the sake of the conservation articles alone? In other words, non-sportsmen who are starting to go to the traditional sporting magazines for conservation.

MR. CONLEY: We have had a pickup particularly of young people in colleges. I notice from the letters I get, which is about the only sampling we have for people's interests. I think young people buy it for that, or read it in the libraries. However, we believe that conservation should be pitched at the people who are using the outdoors and, consequently, we are heavily after the sportsman.

The curious thing about outdoor sports and the people who participate in them, is that they are generally placid by nature and they don't want to get into battles. They don't want to be militant and we have tried more recently to get them to take a tougher stand; and so we pitch our conservation to these people. There are probably 40 to 50 million fishermen and 20 million hunters or more, and that's a lot of people. That's probably a fourth or a fifth of the United States.

One thing I would like to ask Mr. Northshield—Chad, I see a lot of shows on television that are not documentaries but entertainment, that are the fruition of Walt Disney and Bambi. You see things pitched at children that are outright fakery, as far as animals are concerned. They have a tendency to make animals into human beings. Do you feel that this is television's role; that entertainment for entertainment's sake justifies these things, or should we begin to take another look at portraying outdoors and wildlife and conservation as it really is? It's interesting enough without having to ham it up.

MR. NORTHSHIELD: I couldn't agree more. This may have been what happened with *Say Goodbye,* by the way, but each of you would be appalled to learn that if you told the guys responsible for those programs that they were nature faking, they wouldn't know what you were talking about. They think that scorpions do a square dance because they saw it years ago on Disney and Disney is an American institution and Disney, live or dead, doesn't lie!

I don't suppose they do it out of malice. They don't even do it for profit necessarily. They could make as much profit by dealing with truths. They just don't know what they are doing, for the most part. And so how you tell them what's right and what's true, is once again the terrible problem.

But it seems to me has a rational and relentless education campaign on the part of you people to us would be good and certainly very helpful. Some of these animal shows really bother me. They bother me a lot. I don't think they have to be that way. It's just as easy to make them the other way, and certainly just as cheap. But it's a kind of fun to be anthropomorphic and to think that ants are little people. I don't know, I guess the ants are entitled to equal time. Maybe you guys pressuring us will make us do something about it.

MR. CONLEY: In regard to *Say Goodbye* the president of the International Game, Fish and Conservation Commissioners, Chester Phelps, wrote to the president of NBC, Mr. Goodman, and I will just quote one thing that was really to the point. Mr. Phelps says, "In my view, manipulations such as this make no contribution to wildlife conservation. They do succeed in unfairly undermining public faith in federal and state wildlife officials and as the truth actually becomes available, as they eventually do, such would serve only to undermine the public's faith in television broadcasting. I believe the networks have a responsibility to the public as well as do network affiliates, to guard against occurences such as this."

I couldn't agree with him more. I asked one of the officials of Quaker Oats, very much involved in this, why it wasn't more accurate, why nature was so distorted. And he said "We had that checked and approved by people who know." And I

asked by whom. He replied, "The World Wildlife Fund and the curator of the Museum of Natural History of Los Angeles!" So there you are.

Obviously, lack of checking or lack of knowledge, led to this thing, even though Quaker Oats thought they were protected.

MR. DARRELL EAGLES (Director of Information, Department of Fisheries & Forestry, Canada): Earlier reference was made to the life styles. As Mr. Northshield said, "TV journalists must tell what is going on but they must explain that environmental problems are not simple; they must elucidate, predict, warn." Is this going to be enough to change life styles? Because surely, this is what it's coming to.

We can talk about the mechanics of medial liaison, but it seems to be when you come right down to the projections of resource use in North America, when you see what is happening to water resources, when you think about whether someone sees a program about hitting seals on the head or somebody blowing up a prairie dog with a .30-30 bullet—what has this got to do, really, with the basic question of life style and resource use?

Can we maintain or is it even desirable to maintain an atmosphere of crises? I was talking to a gentleman yesterday who had been in wildlife research for quite a while and he said, "Well, Darrell, the crises are going to come anyway, whether it's heavy metals in fish or whatever. The crises are going to come whether we like it or not." But I think any of us here who are concerned with public information or public relations, if we know some of the facts, are concerned with motivating people. I wonder if you could, as professional communicators, give us your opinion on whether, in the normal course of your work of informing people with documentaries or articles, you feel this is going to be enough to motivate people to, in time, change their life style or support legislation that changes, in part, the quality and the charcter of consumer goods?

MR. CONLEY: I think we fight two kinds of battles—talking about this show and perhaps mercury, and in this sort of thing, we are fighting an immediate battle.

I carry articles in the magazine to indicate what I believe, and that is that population control is the ultimate battle. Population puts demands on our resources. Population eats up our outdoor space. Certainly, life style has a lot to do with it, but I believe that if we could fix our population or at least hold it where it is, we would solve major problems right there. Certainly, we would go on using resources and, in some cases, using them up. The American public will not readily accept a lowering of its standard of living. I am not altruistic enough to believe that people will live with less of the nicer things of life or make the change voluntarily. I know some will, but very few, except in the area of population control. I believe we must gain ground there first. Then, we could begin to think about recycling—of course, we are doing that now—of more conscious use of our resources. Then we will be on the right track.

Finally, if we go downhill in total resources, a lower standard of living will come about naturally. It has to. But I believe in fighting the battle that is practical, and that is in population control, so that's where I am going to direct my efforts. That, and the immediate problem of not wasting everything before we get some understanding of what we are doing.

MR. NORTHFIELD: In answer to your basic question about what will people like us do—will that solve it? I must answer with a resounding 'Hell, no, of course, it won't." But that is the very least we can do and we must continue to warn. I think that we are finally all terribly involved, and all of us, or most everybody in the world, now is worrying and facing the fact that we are not exaggerating when we use words like "crisis."

What happens after that, I don't now. There are some things that we can look at in recent history, where sheer publicity has turned things around. American attitude—for better or worse about the Viet Nam war, has changed in the past couple of years, so that just about everybody, for a variety of reasons, is opposed to the war. There are those who want to "nuke the Chinks," and on the other hand, those who want to pull out right now; and everything in between. But

everybody is opposed, and that's because everybody is aware. Certainly, the racial crises of the 50's and 60's in the United States, while they didn't get solved, did get changed and get attended to, particularly at the legislative level, because of everyone's knowledged that they existed. That's where we are now in regard to the environment.

We are entering what I consider to be phase 2, which is telling everybody that it is complicated and expensive. I think, we are going to get to the point where we will be limited in the number of air conditioners we can have.

I approve completely, but it is unbelievable to me that the Congress of the United States has, in effect, said that by 1976, we can't have automobile engines like those we've always had. Now, I don't get excited that that will solve all the problems, but it is a recognition that there is a problem, which is a tremendous advance. These meetings probably were attended by one tenth this number of people thirty years ago; and that was all the people who cared. Now, everybody knows about it and an awful lot of them care. So we are on the right track. Whether we have enough time is for you experts to tell us. I gather we don't. At the rate we are moving, it's very nearly hopeless.

By the way, speaking of Canada and publicity, this morning on the *Today Show*, there were a couple of Canadians telling about a terrific new thing. They are going to open up the Mackenzie River to tourists !There was someone who owned a boat and the only Eskimo airplane pilot in Canada. And they went to some length to explain that it is not going to hurt anybody to stop at these communities of 60 and 65 people, because they will containers on the ship, and are not going to dump anything—not until the container gets filled up.

And it occurs to me that counter to all our concern, love, and our demand for wilderness, we are plunging into it all the time, in an uninformed, naive way. There is a terrible contradiction here.

Communal living is terrific on paper. I know a little something about this, because I have an 18-year-old son involved in it. He and his friends take a lot of junk into the Vermont woods and it doesn't come back to New York. I assume it's somewhere in Vermont. Now, they sought wilderness and they found wilderness and they got very turned on by wilderness and I think they are terrific. I also think they are litterbugs, in additon to my other problems. (Laughter and applause)

DR. DAVID HATTER (University of British Columbia): I would like to comment about Mr. Conley's relating life style and the lowered standard of living. You might call me a short-haired hippie, in some ways, but before my wife married me, she dreamed the typical American dream of a nice little house with a white picket fence and all the trimmings; and to show how the evolution of our wedded life has gone over the past six years, recently we traded our refrigerator for a pedal sewing machine. We don't have a refrigerator now and we both think that that was just a real great trade, because it was a good pedal machine.

We went from an oil stove to a wood stove and I think quite clearly my wife would agree with me that her standard and our standard of living—is happiness, and she certainly has a higher standard than we ever had before.

I do think any medium that is supported by advertising can't possibly make a credible attack on life styles. But we do need to think about life styles. It doesn't necessarily have to be communal. We don't need all the things that we use and I am certain that just by some of us living and communicating in our own ways, we can make this; but I don't think that the media can do it. Thank you.

MR. CONLEY: First of all, let me say that I envy you very much for putting into action what a lot of people believe. I got into this business because I wanted to be outdoors and I wanted to hunt and fish and do the things that I enjoyed doing as I grew up. And then by one step and another, I worked my way into New York, which is about as far removed from the outdoors as you can get.

I can't help but say that, in many ways, I regret it. I have had a good career in publishing, but I regret being away from the outdoors. About the only thing I can do is fight for it. It isn't true, however, that a magazine supported by advertising

cannot fight for anything that it thinks is right, as long as the management of the magazine is correct; and that is, that advertising does not necessarily influence editorials. I have practically no pressure from the advertising department or from the publisher, as to direction, particularly in this area. There are no conferences. I do more discussion with Mike Frome than I do with the publisher about conservation. He trusts my judgment and he knows that a magazine has to have a conscience, even though it has advertising.

MR. MADSON: We are coming right down to the wire. I would like to limit further questions and comments to the two gentlemen who are on the floor. Howard Gray, the chairman of the board of directors of the Outdoor Writers Association has asked, at the close, to make a statement that should be interesting.

MR. CHARLES PLATENCE: I work as a professor with young Americans in Oregon. I want to say that I am speaking for myself and not for the Oregon State System of Higher Education, because I am going to take issue with a point that came up yesterday. At the Conference at Baltimore many years ago, one of the first I ever attended, you wouldn't find people such as the young ones that are here, in their 20's, and raising very serious questions.

In this state, for about a year now, the young people of various colleges have voted on a proposition that would form a corporation which would investigate the environmental problems of Oregon and try to do something about them on their own. We counsel young people to work within the state, within the system, and what happened yesterday seems to be to be an unimaginative approach by the State Board of Higher Education and by the Chancellor of the State System. They are going to let the young people—28,400 students, by the way—sign a petition for taxing themselves so much a year to set up a corporation, hire researchers, to use persuasion, if it seemed necessary and at the last resort, to use legal action.

But the legal part was turned down, even though the Attorney General of Oregon ruled that the State Board of Higher Education had the discretionary power to approve the entire proposal of the Oregon Students Public Interest Research group. Since the State Board of Higher Education has no minority members and is composed almost entirely of corporation lawyers, lumbermen and people of this kind—entities are important in our society, but they don't represent all of Oregon—my question is, when we ask young people to work on problems such as environmental issues, within the system provided by America, why is it that the State Board of Education is unwilling to let them try the legal part?

MR. CONLEY: I don't know why, except that they may have felt that because these were state university students, they shouldn't be allowed to take resource problems to court. This group was inspired, as I recall, by Ralph Nader and requires a dollar a year from each member. They will hire research people to look into public-interest problems and, I suspect, mostly environmental problems.

But I can't see why the State didn't want them to get into legal matters except that the State might be unwillingly dragged into a case because of the universities being part of the State. That is only my guess.

MR. HARRY HAMPTON (Treasurer, Wildlife Management Institute, New York): I have a bit of information that Mr. Northshield may intentionally not have wished to give, but I can do it as I have a personal relationship with one of his bosses. You can put the grease to the wheel that squeaks by writing to Mr. Julian Goodman, the president of NBC, at the National Broadcasting Company, Rockefeller Plaza, New York 10020. If you think he is going to be short-stopped by a dozen vice presidents, you can reach him at Greystone Road, Larchmont, New York.

And Julian Goodman—I see him frequently as he is a neighbor of mine—is sensitive to these things. If you felt that what Mr. Northshield did in *Man's Thumb on Nature's Balance* was good, and I think you have already expressed yourself to Mr. Northshield in this regard, then tell Mr. Goodman. You can also jump him, if you would like, about *Say Goodbye*; he would like to hear of that. But remember, please, the initials NBC—non-argumentative, brief, courteous.

CHAIRMAN HALAZON: I would like to thank our speakers and our panel and especially the audience for participating.

After Mr. Gray reads his statement, we will be dismissed immediately.

MR. HOWARD GRAY (Outdoor Writers Association of America): Thank you, George, Bob. If I am ever unfortunate enough to be on the some program as you, I hope the hell I precede you and not follow you. (Laughter)

In regard to OWAA's standing on the controversial film, *Say Goodbye*, we all know it was extremely unfortunate, but I cannot help but believe that this may be a blessing in disguise. But unfortunately, we had two or three members who have by-lines in it. As you know, this film was made up of a tremendous amount of film footage supplied by individual photographers. And I know two of our members are cringing now, because their names were shown at the end of the film. And I am sure that a lot of people will look at it and say, "So you had something to do with *Say Goodbye?*" This is extremely unfortunate.

In spite of all the criticism that was forwarded to NBC, to Quaker Oats, and to the producer, three or four days ago, a news release appeared saying that the producer was up for an Oscar on *Say Goodbye*.

This not only made me mad, but it was an insult. However, the TV editor in Seattle mentioned that he hardly thought he would get it because he was in the documentary class, he was up against strong competition. I believe that we have a tremendous amount of integrity in OWAA. As you know, we have the entire spectrum of the outdoors, and probably 100 producers of outdoor movies. We have more who have syndicated radio or television columns; and will assure you that if Wolper had been a member of OWAA, he would have been asked to resign within 24 hours.

But I do believe that it is good that this happened. We have not heard the last of it, because OWAA is compiling all of the facts and is going to take some official action. So with that, it was nice to be here, and thank you very much, George.

CHAIRMAN HALAZON: Thank you, and the session is dismissed.

PART III

CLOSING GENERAL SESSION

GENERAL SESSION

Wednesday Afternoon—March 10

Chairman: CORNELIUS H. SIEMENS
President, Humboldt State College, Arcata, California

Vice Chairman: WILFRED R. WOODS
Editor and Publisher, Wenatchee *Daily World,* Wenatchee, Washington

NATIONAL WELL-BEING DEMANDS SOLUTIONS

REMARKS OF THE CHAIRMAN

CORNELIUS H. SIEMENS

Welcome to our afternoon session.

The first item on our program for the general session is a presentation of the B. Y. Morrison Memorial Award. Dr. G. W. Irving, Jr., Administrator, Agricultural Research Service, USDA, Washington, D.C., will present the award.

Let me say that Dr. Irving is a native of Minnesota and holds degrees in chemistry and biochemistry from George Washington University, Washington, D.C.

Dr. Irving has been with the USDA for most of his professional career. He has written many articles and received many awards, including the Distinguished Service Award of the USDA, which is the highest honor the USDA can bestow upon anybody.

He is a Past President of the Washington Academy of Sciences. Therefore, without further ado, I would like to present to you Dr. Irving.

PRESENTATION OF THE B. Y. MORRISON MEMORIAL AWARD

G. W. IRVING, JR.

Administrator, Agricultural Research Service, U. S. D. A., Washington, D. C.

It is a pleasure to join with you in your 36th North American Wildlife and Natural Resources Conference. To some, maybe to most of you, the name "Agricultural Research Service, USDA" conjures up notions of pesticides and things generally considered adverse to the environment. However, I would like to emphasize that so much of the work of the Agricultural Research Service deals with the protection and restoration of all that is good in man's physical environment. We do sincerely feel a deep kinship with you as you confer here today.

We are grateful to the Wildlife Management Institute for cosponsoring the B.Y. Morrison Memorial Lecture and to the Conference for providing such an outstanding audience.

Mrs. Lyndon B. Johnson received the first Morrison Award in 1968 here in Portland. We in the Agricultural Research Service established this lectureship to recognize outstanding accomplishments in the science and practice of ornamental horticulture and other environmental sciences; to encourage their wider application; to improve the quality of living; and to stress the urgency of preserving and enhancing natural beauty in man's surroundings.

Nominations for the lectureship are provided by former lecturers and by officials of distinguished organizations concerned with many of the environmental sciences and professions.

The B. Y. Morrison Memorial Lectureship was named for a noted plant breeder, administrator, landscape architect, author and lecturer. He was the first director of the National Arboretum at Washington, one of the world's greatest centers for research and education on trees and shrubs.

Our Morrison lecturer today, Ian McHarg, was born in Scotland. He holds Master's Degrees in landscape architecture and in city planning from Harvard University and honorary doctorates from Amherst and Lewis and Clark College.

Mr. McHarg is the founder and chairman of the graduate department of landscape architecture and regional planning at the University of Pennsylvania at Philadelphia.

He is also a partner in a Philadelphia firm of architects—landscape architects and planners—whose ecological approach is evident in the studies of regional areas in many states. As a teacher, practicing

landscape architect, planner, writer and lecturer, Mr. McHarg is in the vanguard of ecological planning in this country and abroad.

For example, he has been invited to share his methods and convictions with educators and planners in Australia and Japan later this spring.

Many honors have come his way. He is an extensive writer and is widely known for his television programs concerning man and his environment.

The title of his lecture is "Man—Planetary Disease."

However, before he speaks, I would like to present him a bronze commemorative medal which the Agricultural Research Service has created especially for this occasion and we hope, Mr. McHarg, that this small memento will be a pleasant reminder for you of this occasion.

MAN: PLANETARY DISEASE

1971 B. Y. Morrison Memorial Lecture

IAN L. MCHARG

Chairman, Department of Landscape Architecture and Regional Planning, University of Pennsylvania, Philadelphia

My propositions are simple.

You have no assurance of a future.

The views of man and nature which permeate the entire western culture are the reason.

Our view of man and nature does not correspond to reality, has no survival value—indeed, it is the best guarantee of the extinction of man.

Man is an epidemic, multiplying at a super-exponential rate, destroying the environment upon which he depends, and threatening his own extinction.

He treats the world as a storehouse existing for his delectation; he plunders, rapes, poisons, and kills this living system, the biosphere, in ignorance of its workings and its fundamental value.

Survival of man is contingent upon categorical rejection of this cultural inferiority complex that is the western view, and its replacement with the ecological view—man in nature. This reveals the ways of the working world and shows our ignorant interventions as self-mutilation, leading to suicide, genocide, biocide.

IS MAN BUT A PLANETARY DISEASE?

The first story I tell is of an image conceived by Loren Eiseley, who is a great cultural anthropologist at the University of Pennsylvania—a large, wise, round, magnificent man who wrote *Darwin's Century, The Immense Journey*. Seven or 8 years ago he conceived that a man in space might be able to look from that distant vantage at the earth, and this hypothetical man saw the earth—this small rotating orb, our home—and he perceived that the earth was green: green from the maritime algae of the oceans, green from the verdure of the land. He perceived that the earth was indeed a green celestial fruit, this green epidermis encircling the globe, this interacting biosphere which encompasses all life. He looked more closely and saw a number of blemishes, brown, black, and gray; and from these extended dynamic tentacles. And he realized that the pathological tissue in the world's life-epidermis was indeed the works and cities of Man; and he asked, "Is Man but a planetary disease?"

I think the answer to that is that some men are, and some men are not; and it is important to look deeply into our hearts and into our institutions, to decide who is and who is not.

The real battle in the world is not between communists and capitalists, black and white, rich and poor, green and purple, heliotrope or gamboge. The real fundamental division in the world is between these people who are not planetary diseases and those who are—necrotic pathological tissue walking around pretending to be men. They are pathogens, no matter whether or not they get up in the morning and wash and shave, put deodorant under their arms, and kiss their wives before going to their work. They are by their acts those agents who are threatening our very survival and making impossible any prospect of fulfillment. There are people who are planetary diseases, and we've got to decide who are and who are not.

It is important to recognize that we are engaged in a war, and this war is much more important than any ostensible war or any ridiculous kabuki dances of violence which are represented as wars to us. These are not wars—these are irrelevancies. The only real war is with these people who, by their acts, have been inflicting lesions upon the world life body by producing a rain of death, by inhibiting this green, gorgeous biosphere, this culmination of 6 billion years of time and 2½ billion years of life, threatening the possibility of our survival and inhibiting any possibility of our fulfillment.

We are not interested in protecting birds or bees or flowers—we are concerned with the survival of Man. Conservation has got nothing to do with cardinals or azaleas—it has to do with survival. This is a

battleground! Think then, upon those people who have inflicted lesions upon the world life body—they have laid about with cudgels and with gouges and with axes, they have decimated life and extirpated great realms of life, have inflicted enormous wounds upon this continuous green epidermis. That is their work, their act, and this is their view of themselves and their accomplishments. These are, by definition, planetary diseases.

If there were such a thing as a planetary doctor who could look upon the earth and see that there was one creature who was multiplying at an exponential rate and who was not only extirpating great realms of life upon which it was dependent, but was inhibiting its own chances of survival, he would say, "There is a planetary plague, an epidemic." Man and the acts of man would be seen as impinging upon this world life body, rather like an epidemic of so-called locusts—except that these insects may have a 17-year cycle, whereas man has no cyclicity; his depredations are absolutely continuous and are accelerating.

PLANETARY DISEASES INSTITUTIONALIZED

Some of the things I say may not be palatable, but I do not say them to please you, only to share my obsession with you. It is important to recognize that there are a lot of planetary diseases that have been institutionalized, that we have made instruments which are competent only in destruction and whose only works are destruction. In my view, the military is almost entirely a planetary disease from top to bottom. Certainly the creators of napalm, defoliation, ICBM's, biochemical warfare—all these people are in fact not men, they are absolute pathogens, worse than any kind of plague you can imagine. The bubonic plague is a mere dandruff in comparison!

These people you cannot treat as though they were human beings—their wives should have nothing to do with them. They can't be allowed to represent themselves as people and be recognized by friends because they are in fact planetary diseases and agents of destruction and retrogression. It's as if the whole of evolution is working toward one objective, and these putrescent things are in fact retarding it.

We must recognize that there are institutions that have encapsulated planetary diseases—much of the military, all of these horrifying people who are concerned with biological warfare. . . . Can you imagine a man coming home at night and saying to his wife, "Darling, I have just invented a new anthrax which can eliminate every bovine animal in the world instantaneously," and his wife embraces him and says, "Oh, darling, what does it mean for us?" And he says, "Well, I

get $10,500 now, and I'm going to get $11,300 and an extra day's vacation—why don't you buy yourself a dress?" . . .

These people must be identified as putrescent, loathsome, almost beyond salvation.

And then one makes one's way down to the major industrial corporations who so cynically void their excrement into our environment, air and water—these great, noble corporations whose products are household words, but who have not been toilet trained! They are filthy! What do we say to children who dump their excrement in public places? Why should we say anything different to these great corporations?

I went on the Mike Douglas Show once, and at the end, Mike Douglas asked for questions from the audience, and some lady said, "What do we do about pollution, Mr. McHarg?" I said, "Well, the first thing to do is to identify these people who are filthy . . . Call them up, all these dirty polluters, whose excrement you can see, tell them they are dirty, filthy, and should be toilet trained."

You cannot allow business as usual to proceed, because there is a planetary disease at work. That planetary disease can be identified. It must be stopped if we are to survive. Survival is the first quest, and these people are hell-bent on insuring our extinction. Now, why should we have produced a culture in which this kind of thing seems so inevitable? Why should so many people believe it is their God-given role?

"NEXT TIME, NO BRAINS"

I have a nightmare about this. Some unknown, white-coated, miserable, sepulchral warrior decides that the resolution of some temporary human squabble must be done by a great hail of atomic weapons across the world. We don't know who this man is or what the circumstances are, but this arrogant, witless man is prepared to sacrifice 2½ billion years of evolution, and 1 million years of human evolution, 10,000 years of human cultural evolution, to resolve some temporary, irrelevant human squabble—and in my nightmare, he does. So there is a rain of death and all life is extirpated—except that there persists a small colony of algae, these tiny unicellular plants, the origins of us all. And these algae perceive that all life is extirpated save they, and that 2½ billion years of evolution must ensue in order to recover only yesterday. They come to the immediate, spontaneous conclusion, "Next time, *no brains!*"

Brains are a recent phenomenon; brains justify the view of man that everything from the neck up is all right because that's where the brain lives, and that everything from the neck down is scented,

smelly, glandular, and basically sinful. The job of the brain is to stabilize the sinful proclivities of the area below the neck. The conception of this dichotomy is an illusion, but it is very deep in our culture. It is an illusion that is important because it motivates our attitude towards nature, because we have taken this same dichotomy and extended it to the relation between man and nature. We have said that man is brain and the area below is nature. We assume that brain will conquer the carnal man, and man-brain will conquer carnal nature. Thus the despoliation by man—which is really his only work—becomes comprehensible.

THE WESTERN VIEW OF MAN AS DIVINE AND DOMINANT

If any of you has the slightest kind of theological bent, what you say in passing is that the basic attitude of man and nature is explicit in Genesis, central to Judaism, absorbed and changed into Christianity. It says in the first chapter of Genesis that man is exclusively divine—which means that everything else is rubbish—man is made in the image of God. Man has pre-empted the image of God. The second line says man is given dominion over life and nonlife. Dominion is not a negotiating term. You cannot love anything, as St. Francis did, and have dominion over it. Dominion means that the other thing lies down before you. If there is any doubt about the relation of man and nature, the third line clinches it when it says, "Man is licensed to subjugate the earth."

If you want to understand the Western view of man and nature, in the Judaic-Christian-humanist tradition, all you have to know is these three lines: Man is exclusively divine and everything else is rubbish; Man is given dominion over life and nonlife; and Man is enjoined to subdue the earth. Understanding that text, look retrospectively back to the despoliation of all the land which has been accomplished by man, particularly Western man, and you will recognize that the men who believe this to be so can only accomplish destruction.

I say—with better men than I . . . Paul Tillich representing Protestantism, Gustav Weigel speaking for Catholicism, Abram Heschel speaking for Judaism—that this is an allegory, that it must never be accepted as literally true. It not only has no survival value, but it is absolutely the best guarantee of extinction. If you want to find a moral text to motivate that man who will press the button and produce a hail of atomic weapons which will extirpate all men and all life, that is that text . . . He is forever forbidden any possibility of any creative role.

I have spent 10 years talking to the best theologians on this subject. This is not an anti-Jewish, anti-Christian, anti-Catholic, anti-

Protestant view. My view has been espoused by every important theologian I know—Martin Buber, Schweitzer, Karl Barth, the lot.

This is, of course, not a literal text. We have absorbed through our mothers' milk, in kindergarten tales, in fairy stories, books, and magazines, that the world exists for human delectation; the world is a pyramid erected to support man at its pinnacle; reality exists only because man can perceive it; the world is a stage to allow the human drama to be played; the world is a storehouse for our delectation, and we in fact have dominion, we are exclusively divine, and we shall subjugate it. It is an absolutely horrifying text, and it is important to recognize that it has no survival value, but that if many people believe this, we cannot survive. It simply doesn't correspond to reality in any way; it is not a working text. It absolutely has extinction value.

THE WORLD, A SINGLE INTERACTING BIOSPHERE

We have got to put it together again; there has got to be a better view. This view that we have absorbed with our mothers' milk is absolutely calamitous and in every single way is wrong. There is no bit of information reposing in any of the sciences that is in conformity with this view of man. This conception has only one verb in the relation of man to nature, and that is "conquer." That is why it is no surprise that we talk about conquering the West, conquering the land, conquering the seas, conquering Mount Everest. It is always "conquest," and this is our only possible role as long as we have this view. We have got to junk it because there is no place for conquest.

If you think of the world as a single interacting biosphere which includes not only ourselves but all of our antecedents, by virtue of living you see you are united to all life. Not metaphorically—really—you only got a little bit of life from your father and your mother, and they only got a little life from their father and mother, and back we go to pre-*Homo sapiens* and then to *Australopithecus* and then to our primate precursors, back through this great evolutionary table—life given only by life, all life connected to all life, until finally you are right back to this primeval organism wherever it was. So this other life is not something else, it is an extension of ourselves. All things that live come from the same origin. We are united by all forms of life, so the conception of our being apart from it is an illusion—there is no apartness, it is all one thing, all derived from common origins.

Not only is all life descended from a common source, but all life is descended from matter. As all matter is descended from the original hydrogen, we are then united to the original hydrogen. This is even more hair-raising when you consider that in the original atom

somewhere in the universe was the possibility of the evolution of all matter and all life—this was intrinsic in that first atom of hydrogen. The unity of all life is a most important proposition—all life is unified by virtue of the transmission of life by life, which is the only way it can be transmitted—so, to destroy something else is self-mutilation. There is no other conception except one biosphere on which the destruction of any part is self-mutilation. It is us, we are it, it is one thing, we are unity.

"THAT'S THE WAY THE WORLD WORKS!"

What is the view that can begin to put this thing together? For me, the beginning of putting it together started about 7 or 8 years ago when I was employed by Glenn L. Martin. I met a scientist who was trying to send a man to the moon with the least possible luggage. This man's experiment consisted of a plywood "capsule" in the lid of which was a fluorescent tube simulating sunlight; but electricity is only fossil sunlight, so it's not a very distant simulation. Inside this was some air, some water, algae living in the water, and a man. In the water there were some bacteria as well. The system works as follows. The man breathes some air, he consumes oxygen, and breathes out carbon dioxide. The algae breathe in carbon dioxide and breathe out oxygen, which the man breathes. So there is a closed cycle of oxygen-carbon dioxide.

The man gets thirsty, he drinks some water. He urinates, the urine goes into the water solution in which the algae live. The algae transpire, the transpirations are collected; the man drinks the condensation. So there is a closed cycle of water. The man gets hungry, he eats some algae; he defecates. The excrement goes into the water solution in which the bacteria and algae live. The bacteria break down the excrement into nutrients which are consumed by the algae, which grow, which the man eats. In this experiment, then, there is only one input, which is sunlight; there is only one output, which is heat. There is a closed cycle of oxygen and carbon dioxide, of water, of food. And the question is, "Is that the way the world works?"

And the answer is, "YOU'RE DAMN RIGHT, THAT'S THE WAY THE WORLD WORKS." And everybody who knows this is the way the world works knows enough to insure survival. Anybody who doesn't know this is the way the world works—no matter what he knows—knows *nothing*!

So planetary diseases are people who either do not know this or, while knowing it, act contrary to it. Those people who are husbandmen, in the Biblical sense, or stewards, and who believe that there is a deferential, creative role for man, know it, whether they have been in

the capsule metaphorically or intellectually. They understand it intuitively. Man is a plant parasite; there is no other thing for him to be. The plants don't need him, but they can use his waste, so man is a plant parasite.

FIREWORKS AT CANAVERAL—ECOLOGY ENCAPSULATED

I would love to use that experiment for all sorts of purposes. One would be to get all the putrescent men, all the pathological tissue men, all the arch-destroyer men, and make thousands of these capsules, each with water and algae and bacteria equal in biomass to the man. Get all of these people into these capsules and have what I'd call Fireworks at Canaveral—we take all the arch-destroyers, each one in his rocket capsule, and send them off on great, long, helical, indeterminate trips into space! Off they go, and the marvel about this is to get rid of them from earth. If the earth knew it, it would say, "Oh, what a relief! These arch-destroyers are gone, the chance of survival will be extended; they can accomplish no destruction while they are in space."

I would not feel badly if we lost any of them. This is a real war, you see—we're not kidding around, we're not protecting dogwood, we're talking about survival!

Just imagine each of these arrogant, witless men in his little capsule. We'll assume that after 3 or 4 weeks in a dark, empty space, one of them would say to the algae, "I'm divine, you know, I have dominion over you, I am licensed to subjugate you." The little alga continues to perform its work, and this plant parasite's atrophied brain begins to work. He realizes that, given enough time, in the recirculating system all that had been the algae would be man, everything that had been man would be algae, and at a certain point there would be a total exchange. If he had any theological turn of mind, this man would realize that a halo on the algae was no more or less ridiculous than the halo on the man—if there is any divinity, the divinity is pervasive. It would cross his calcified mind that there is no place for dominion in this, that here was interdependence to a degree which exceeds the dreams of marriage, that the algae were closer to that man than wife or child could ever be.

I would extend from this mind that what was true in the capsule was true in the world at large, and there would be some other lessons. Man would realize that into the capsule he could not introduce any radioactivity—the radioactivity would cause a mutation, and mutation was the last thing that he wanted. His survival was contingent on there not being a mutation; but that is true in the world at large—any increase in radioactivity increases the amount of muta-

tions, and most mutations are deleterious. Who wants deformities? Who wants leukemia?

And he would also understand that in that capsule he couldn't tolerate any DDT or any poison at all because this is a recirculating system and that stuff was going to get into his fatty tissue right fast. He would realize that this is true in the world, too—you can't sweep death under the carpet. He would understand that you can't lose any of the nutrients in the system—you can't blow away 10 percent of the topsoil into the river every year forever.

And so through his calcified, witless mind would enter these primitive lessons which ancient people knew, and we in our high civilization don't know, and he would begin to learn. And at Houston they would be listening to all these destroyers whistling about in space, listening for their conversion. The conversion would take many forms, but it would have these components.

The first would be that the man would address the world in some deferential, understanding way. He would say to matter—to all the elements, "Matter, of this are the universe, the world, and life made." And he would address the ocean and say, "Ancient home!" He would address the sun and say, "Shine, that we may live." And he would address the clouds and rain and sea, "Nourish us from the sea—we erstwhile sea creatures who have escaped from the ancient sea by only the length of a cell." He would address all plants and say, "Plants, live, grow, breathe that we may breathe, eat, and live." And he would address the atmosphere, this sum of ancient breaths—that's what the atmosphere is made of, the exhalations of plants over 2½ million years of life—and say, "Nourish and sustain us." He would talk to these little micro-organisms that are in the mud and in the soil and in life, and say, "Decomposers, reconstitute the wastes of life in life; reconstitute the substance of life after death in order that life can endure."

And when he had said these things with understanding, we would say to him, "Come on home! Enter into the warming spiraling arms of the earth's gravity, enter this green celestial sphere that is our home, the home of our origins and that place where we will accomplish our destiny. Exercise now your creative will, because you have learned that deference born of understanding."

EVOLUTION A CREATIVE PROCESS, INDEPENDENT OF MAN

I can't now recount to you the model of the operation of the biophysical universe which reposes in the natural sciences, but there are one or two things I'd like to say about it. Nobody writes about it, you see, because this understanding exists only in a few ecologists,

probably 200 in the United States. Two hundred million people who don't know enough to insure our survival, and probably only about 200 ecologists who know that which everybody should know!

The first proposition in the biophysical scientist's model of the world is that the world—that is, all matter and all life processes—is creative and has been since the beginning. Creativity has nothing to do with man.

There is something called creativity, and it isn't metaphorical—it is absolutely literal. That is, the evolution of matter from the primeval hydrogen, helium, lithium—every step in the table of the elements—was a creative act involving enormous quantities of energy. For instance, to get the heaviest elements required the explosion of a supernova—to drive these elements up the periodic table, to get those heavy elements which are indispensable for evolution and essential for life. Every step in the evolution of compounds was a creative act.

The most important single creative act in all of evolution, I think, was the evolution of the plant. We are now talking about basic creativity—what the world has been doing since the beginning of the world. This means that matter and energy have been employed to raise matter and energy to higher levels of order. This has been directional, or at least it seems to be so as we look back over 6 billion years of time. So the world has been a creative process since the outset, engaging all matter and all life. And the plant is a particularly marvelous point in this evolution of creativity.

Think of a time when all of the sunlight that fell upon the earth equalled the heat that the earth lost. That went on until the advent of the plant. And the evolution of the plant appeared with this marvelous gift of photosynthesis. The plant, then, in the presence of carbon dioxide and water, can take sunlight and transmute it into "stuff," into glucose. So here we have a little dialogue between the plant and the sun.

The plant says, "Sun, do you mind if I have some of your energy?" The sun says, "Sure, but you know the second law of thermodynamics—you've got to give it back." And the plant says, "I don't mind, you can have it back after I have used it." So in the presence of carbon dioxide and water, the plant held its little ol' protoplast up to the sun, transmuted the sunlight into the essential stuff of the cell, kept losing energy (as you are and I am now); but the energy is always replaced. Meanwhile the cells are replicating, the plant is evolving—shifting sidewards—more and more and more plants encapsulating more and more sunlight into themselves, altering and evolving in this marvelous way . . . all of this creativity, all of the evolution of all organisms in all time is based upon the capacity of the

chloroplast in the plant to temporarily entrap sunlight in its path to degradation. That is absolute, rockbottom, fundamental creativity, without which there can be nothing.

So any time you see a plant——I don't care whether or not you think it is beautiful—just know that this is engaged in the most profound creativity in the world, without which there would be no world; that all life is dependent upon the plant, all the orbiting which is accomplished by all life in all time is dependent upon the capacity of the plant to temporarily transmute and encapsulate sunlight into its being—only temporarily, because the energy will be lost. But the energy is replaced—meanwhile, more of this energy is encapsulated into this evolving thing.

This is one of the most fundamental things in the whole world. To see that in over 2½ billion years of life in plants they have been evolving, encapsulating more material, raising it to higher levels of order—this is creativity. So the conception of the world as being engaged in a creative process, independent of man, is a terribly important proposition. The world is engaged in some yearning and fulfillment—to which man must subscribe, there must be a role for man—but it's proceeding independent of him. It did without him for 2½ billion years, and it can proceed without him. If he extirpates man, evolution will move back to that last step that remains, and the process will proceed again, presumably without brains.

But there must then be a creative role for man, and that we have not found. In thermodynamic terms, we have only and always, in the Western tradition, been destructive. We have not yet found a human creative role. We have behaved like vandals despoiling a storehouse, on this great continent of North America—this great storehouse 6 billion years in the making, the best that nature could do with 2½ billion years and the whole genetic pool, and these witless men, knowing nothing, came over to it and treated it like vandals raiding a storehouse, like drunken sailors on a spree, destroying all these resources, blowing them up the chimney.

The conception of the world as a creative process, I think, is a terribly important one. There's lots more to this thing, and if you want to read it and can get through my turgid prose, read my book, *Design with Nature.*

APPERCEPTION, MAN'S CLAIM TO A CREATIVE ROLE

There are one or two more points which are also terribly important. One is, there can be no creativity in organisms or in man without an understanding, and for man the important understanding is the way the world works, the knowledge of the capsule, and more.

If the sunlight falls upon me and also upon a stone beside me, the sunlight (which is just energy, whether it hits me or the stone) that falls upon the rock heats the rock and the rock expands. The energy that falls upon me may or may not cause me to expand, too; but I see the sunlight not only as energy but as information. The sunlight tells me I am getting warm, and I then take off my tie, take off my jacket, look for a beer, and want to go for a swim. What has happened is not that the energy has changed, whether it falls upon me or upon the rock; but I have transmuted it from energy into information, from information into meaning. Presumably, the rock is not able to do that.

Now, that is apperception. That is the capacity of an organism whether it is a subcellular process, an organism, or an ecosystem—to transmute energy into information and thence into meaning. And this is man's claim to a creative role—his capacity, his marvelous apperceptive device, his capacity to perceive the world and to reconstitute it into information and thence to meaning. So that is his opportunity to become the husbandman, the steward of the biosphere, helping to manage this work—which is contingent upon the development of his apperception. That is, he's got to know the way the world works, and we have just observed that his view of the way the world works is a fallacy, an illusion, and has no survival value whatsoever.

SYMBIOSIS, SPECIALIZATION, AND THE GOLDEN RULE

There is one other thing which has a tremendous moral implication. Creativity depends probably most of all on something scientists call symbiosis. Symbiosis simply means a cooperative process—if you do this for me, I'll do that for you. Now, each of us is an integrated human organism, more or less. We consist of 30 billion billion cells. These are replicated at the rate of about 10 billion cells a day. All of them come from a single fertilized egg. That egg begins to divide, and the earliest divisions are unspecialized cells that are almost indistinguishable from our ancient ancestors, those little unicellular animals that swam in the ocean. So our replication from a single cell to a whole organism with 30 billion billion cells is really a mirror of all evolution.

Now think of what happens—the first cell is an unspecialized cell, almost identical to those ancestors of ours which are now, 2½ billion years later, swimming in ancient seas—protozoa. As the cells evolve, they assume specialist roles—white blood cells, red blood cells, tissues, organs, and then a whole organism.

Remember that every time there is a specialization in a cell, it is conceding some part of its immortality—because the original ancestors were immortal. The edge of life moves, but the thing is immortal.

But, when it's in us and changing from an unspecialized to a specialized cell, it is conceding some part of its immortality, some part of its freedom, its autonomy, toward a cooperative arrangement in which it says, "I'll be a tissue," "I'll be a pancreas if you'll be a heart." Every one of these specializations involves a concession of autonomy, of immortality, of freedom, toward a cooperative enterprise which is the integrated organism or process—subcellular, tissue, organ, organism, or an organism in an ecosystem.

In every case the thing we are considering concedes some part of its immortality (That's a theological term!) toward the end of a cooperative mechanism that is believed to have survival or fulfillment value. And that is altruism. Altruism is something that philosophers and theologians are supposed to talk about. That's what the Golden Rule is. It's important to recognize that the Golden Rule is fundamental to life. It exists as subcellular processes, and it's at least 2½ billion years old. The whole operation of the working world and the whole of creativity in the working world depend on this symbiosis. Because the cooperative mechanism is essential for the plant to accomplish its creativity in photosynthesis. This cooperation is necessary for the apperception that exists in the plant and all other organisms. So, altruism and the Golden Rule are fundamental to life and fundamental to survival and fundamental to creation. And this, of course, is antithetical to the concepts of dominion, subjugation, and exclusive divinity.

Can you conceive of any division within yourself in which some cells are divine and some cells are not divine? That some cells have dominion over others? That some cells have any possibility of subjugation? None. And so, you simply have to observe the conception of the cells within the organ, the organs within the organism, the organisms in the ecosystem, the ecosystems in the biosphere—and you learn that all life is engaged in a cooperative venture, which has been shared from the beginning and which is a common yearning now, and which is the basis for some kind of future.

Now, this is a metaphysical view to which we must subscribe, because this seems to be the way of the world and the yearning of the world.

CONSCIOUSNESS DOESN'T MEAN WE HAVE TO BE A PLANETARY DISEASE

We now believe that creativity is real and true, that the world is a creative process engaging all physical matter, all life systems, and that it has been so since the beginning. The world is a great yearning, as if everything had closed its eyes and was dreaming of some

unfulfillable process which has taken many courses—in atoms, in compounds, in unicellular organisms, in multicelled organisms, and in all creatures in all times. It is a creative process, and we must find within this our creative role. Just because we walk erect, have binocular vision and opposing thumbs, and have consciousness doesn't mean that we have to be a planetary disease.

I think perhaps people in the East, or simple primitive people who behave as if unconscious, like Pueblo Indians—the great people who occupied *this* land for 10,000 years and left it as good as they found it (Who could say that today?)—only simple people were able to act creatively in the biosphere. When consciousness and sophistication intervened, then came destruction. But Oriental people and primitive people have not been so destructive—only Western, Judaic, Christian, humanist Man!

This creative study has some other attributes which are worth perceiving. The creativity consists of employing matter and energy to raise matter and energy to higher levels. An example: Let's consider a beautiful forest with plants and animals and micro-organisms. Now, if we ask a chemist to inventory the forest, he'll identify it as 99 percent-plus of organisms consisting of hydrogen, nitrogen, carbon, and oxygen, with 1 percent consisting of micronutrients and macronutrients. That's all it is, you see.

But then we have a forest fire. The chemist goes in there again and identifies all the stuff that's left, and we've got an inventory of the same oxygen, hydrogen, carbon, and nitrogen. In the fire we've lost some carbon dioxide and some water—that's all. But, we say, "Gee, that's not what it looked like!" The chemist says, "It's the same stuff, but over evolutionary time it had been raised to higher levels of order."

It takes work and energy to go from algae to fungi to liverworts to mosses to ferns—every step requires energy in a cooperative mechanism. The alga says to the fungus, "Look, fungus, you depend on me." And the fungus says, "That's right." The alga says, "You seem to be pretty good at anchoring, and I could do with some anchoring." The fungus says, "All right, I'll feed on you and you anchor on me." So, the alga and the fungus unite and become a lichen. That takes energy, work, and apperception over long periods of time.

So, the forest consists of the same matter as remains after a forest fire, but it has been raised to higher levels of order. Evolution has accomplished this, taking the same stuff which has been around the world since the beginning—the only thing that has been added is sunlight—and has raised it to higher and higher levels.

"SIMPLE TO COMPLEX," THE TEST OF PROGRESS

We know that this process is a movement, not only engaging basic creativity, apperception, and symbiosis, but having a movement. It has always gone from greater to lesser randomness. To begin with, the universe was just a mess of rubbish. Later some observer would have said, "Look, this rubbish seems to be coalescing." And, a little later, "I think some of this planetary rubbish has coalesced enough to give it a name. Let's call it Earth!" So, it moved from greater to lesser randomness; it started off as random gases which became less random and became air.

All of the movements—whether of atoms or compounds or organisms—moved from greater to lesser randomness. They have also moved from simple to complex, uniform to diverse, unstable to stable, low to higher number of species, low to high number of cooperative mechanisms. That is the way the world works, and these are the attributes of creativity.

If you find any institution which is going from complex to simple, it's going backwards, it's uncreative. If you see engineers moving into a complex, natural environment and building a dam, it's reversing and going from complex to simple, going backwards. If you see a great settled area in which there is an enormous diversity of people living symbiotically and in some sort of harmony—and all this is eliminated in the name of urban renewal and up come "suitcase architecture" and uniform WASP-rich—this in fact is retrogressing, going backwards from complex to simple!

This is a marvelous model which you can use to examine any kind of system at any level at all.

FITNESS AND SURVIVAL, EVOLUTIONARY THEORY

There are two terms which have enormous utility and are not used much in the English language, but should be. The critical word is something called "fitness," and it has two meanings derived from two different men. One is Charles Darwin. Darwin said, "The surviving organism is fit for the environment"; that is, only the fit organism survives, the nonfit species does not. The center of the whole evolutionary theory is that the surviving organism is fit for the environment.

Another man named Lawrence J. Henderson had another, more important proposition. Henderson said, "The real world with all its environmental variability is the fittest possible abode for life —for every form of life that has existed, does exist, or will exist."

So, if you put the two of them together, you find there is such a

thing as the most fit environment for every organism, for every human being, every family, every institution, every bird, every plant, every micro-organism. The organism that is fit for the environment survives, the organism that isn't fit, doesn't. That's what it's all about!

Survival is the first test. If you survive today, you can survive tomorrow, and you might even argue about the next day. If you don't survive today, no argument about tomorrow! That's what nature is all about—survival and fulfillment. There's no fulfillment without survival, so let's argue about survival now and we might stay around to talk about fulfillment later.

Fitness! There's the conception of the most fit environment and the conception of the surviving organisms fitting the environment. We know that in evolution there is a tendency for every organism to try to find the fittest environment, and the necessity to adapt that environment. Environment changes, you see, all the time. The environment, remember, includes not only you, but all other organisms and physical processes, too. They are changing, the environment is changing, and so you have got to change.

So, there is a requirement, not only to find the fittest environment, but also to adapt the environment and to adapt yourself in order to accomplish a "fitting." And, if you don't, there's something called a misfit. So we have two things—one a fitting, a creative fitting, and a nonfitting which is in fact a misfit. And the fitting is in fact dynamically, literally creative. Like the forest fire example, it's moving from ashes up to a forest, it's literally creative; and the failure to do this thing is literally destructive. The surviving organisms in a forest have in fact accomplished a creative fitting; the reduction in a fire is in fact destructive.

Misfitting is in fact reductive. That's important, because we are engaged in this whether we like it or not. We are engaged in adaptation for survival at every level—cells in you, tissues in you, organs in you, you in a community, you in an ecosystem, all ecosystems in a biosphere—all are engaged in trying to find a creative fit.

The terrible thing is that all of this is known to only a handful of natural scientists. Every school child should learn it. We could make these "capsules" to send the generals off into space, but we should also make great, glorious capsules for children—enormous, wonderful greenhouses with plants and micro-organisms and mussels and snails, sunfish and bass, butterflies, and everything gorgeous as a recirculating system—and we should allow little children to come in and live in it and eat from it, and see their wastes reconstituted. They should live

in it long enough to see that this is the system within which they live, and to love it and exult in it and know it. If only we could do that. . . . That this is known to so few people is horrendous!

CONCLUSION: HAVE YOU SURVIVED? ARE YOU HEALTHY?

I will now come to my—hopefully—triumphant conclusion. Isn't there a simple way in which we can see the whole thing at a glance? Of course there is! If you want to look back at this whole business of evolution, ask the creatures that have been around since the beginning: "How have you been doing? Have you been able to find a fit environment? Have you been a success, in evolutionary terms?" So you look back 2½ billion years at the algae, protozoa, fungi, mosses, and so on, and you speak to them (because they are still around) and say, "Have you been a success in evolutionary terms?"

They will say, "Friend, we have been here since the beginning. Some of our descendants are entertaining novelties; they may have augmented us but they have not superseded us. We are still doing 99.9999 percent of the world's work." So, you say to them, "Thank you, you *have* been an evolutionary success."

But on the other side, some didn't make it. They were not able to find a propitious environment, to adapt the environment and themselves. They accomplished a reductive misfit, and they were extinguished.

But you say, "Two and a half billion years is too far back." So I say, "Let's go back a million years. This includes man." So we look back a million years and ask the same question: "Have those of you who have been around for a million years been able to find a propitious environment, to adapt the environment, to adapt yourself? Have you survived?" Man and other creatures who have been around a million years would say, "Yes, we've survived." So this would be evidence that they have indeed been able to find a propitious environment, and adapt themselves. But the passenger pigeon and *Tyrannosaurus rex* have not.

Can you bring this down to a nearer time? Sure, we can ask the same questions on the scale of a day, a week, a month, a decade. The question for a decade is exactly the same as the one for a million years (which was "survival") or a billion years (which would be "evolutionary success"). That question would be, "Are you healthy?" That's all—physical, social, mental health in human society, and physiological health in ecosystems. If you find any system which is healthy, you have found a system which has been able to find a propitious environment, adapt the environment, and adapt itself.

Think of America 10,000 years ago, when the first man made his

way across the Bering Strait. The continent had been 6 billion years in the making—2 ½ billion years of life — and had been able to exercise, all of this time, all of the world's genetic pool in order to accomplish a creative fitting. When that man first came to this land, he found that here was the best that nature could do in terms of creative fitting. Think of that time, now, and think of *us*, now, if it were possible for us to say, "How can we intervene in this wonderful biosphere which encapsulates all the dreams of the origins of matter, all the dreams of the origins of life itself and all of its offerings? And we are a part of that dream, presumably, because we have come from it."

What is now the creative role for man? The countryside has been devastated, but it is still rich and beautiful. We still have opportunities for fulfillment beyond our dreams. America is the crucible for the whole world. If America wins, the world wins; if America loses, the world loses. The battle is really for survival first, and fulfillment next.

This is our concern. I commend it to you!

A QUALITY ENVIRONMENT: INDIVIDUAL RIGHTS AND RESPONSIBILITIES

JAMES W. MOORMAN

Staff Attorney, Center for Law and Social Policy, Washington, D.C.

In our present age we are suffering from a serious, general and increasing degradation of our environment. The causes of this degradation are general phenomena which affect us all. Thor Heyerdahl in his recent voyage across the Atlantic noted that ocean pollution is not confined to shore areas but has been carried on the currents to every part of the ocean. We now know that DDT travels widely and that DDT used by a farmer in one place may end up in a mother's milk or a brown pelican's reproductive system many hundreds of miles away. Pollution is carried on the winds and tides to every corner of the earth. The air now seems everywhere to be filled with a brown haze. Once clear streams seem to be everywhere polluted. Many species have disappeared from the earth in recent times and many more are threatened. Wilderness areas are everywhere being assaulted, subdivided and eliminated. Forces and circumstances beyond the average individual's control are leading our people to live in our age's biggest joke on man and the environment: the slurbs surrounding our cities. These vast areas, with their attendant support systems, are the urban

equivalent of strip mines, destroying city and country, and leaving man and nature without refuge.

With respect to the individual, this environmental degradation transcends what we have thought of as trespass and nuisance. Indeed, the common law remedies for trespass and nuisance and the like have not slowed that degradation and do not appear to be particularly useful tools for dealing with the problems of environmental degradation. The reason for this, I would suggest, is that environmental problems involve complicated social and physical conditions that do not lend themselves to solution by the assertion of one individual's rights against one of his fellows. Take the problem of air pollution. As you move about you breathe air in various locations. That air moves about in a complex way different for each area, bringing pollution from many sources, impossible for the individual to identify or even guess at. In most places where you breathe as you move about. you have no property rights. Furthermore, you usually don't know how you are being assaulted, you don't know whom to sue, and you don't know what damages to sue for. A similar analysis could be made, I contend, for most of our serious environmental problems.

Thus I come to the tentative conclusion that the environmental problems we face are not amenable to solution by the creation and exercise of individual rights. I come to this melancholy conclusion at a time when there is a good bit of talk about developing or enacting such rights. People are suggesting, for example, that the recently enacted National Environmental Policy Act contains the seeds of an individual right where it says:

> "The Congress recognizes that each person has a responsibility to contribute to the preservation and enhancement of the environment."

Whether there is a "right" to a quality environment pregnant in those words I do not believe can be answered at this time. Likewise, I do not believe at this time that it is possible to describe the content of any such right or how it would be applied in a way that would be satisfactory to society in general.

Where then does the remedy lie? The remedy, I believe, lies in the large decisions of government and industry which degrade or enhance the environment. The individual, I contend, can have an impact on environmental problems only to the extent that he is able to influence the decisions of government and business. Thus the problem is to bring environmental awareness and citizen participation in a meaningful way into the process by which high impact decisions are made.

I believe an examination of recent environmental litigation will show that it in fact involves an attempt by citizen organizations to

break into the decision making process. *Citizens to Preserve Overton Park* v. *Volpe,* just decided by the Supreme Court, is a leading example. In that case, planned construction of a highway through a public park in Memphis was challenged by citizen organizations on the grounds that government officials were making improper decisions under statutory provisions designed to protect parks. The case involves the meaning of statutes passed by Congress to keep highways out of parks unless there is no feasible and prudent alternative and then only if all possible planning has been undertaken to minimize harm.

Another example is the well known case involving Mineral King and the Disney ski development, the case of *Sierra Club* v. *Hickel* which the Supreme Court has just agreed to hear. As many of you undoubtedly know, the case involves Department of Agriculture and Interior permits for a massive ski development in Sequoia National Game Refuge and for supporting highways and power lines through Sequoia National Park.

Again, in *Citizens for the Hudson Valley* v. *Volpe,* citizens stopped a massive fill for highway purposes in the Hudson River by successfully challenging a permit to be issued by the U.S. Army Corps of Engineers.

In the case, *Environmental Defense Fund, et al.* v. *Hardin,* I brought legal action on behalf of several groups to ensure that citizen demands that DDT use be banned were implemented by the Department of Agriculture.

These cases, and many others, like them, involve attempts to gain access to the great decisions of government. They do not involve classic personal right and injury situations. Indeed, I believe we can say that environmental litigation increasingly raises issues which do not involve, or only incidentally involve, direct users. In this regard, I refer to such issues which are being raised as the protection of wilderness areas, the preservation of wildlife refuges, the survival of rare and endangered species, the integrity of natural rivers, and the natural or scenic aspect of landscape. Those who bring the suits to protect the values mentioned may incidentally be users in that they or their members have walked, watched, and beheld the subject of the litigation. However, such use is often incidental to the larger purpose, which is to protect the integrity of the environment.

The citizen suits will, if allowed to continue, help in two very important ways to reorient decisions that affect the environment. First, they will help to reorient the substance of agency decision-making so that the environment is given equal weight with other factors and is genuinely considered. Second they will help alter the

procedure of agency decision-making so that citizen input will have a genuine effect on decision making. Professor Charles Reich, in his landmark article in the *Yale Law Journal,* "The Law of the Planned Society," pointed to these same factors as necessary innovations in agency decision making if large government is going to meet the challenges of modern society. Thus he called for a broadened definition of the agency task to specify the necessary factors which must be taken into account. Agencies tend to religiously consider only what they are specifically mandated to consider, and nothing else. Therefore broadened definitions must be clearly spelled out.

Reich also called for a broadening of public participation in agency proceedings. The reason stems from the fact that our agencies tend to assume a narrow provincialism. To quote Professor Reich, the Agency lacks:

> enough democratic participation by the community as a whole to know the community's wishes. As a substitute for ability to reflect all of the interest in the community, the agency cultivates a form of professionalism in which it attempts to "know what is best" for the community. The trouble is that professionals have their own peculiar narrowness of outlook. Like all experts they are likely to adopt a particular point of view and then to pursue it without re-thinking the problem from time to time. The Bureau of Reclamation is a dam-building machine which will keep building dams as long as there is running water in a stream in the United States. At the same time, it lacks a broader outlook which might consider the values that dams destroy. Professionals, in short, can be counted on to do their job but not necessarily to define their job.

The National Environmental Policy Act may go a long way toward reaching the goals of broadening the definition of agency concerns and providing participation of the public in agency action. It is certainly a step in the right direction. Of course a great deal will depend on how seriously the Act is taken by all federal agencies and on how it is interpreted by the courts. Nevertheless "The purposes of this act (to quote it) are to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man" and to create a ". . . continuing responsibility of the Federal Government to fulfill the responsibilities of each generation as trustee of the environment for succeeding generations." The Act goes on to declare that "it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned

public and private organizations, to use all practicable means and measures . . . to create and maintain conditions under which man and nature can exist in productive harmony. . . ." Further the Act places on the Federal Government the continuing responsibility to use all practicable means . . . to improve and coordinate Federal plans, functions, programs, and resources to carry out its purposes. Thus the Act calls for the Federal Government to reorient its programs to ensure environmental protection and citizen participation.

It is fine to talk about citizen participation in the abstract, but what does it really mean? I believe it means that an extra burden of responsibility must fall on certain groups in our society; many of whom are represented here at this conference. First it is going to be up to those in places of responsibility in the government to implement the National Environmental Policy Act and to facilitate a lowering of the barriers to citizen participation in the implementation. A powerful tool for the preservation and restoration of our environment has been created in the Act, but it is not self-executing. It requires proper implementation. For those working in the federal agencies a difficult time may be approaching. Before our society makes the transition to one of fuller environmental awareness, before the inherent conflicts between this new awareness and some of our more destructive values work themselves out, political controversies will develop. We are involved now in some knock-down drag-out fights and can expect more. The SST and the Alaska pipeline are examples. The people who work in our federal agencies may be forced to make a choice. Many may find that their very jobs depend on the choices they make. Much may depend on how many are willing to place the environment above salaries, to put wildlife above pensions.

A second group who must take responsibility are those with expertise. Upon men of knowledge rests, today, perhaps the heaviest responsibility of all. Those who have a stake in decisions often ignore the data or information which would tend to call for the defeat of their pet projects. Yet we must all believe that the best decisions are based on full knowledge. The only way we can insure that the fullest knowledge possible is brought to bear on problems affecting the environment is for those with knowledge to assume the obligation of stepping foward and making the facts known. Otherwise we know in advance that decisions will be made on less than all the information actually available. The responsibility that falls on those involved, such as scientists, because of their special knowledge and abilities, may entail some serious sacrifices. Job security, research programs and high pay are hard to turn one's back on.

In conclusion, we face a situation where the knowledge of those

outside decision-making hierarchies must be inserted into the process by which vast environmental decisions are made. The process has begun through the lawsuits and legislative activity of citizen groups concerned with the environment. A vigorous continuation of these efforts is in order. Upon the strength of those efforts depends the citizen's hope of taking effective action to protect the environment.

DISCUSSION

MRS. SETH JACKSON: Now, do you have a comment as to why these citizen suits may not be allowed to continue?

MR. MOORMAN: Many of the lawsuits depend upon people who depend on charitable contributions for their complete activities. There has been legislation introduced into the Congress to restrict their tax deductibility of contributions for litigation purposes. In addition to that, as we all know, the Internal Revenue Service recently tried to cut off public-interest litigation. Of course, I don't think that we have seen the last of the attempts to cut off the sources of funds to lawyers who litigate on behalf of the public interest.

Another factor which might possibly cut off litigation is the legal doctrine on standing, which will be aired fully before the Supreme Court in the Mineral King case. If the Supreme Court decides that there was not sufficient standing to institute this suit, this would severely restrict further operations.

MRS. LOIS WEISS (British Colombia): I too am a little surprised about the reticence to sue as you have indicated. Just before leaving Canada we had an indication from our new Minister of Environment that he was going to make this possible. I have just been through a case of lead poisoning. This was identified and the groundwork and the basic research was done by our university and this was a public service done by graduate students and definitely identified the various factors involved. There are presently lawsuits pending on this. What is your recommendation in following these things up?

MR. MOORMAN: I am sorry, I don't understand the question.

MRS. WEISS: I am wondering about the reticense of being able to sue the Crown first, and secondly, in relation to individual rights, whereby I share common air. For example, very recently we have identified some polluter. However, he has not brought up the standards of his plant and there are law-suits pending.

MR. MOORMAN: Well, what you are talking about can be done. However, I would suggest that generally speaking, at least in the United States, it is very difficult for any individuals to bring suit against a polluter under the common law doctrine. This is true for several reasons.

First of all, the judges have always felt that the value of a plant and the employment it provides is far more important than the single individual and his discomfort. As a result of this attitude, which I don't think is necessarily unreasonable, Congress has undertaken to pass broader legislation under the Air Quality Act, in which an administrator system has been set up, under which it all depends on government decision and on what you can really do in relation to air polluters. Under this scheme, the Federal Government plays a very great role.

ON COMPROMISING THE PUBLIC GOOD

DENIS HAYES

National Coordinator, Environmental Action, Washington, D.C.

An uneasy moment comes for every speaker just as he is about to be introduced. He is entirely at the mercy of the master of ceremonies, and the actual introduction may range from a flowing tribute to a resounding denunciation.

I had a disturbing experience the other day when the gentleman concluded with the statement, "Mr. Hayes is with us today as a representative of Youth—America's greatest natural resource." This filled me with some genuine fear. After all, you know what America does to her natural resources.

We face a most difficult problem, you and I. We are fighting for a set of principles in a society where we hold but a miniscule portion of the available power. When we raise our issues, we occasionally are lucky enough (or loud enough) to get a hearing from the real powers that be. And if we have done our homework, and if we have a militant, impatient organization behind us, those powers that be will sometimes meet us part way. We define the least we will accept, they describe the least they will give, and we draw a line somewhere between those two points.

Sometimes the line is close to our demands. The recently passed Clean Air Act of 1970 is a case in point. The bill is dreadfully short of the demands first posed by the Coalition for Clean Air, but considering that we were opposed at every step of the way by Detroit, by the heavy metal industries, by much of the leadership of both Houses of Congress, and by the President of the United States, we managed to enact a reasonably tough bill.

Generally, however, we're not so lucky. A classic example was the battle last year to get DDT banned in Florida. It culminated in a compromise. Oh, DDT was banned, all right, but with the following exceptions:

Except indoors;

Except underneath buildings, or within a foot of buildings, to control house pests;

Except in emergencies certified by state health officials;

Except to control forest or farm pests where no safe and effective alternative is available;

Except for research purposes;

And except for direct application on cabbage, corn, cotton, peanuts, soybeans, and sweet potatoes.

One is reminded of the classic question: "Well, *except* for that, Mrs. Lincoln, how did you like the play?"

Another area where compromise has worked to our disadvantage is in the whole field of transportation—with particular emphasis on highways and the highway trust fund.

Admittedly we are facing a set of foes on this issue which deserve our healthy respect. The highway lobby is the second most powerful interest grouping in this country—ranking behind only the military-industrial complex in terms of legislative clout. Traditionally our efforts have not even made a dent in their goals.

Even when we compromise before the fact, and limit our objectives to such tinkering as beautification and billboards, they sacrifice not an inch. This is an area where we have compromised ourselves away to nothing, and compromise is no longer acceptable. This society, and particularly its cities, are crying out for new transportation options.

I just came up here from Los Angeles. It's unbelievable.

Five years ago you couldn't get anywhere in Los Angeles without an automobile. Today you can't get anywhere with an automobile.

Two-thirds of the city's land is devoted to freeways and roads and parking lots and service stations and automobile dealers and private garages—and it doesn't do any good. You still can't get around.

The beautiful for spacious skies over Los Angeles have turned a wierd shade of yellowish-green, obscuring the nearby purple mountained majesty from view. The emphysema mortality rate has been shooting upward for more than 20 years. Death rates from automobile accidents are staggering. The city grows relentlessly noisier, dirtier, and uglier. Yet you can't get around.

Especially if you live in Watts. Or in the Chicano barrio in East L.A. That's the end of the line, only there isn't any line. There's just a road, and if you can't afford wheels . . .

For the highway-automobile complex is not only inefficient, unhealthy, and ugly. It's also discriminatory. It discriminates against the young, the old, the poor, the crippled, and others who can't afford cars or can't qualify for drivers' licenses. It doesn't work too well for the rich, either.

As goes Los Angeles, so goes the nation. There is not one American city which is not beset by these same problems. Citizens groups have drawn battle lines and thrown up barricades in Atlanta, Baltimore, Boston, Charleston, Cleveland, Detroit, Indianapolis, Memphis, Nashville, Newark, New York, Philadelphia, Washington D.C., and elsewhere.

Yet here, as in so many areas, our national government has not

responded to address even our most minimal demands. The public good has been compromised away to the point of being negligible.

The difficulty with compromise is that the more you compromise your principles, the more blurred your principles become. This is the very essence of politics. The young man enters the political arena for the ostensible purpose of "doing good," but in order to survive he must make a series of small compromises, then bigger ones, then bigger still, until he is himself the very epitome of what he was originally fighting against.

Sometime his reputation as a zealous crusader outlives the crusading spirit itself. In such cases the voters unwittingly return to office a man who is the opposite of what they had hoped to elect.

Those voters are not likely to learn the truth by following the political rhetoric. Words have tended to lose their meanings as we have all become merchandisers. Learning from Madison Avenue, the Democrats and Republicans alike are selling us politicians the way drug stores sell us mouthwash.

Every politican co-opts whatever terms seem to be popular at a given time, caring not a whit whether the terms have anything at all to do with his position and programs. President Nixon speaks of the "revolutionary changes" we need, much the way Procter and Gamble merchandise their "revolutionary new" laundry detergent.

The new "in-word" today, of course, is "environment," and everybody and his broker is passing himself off as a responsible custodian of the environment. Judging from their ads, one would have to consider Union Carbide, General Motors, Consolidated Edison, and Standard Oil to be the greatest life-forces to hit earth since protoplasm.

The area where this hypocrisy is most disgusting is among politicians. Calling Senator Henry Jackson, for example, an environmentalist is like calling Atilla the Hun a flower child. Yet Scoop Jackson has the audacity to run for the Presidency as an "environmentalist."

Well, it's certain he couldn't run as anything else. As Richard Nixon's first choice for Secretary of Defense, Jackson's credentials with the peace movement are non-existent. As a consistent advocate of building up our storehouses of nuclear-tipped missiles (a direction not inimical to the short-range interests of Hanford and Boeing) his credentials among those seeking to avoid a nuclear holocaust are nonexistent.

He has no reputation as a vigorous champion of the underprivileged, of minority groups or poor whites or the elderly. He has not spoken firmly on health care, or the urban crisis.

So Mr. Jackson has decided to run for the presidency as a hawk environmentalist.

This course, however, may not prove as easy as Senator Jackson might think. A great many of us remember full well his authorship of the Timber Supply Act—where he once again acted in the behest of industrial interests in his state. We will bear in mind his utter lack of leadership, as Chairman of the Senate Interior Committee, on such key issues as the Trans-Alaskan Pipeline and a large number of ill-advised Corps of Engineers projects.

Unlike many politicians whose environmental awareness seems to be heightening over time, Jackson actually seems to be going downhill. He reached the very bottom two weeks ago at the AFL-CIO conference in Florida when he used his speech to denounce environmental activism.

He should have spoken to those labor leaders about the need to convert our economy away from war, space, and plastic junk, and into the full-employment production of homes, hospitals, air and water purification devices, and a balanced transportation system. He should have explained to them that our present environmental crisis will produce more jobs than it will eliminate.

Instead Jackson abused his opportunity with cheap, anti-student demagoguery, and with unabashed praise for the cock-eyed priorities of our war-based economy.

The League of Conservation Voters compiled a list of key environmental votes prior to last year's election, and ranked the records of the members of the Senate. Jackson did not fare so well among the other leading Democratic contenders:

Harold Hughes	100%
George McGovern	79%
Edmund Muskie	73%
Birch Bayh	58%
Henry Jackson	53%

As a leading senatorial supporter of the SST, the ABM, and defoliation in S.E. Asia, Jackson has an environmental credibility gap before the campaign really begins.

The point of all this is not to say we must never compromise. The point, rather, is that we must watch ourselves very closely, and we must not allow ourselves to be misled by appearances.

Mankind probably faces a future of continual crisis. We have been breaking a lot of little laws for a long time, and they are beginning to call their accounts.

Significant and immediate changes are required in the basic structure of our society, and in the way it operates. We must choose our issues judiciously. We must play to our own strength. We must score some substantial victories.

Working together, perhaps we can.

YOUR ROLE FOR A QUALITY ENVIRONMENT

SHIRLEY A. BRIGGS

Executive Director, Rachel Carson Trust for the Living Environment, Inc., Washington, D. C.

The term 'a quality environment' is bandied about freely these days, with considerable flexibility in meaning. Those who attend this conference would probably agree to a rigorous definition, going far beyond the popular ideas of cleaner air and water, and more esthetic surroundings. With a clear concept of the complexity of what we already know about our ecology, and an even sharper realization of the critical gaps in our knowledge, you would surely include a judgment of the peculiarities of each component natural community, now and in the long reaches of time to come. If we could agree that a quality environment for any species is that which permits it to reach its highest potential, and for man as the most pervasive species this must include the well-being of our fellow species worldwide, we could draw up requirements that would turn from the exploitive economy we now inhabit, and stress living within the energy budget of each locality as well as of the earth as a whole. If we consider the highest mental potential of man, we might attain a way of life with environmental health instead of gross national product as our goal, and with the ultimate status symbol in personal achievements and satisfactions rather than material consumption. As many of you have pointed out, acceptable solutions to our present problems involve drastic changes of direction in everything from our personal habits to the basic assumptions behind industrial and governmental practices.

By any such definition, a quality environment is not something any of us is apt to see on a large scale in our lifetime. At best we can hope to detect changes of course in the right direction. Bits and pieces of high quality environment can be found, with examples of the way of life that sustains them, whether in a remote wilderness still unspoiled by more than air pollution and radiation, or in man-altered areas that still keep some sort of balance between input and output, and whose diversity remains sufficient for stability. The quality of such places

can be recognized by ecologists, wildlife managers, and well-trained conservationists. We can all appreciate such areas, study them, and strive to preserve them. But teaching others to see their merits and field marks may be even more important. How can we devise a Peterson Field Guide to the health of landscapes? Aldo Leopold said, "One of the penalties of an ecological education is that one lives alone in a world of wounds." Since he wrote that, we have become less alone, but it must be our first task to try to reverse the balance, so that those who are callous to the damage around them become the exceptions. Somehow, we must show our fellow men how to recognize the wounds, to know how they have come about, and to insist on applying the known cures and to press for better ones. If man is a planetary disease, he must become the first known pathogen to reform itself. If we can so confound natural processes as to accomplish this, it might be the one instance of our defying the laws of nature to good effect.

The present furor over environmental pollution shows that we have made some headway in this first step. Enough people are learning the lesson to call for the elementary changes that come most obviously to mind. Everyone wishes to survive, to breathe, and to escape becoming a non-target victim of some passing contaminant. At last, there is a wide audience for the truths that many of you have been expressing for years.

My role in this process has been that of intermediary, trying to keep up with your discoveries and ideas, and bringing them to public notice. In reverse, I have referred to many of you the questions that come to me from concerned people. If I can suggest ways in which your ideas can reach a wider public, or indicate a new trend among the questioners, perhaps new approaches can be devised.

My clues come largely from two sources: the mail that reaches the Rachel Carson Trust for the Living Environment, and a couple of classes that I teach in the Graduate School of the U.S. Department of Agriculture, one on the development of conservation philosophy, and the other in political action for conservation. These are part of the Natural History Field Studies organized by the Audubon Naturalist Society. The students are mostly professional people, many in government, who used to seem most concerned with developing their own knowledge and attitudes toward the natural world. The past year or so, many wanted primarily to find a firm basis and tough arguments for dealing with colleagues whose attitudes were anti-ecological. People in the Department of Commerce, the Federal Highway Administration, The National Academy of Sciences, The National Insti-

tutes of Health, and the Departments of Defense, Interior, and Agriculture as well as private organizations in Washington shared this viewpoint. Perhaps the difference from former years was partly one of confidence. Recognition of environmental problems at the highest governmental and professional levels has given them courage to speak out in hostile circles, and has made people in such circles aware that they should pay some attention.

But the finest policy declarations by top people, even the best laws, can flounder on the incomprehension and opposition of the general public, and particularly of professional middle level people. Judging from those in our classes, many who are well-disposed are eager for more than general evangelizing. I have found them properly inspired by such writers as George Perkins Marsh, John Wesley Powell, Aldo Leopold, and Rachel Carson, who combine a synthesis of complicated scientific facts with a coherent philosphy of man's relation to nature, and a clear and effective way of saying it. But they are also searching for different ways of expressing the important concepts to reach particular people—especially technologically oriented ones, and those with a traditional business outlook. Howard Odum's *Environment, Power, and Society* came out just in time to suggest some such approaches to this year's class. Perhaps the systems analysis people are more apt to grasp the energy cycle idea first, and Leopold later.

Your counterparts in other professions, that is, are becoming aware of the questions, though perhaps not of the answers you can provide. They want to know particulars, for definite problems. It may not be so difficult to reach them in a university community, but how do you do it in a city where they are dispersed in many industries, schools, and professions? Perhaps one important change in our customs should be a relaxing of present restrictions on speaking and writing on sometimes controversial topics by those employed in large organizations. Around Washington, it is very hard to find speakers for civic groups and hearings on critical environmental problems. This is not for lack of highly qualified people to do it, but because most agencies will not let their employees speak as individuals, but only as mouthpieces for the current official line. Some independent souls manage to circumvent the red tape, but it takes persistence, some courage, and a superior with the same qualities.

Church people are bestirring themselves in these matters, too, and groups have arisen based on a joint effort of scientists and theologians to explore environmental problems together. I am most familiar with the Faith-Man-Nature Group, and understand that the Institute for Theological Encounter with Science and Technology is working closely with them. This is surely a striking change from the situation

between these disciplines one hundred years ago. By working through such groups and directly with churches, we can reach a new audience, and an influential one. The state of the Judeo-Christian tradition is not as dark as Lynn White indicated.

People want sound facts on which to base their own judgments, and they also want to know the best procedures for getting things done. Three wildlife biologists who took my course in political action for conservation said that although they were unable to take part in such activity, being government employees, they found that people came to them for general advice on how to proceed, how to deal with local and federal programs and officials, what sources of information to seek, and what allies to enlist. Without getting involved in particular local issues, they wanted to be able to give sound general guidance. Perhaps many of you find yourselves in this position. Would a cooperative project with some political scientists help?

I do not wish to imply that by attending to specific local matters we should leave the broader issues altogether to such eloquent writers as Lewis Mumford, René DuBos, Loren Eiseley, and the few others in their league. Before practices can be changed, we must deal with what F. Raymond Fosberg has termed the conceptual environment. At every level the idea of man performing as a climax species must be established, taking no more from the earth than he returns, and becoming once more a functioning part rather than an infection. A number of promising ideas are about for non-polluting means of power production. People must be alert to the need before they will heed such ideas, and they must know the possibilities before they can appreciate the contrast between them and the means we now use, with their profligate dependence on fossil fuels, or on the doubtful safety of nuclear plants. Even though we may not be engineers with competence to explain the details, we can certainly point out the existence of means of generating electric power from geothermal sources. And we can seize upon such a paper as Cherry's *A Concept for Generating Commercial Electric Power from Sunlight*—now there is a practical offshoot from the space program—and see that it is noticed in influential circles. Solar heating of buildings may have to wait for reform of building codes and trades, but we as citizens could press for this. An international conference on solar energy to be held at the Goddard Space Center in May deserves wide attention.

We can also quote Theodore Edison's plea for a halt to the continual expansion of unnecessary uses of electricity, with the resulting rise in numbers of power plants and their pollution and destruction of the landscape. He concludes, "Why should we act like a chilly man who is willing to burn down his house to gain a few more

hours of warmth? I think power companies should be urged to curtail their promotions of power production."

Wherever possible, a positive approach can be not only appropriate but more apt to convince those now so beset with pronouncements of gloom. I do not mean to discount the gloom. But where there are ways to support the desirable aspects of our technologically dependent society while cutting down on its waste, let us commend them. We need to generate interest in such projects as the increase in productivity of the sea from artifiical upwelling as expounded by Pinchot in his paper, *Whale Culture, A Proposal,* and now being explored by the Lamont-Doherty Geological Observatory in the Caribbean, while we also point out that such inventive and non-polluting methods will be of no avail if we make the water of the ocean increasingly toxic.

After years of speaking out on environmental problems in a few lonely voices, we are now part of a vast onslaught of lectures, TV programs, environmental primers, exhortations, and Earth Days aimed at the general public. This target often seems in danger of being pushed from a 19th century exploitive view of the world right past the sober, factual approach into a cultist romanticism that may appeal with its simplistic, idealistic tone but is hardly apt to solve many problems, personal or national. How can you, standing somewhere there on the firm ground in the middle, deflect these enthusiasts into a program that proceeds according to the careful patterns of science? How can they be taught to rejoice in the complexity and unruliness of nature, trying to understand it instead of reducing it to pat solutions and clichés? How can they be given the intellectual tenacity to grasp the squirming facts involved, and to hang on until a workable program is in effect? These are matters with which most of you have had long experience, but how do you transmit the attitude? It so often means sticking to a complicated undramatic program when a flashy one could gain more immediate support.

Of all of the professions now involved in this effort for a quality environment, I feel that those represented here have special advantages. You are versed in the broad theories at stake, and most of you have also had the kind of field experience that develops a knack for practical applications, and a wariness of the pitfalls of too-tidy theories in the face of biological processes and human perversity. (Before holding forth as general environmental experts, however, some of you might give a long, hard look at some wildlife management and even soil conservation practices. Possibly there is room for improvement even here. The prevalent use of 1080 comes to mind.) Not all people whose work requires that they live close to nature have to engage in objective observation, understand long-range effects, and

above all develop a sense of wonder at the pattern of life. These must somehow be transmitted to those who will shape our society. As Caldwell concludes, "The man to whom the world is truly wondrous is not likely to launch himself blindly toward unforseeable outcomes, nor willingly to invite irrevocable or irreversible effects."

This outook, I believe, cannot ever be acquired from words alone. The experience of living, even briefly, in harmony with nature, must be a direct personal one. Two ways in which a great many people can experience this are gardening and the recreational use of natural areas, where there are many possibilities for learning ecological principles, although our customs often defeat this purpose. In neither case does economic gain need to be a controlling factor, so people can be more receptive to a new approach. And these are fields where your sort of knowledge especially applies.

Gardening is a battlefield of conflicting attitudes now, and of course commercial pressures come from industries trying to sell their products. To far too great an extent, people are taught to view the garden as an extension of the living room—just another part of the decor, to be manipulated and manicured with little regard for any equilibrium of living things. Prestige comes from the excessive tidiness of the effect, the hothouse perfection of the flowers, and of course the virtual absence of anything with more than four legs. Can we guide people to a view of gardening as working with nature, of appreciating the variety and exuberance of plants and their attendant creatures, and not wanting to reduce it all to a limited, rigid plan? Could we even make it the fashion to consider the number of nesting birds in a garden more of a status symbol than the number of flawless roses? We might then reach a point where residential gardens were no longer one of the areas most irresponsibly contaminated with pesticides. Garden clubs are increasingly open to suggestions for better practices. In trying to answer the questions that come to our office, we find the main problem is a lack of sound manuals on a tenable middle ground between the hucksters of biocides and the romantic cultism of some of those who react against them. The Rachel Carson Trust plans to produce some useful materials here, but we hope that others will see the problem and act upon it.

When I first pondered this topic of a quality environment, it occurred to me that I had once known a good example, not an unspoiled wilderness, but a relatively uncontaminated place in which enough people were living equably to make a real test of their practices. This was a summer camp, deliberately set up to be such an example, though most of the campers were unaware of this at the time. It was in a part of northern Wisconsin where the lumbering had

gone through some forty years before, leaving only a patch or so of virgin forests, a variety of regenerating woods, a pure lake, and abundant wildlife. There were no paved roads, no electricity, no plumbing beyond a water tank on the main lodge roof, into which we took turns pumping water for the kitchen and fire protection. The idea was to teach a mixed lot of girls, many from large cities, that one can live comfortably, hygienically, and very independently without most of the accoutrements that city people even in the 30's considered essential. We swam and boated, but without outboard motors. Wastes were buried at a careful distance back into the scrub pine. One handyman took care of the maintenance without undue strain. There were no complicated contraptions to collapse, no main power supply to fail. This seemed to me a normal situation, less remarkable because some of my farm relatives were still living in much the same manner as a matter of course. The point was driven home to me when I revisited the camp 25 years later. Nothing had changed, beyond the paving of the main road. The lake was still pure enough to drink, the forest was a bit more mature. Girls were still being taught a rigorous course in wilderness camping, practiced on long canoe treks, where even more self-sufficiency and competence at living with nature were stressed. But the two directors, Miss Joy and Miss Camp, retired soon after, the buyer disregarded his promise to continue the camp on the former principles, and it soon became just another country-club style place. Last word was that the lakeshore was to be sold off for private summer homes.

Grave problems now beset the northern lake country, with water becoming befouled, eutrophication going on apace, and even the loons losing their hold on old haunts. The practices of resorts, owners of summer homes, and summer camps are accomplishing this by using the lakes for waste disposal, and encouraging the obsession with noise and speed that makes the water-skier the one to emulate rather than the sailor or canoer. The noise and crowding of the cities are brought along as much as possible. This can be changed to some extent, perhaps, by stern anti-pollution laws, but mostly by a change in attitudes. How can it be made more fashionable to enjoy the lakes and forests in non-damaging ways, once we have made people aware of what these are? I wonder how many of the girls who attended my camp kept this as a conscious philosphy. At least, if convinced of the need, they know that such living can be comfortable and reasonable—they do know how it can be done.

Are any camps, to speak of, operating in this way now, using the current concern with the environment as a basis? Boy and Girl Scouts pay official attention to such ideas, but in practice leaders too often

follow familiar customs. It is no use expounding fine principles without some very detailed, practical education on how to live harmlessly in the wild, with minimum fuss and maximum efficiency.

This comes back to another premise I always took for granted but find little honored now: that one should be as self-sufficient as possible. Whether or not you have to make things from scratch, to deal with basic processes for food, shelter, or transport, you had better know how. Only then are you really free, in any event. This bespeaks a rural background, no doubt, for how could a modern city child find it realistic? If this were considered a commendable aim rather than the accumulation of automated devices it could be a great help in turning the public toward more energy-conserving practices. And one place where it can be stressed is in some forms of outdoor recreation. Here we should best be able to convince people, for example, of the validity of Odum's formula for determining the true value of water, with all of its implications.

This is all highly revolutionary, of course. It means countering the dramatic, obvious attractions of a wasteful economy with a plea for slower, more cautious, less noisy ways. Somehow, we must make the need for and the rewards from such a life so compelling that people will welcome the challenge of living in a self-contained energy system.

An archeologist once explained to me two collections of arrowheads found in different sites near Iowa City. As far as we could tell, he said, the two groups of Indians who made them had lived at about the same level of comfort and progress. And the arrowheads seemed about equally efficient. Yet they indicated two vastly different attitudes. One tribe had worked out a small number of basic shapes, and had gone on duplicating them doggedly; they worked all right and that was that. The other group made very few just alike. They tried every variation possible within the requirements for a successful arrow, and left a fascinating array behind them. We presumed that this inventive tendency had applied to the rest of their culture. They may have taken more time to making arrowheads, or houses, or songs, but in return they surely had more pleasure from them all. I should like to have seen their war paint.

Some of the changes we feel necessary in modern life will require more individual thought to adjust ways to local conditions. They may mean spending more time making products to last instead of making many duplicates to be soon discarded. When we urge development of more selective pesticides, for instance, we must face the fact that some will not be as profitable to sell as the broad-spectrum ones, and may need more skill to apply effectively. If we need to try for zero consumption growth as well as zero population growth, this need not

mean just fewer possessions, but also better and more satisfying ones, in the tradition of the various arrowheads. Our ingenuity can be concentrated on those things really needed, as we curb our compulsion to carry out all technological feats just because we can.

Looking at our economy and beliefs in a 1961 article entitled *Conservation as an Un-American Activity,* Irston Barnes spoke as an economist consultant to large industries and governments. He concluded,

"These anti-conservation attitudes are not susceptible of separate and particular attack; they can be successfully challenged only by an appeal to a new standard of values. Individuals will differ as to what that standard of values should be. We have recently had a restatement of goals for Americans. Do we not need a restatement of the goals of a good life? Could one of these goals be the fullest possible development of the individual rather than the fullest development of the consumer? Could we find in increased leisure, in greater capacity to know and understand our world and man's place in it, and in progress in perfecting human society a greater fulfillment than in a 'constantly rising standard of living?' Are these not the achievements that have made all ages look back in admiration to Greek civilization? Is there not room for a conservation ethic that would be concerned with the conservation of what is best in the human personality and spirit?"

Applying such an attitude to international affairs and foreign aid programs, Ivan Illich has pointed out the damage we do to an underdeveloped country, with its low energy budget, by giving our elaborate mechanical devices. A few trucks can disrupt the economy, the level of reasonable expectations, and increase the gap between rich and poor. For the same money, they might have many tough little power carts that would use existing roads and trails, very little fuel, and would bring people just one reasonable step beyond carrying loads on their backs. He comments:

"In Vietnam a people on bicycles and armed with sharpened bamboo sticks have brought to a standstill the most advanced machinery for research and production ever devised. We must seek survival in a Third World in which human ingenuity can peacefully outwit machined might. The only way to reverse the disastrous trend to increasing underdevelopment, hard as it is, is to learn to laugh at accepted solutions in order to change the demands which make them necessary. Only free men can change their minds and be surprised; and while no men are completely free, some are freer than others."

Perhaps, then, if we can help redirect our fellows into ecologically sound ways they will find it not a grim readjustment to a diminished

life but one of expanded zest and accomplishment, with their greatest wealth in the variety and abundance of their habitat.

LITERATURE CITED

Barnes, Irston R.
1961. Conservation as an un-American activity. Atlantic Naturalist 16(4): 234-240.
Caldwell, Lynton K.
1970. Environment: A challenge to modern society. Natural History Press. 283 pp.
Cherry, William R.
1970. A concept for generating commercial electric power from sunlight. Conference Record of the Eighth I.E.E.E. Photovoltaic Specialists' Conference, August 4-6, 1970, Seattle, Washington. 331-337.
Edison, Theodore M.
1970. "Progress" toward points of no return. The Living Wilderness 34(112)52-53.
Illich, Ivan D.
1971. Celebration of awareness. Doubleday. 189 pp.
Odum, Howard T.
1971. Environment, power, and society. Wiley-Interscience. 331 pp.
Pinchot, Gifford B.
1966. Whale culture—A proposal. Perspectives in Biology and Medicine, 10(1):33-43.

RESOURCE USE AND QUALITY OF LIVING

A summarization and appraisal of the 36th North American Wildlife and Natural Resources Conference

M. GRAHAM NETTING

Director, Carnegie Museum, Pittsburgh, Pennsylvania

Well, here we are, the tired remnant of a notable migratory herd of the world's most dangerous animal. The convention bureau and the business community regard us more highly, of course, for we are exemplars of the world's highest standard of living—a euphemism characterizing people with an insatiable craving for material things. In recent generations, particularly, we have been paragons of progress, joyously reproducing to produce hordes of new consumers to help gobble up the world's finite resources at an ever accelerating rate. We mar the deserts, gouge the land, cut the forests, ruin the streams, pollute the air, and pave the surface for verily "broad is the way that leadeth to destruction." (Matthew 7:13). We inflict untold suffering upon uncomprehending peoples afar, and upon ourselves, in wars that grow like cancers, seemingly beyond the control of logic and reason. We constantly demand more and more energy to make our lives ever less challenging. When do we pause to ask whether the person unwilling to hand-carve a roast deserves so much protein while others of his species starve?

If my statements appear too extreme, give heed to these quotations from *The Invisible Pyramid,* by Loren Eiseley:

> A span of three centuries has been enough to produce a planetary virus, while on that same planet a few lost tribesmen, with brains the biological equal of our own, peer in astonishment from the edges of the last wilderness.
>
> A rising world population requiring an improved standard of living clashes with the oncoming realities of a planet of impoverished resources.
>
> When man becomes greater than nature, nature, which gave him birth will respond. She has dealt with the locust swarm and she has led the lemmings down to the sea. Even the world eaters will not be beyond her capacities. Sila, as the Eskimo call nature, remains apart from mankind "just as long as men do not abuse life.[1]

[1] With permission of the publisher, Charles Scribner's Sons.

> Modern man, the world eater, respects no space and no thing green or furred as sacred. The march of the machines has entered his blood.

These matters are the stuff and substance of the theme of this Conference "Resource Use and Quality of Living." They also constitute one of the most compelling issues of our time, "What is the good life?"

It is my frightening task to endeavor to appraise how fully this Conference has developed its theme and to expatiate on other matters if so inclined. Although the results may not evidence the fact, I have done considerable homework for this assignment. First, I backtracked for a number of years, reading the summaries published in the *Transactions*. This was a very rewarding, but also chastening, experience. I had heard many of the summaries delivered, but I was too mentally fatigued on those occasions—as you are now—to appreciate what nuggets they contained. Now I know how difficult it will be for me to approach the same quality. I also learned not to have any false hopes that my gems will be long remembered for many of the splendid recommendations of my predecesors appear not to have been implemented, to date at least. We summarizers may all console ourselves, however, that fresh ideas require incubation before any signs of viability can be expected.

Secondly, I reviewed current events in biology that impressed me during the past year and tried to list the most significant environmental developments. Next, I read the many abstracts and texts forwarded to me by the very efficient Washington staff. Finally, I came to Portland, talked in the corridors, listened in the sessions, then tore up much of my preconceived report and started afresh.

My biological clock was still running three hours fast when I joined the host of delegates who have come to look forward to the Outdoor Writers Association of America selection of outstanding films on Sunday evening. Perhaps this made me more noise-pollution conscious than usual, for some of the splendid photography was marred for me by the musical sound track. I suppose there may be some trout fishermen who play a pocket radio, but most of us enjoy quiet as one of the benisons of nature. Why then do excellent photographers, who go to great lengths to make films as authentic as possible, louse them up with blaring music that is out-of-context whether it be classic or rock-and-roll? A tinkle of water, an insect buzz, or a bird or frog all might be used to punctuate the narration, but let's keep exotic sounds out of the woods.

Several of my predecessors, recognizing the impossibility of attend-

ing two technical sessions simultaneously, chose, instead of summarizing, to devote their time to analyzing trends and offering predictions; one, at least, pressed his employees into service to cover all presentations. I felt that speakers who had co-operated by submitting abstracts deserved some notice in the summary, and I hoped for complete coverage. Alas! By 9:00 a.m. on Monday morning, I had received neither abstract nor text for ten of the 46 scheduled presentations; some of these I heard presented, others I must, like you, read in the printed *Transactions*.

Each summarizer faces an additional difficulty; many abstracts tell what matters will be discussed but fail to give any inkling of the speaker's position on these items. Some were real sleepers; nothing in Dr. Nash's abstract forewarned me that his presentation would be, as Chairman Hartung called it, "one spicy meatball." My summary is, therefore, regrettably uneven; where time permitted hearing the paper, I may have captured some of the fire missing in the abstract.

In 1968, Ralph MacMullan ended his assignment with a question that might be asked annually, "Do you really need a summarizer?" If the answer is affirmative, I suggest that two assistants be appointed in order to do justice to papers *as presented*.

President Ernest W. Hartung, of the University of Idaho, chaired the first General Session of the Conference, which was devoted to "Society's Failure to Solve Environmental Problems." He was introduced by Daniel A. Poole, President of the Wildlife Management Institute, who expressed the hope that all delegates would depart Portland enriched in mind and strengthened in dedication. He noted the recent flowering of environmental awareness from which no professional can remain aloof or detached. He iterated the annual disclaimer that this Conference is not a convention, nor an action body assembled to adopt resolutions, but rather a flocking together of many related organizations and a clearing-house for exchange of ideas. He alluded to President Nixon's expressed desire to reorganize federal agencies into a new Department of Natural Resources, but stressed that such reorganization should be thorough, *not mild*—no draping of new tweeds over a tired body. He deplored some of the Public Land Law Review Commission's recommendations, its failure to come to grips with the outmoded Mining Act of 1872, and its failure to distinguish between public and private interests in these valuable lands. He noted the Federal Government's tardiness in giving planning protection to the huge expanse of public land in interior Alaska, deplored semantic sloppiness in use of such terms as "national park" and "wilderness," applauded the President's courageous action in halting the Cross-Florida Barge Canal, and indicated that conservationists impatiently

await regular and visible signs of further progress and accomplishment by the Council on Environmental Quality, which he admitted had been grappling with many immense problems.

Professor Roderick Nash appeared to me to be too young to have known the Pittsburgh of my boyhood, the Smoky City once described as "hell with the lid off," but I forgive him for libelling modern Pittsburgh because I survived the 1925 earthquake in his community. All levity aside, his presentation established an ethical norm with which other general presentations are certain to be compared. His uncompromising "No" to oil, his challenge to the concept of the private ownership of land—but not carpets—his suggestions that owners of polluting factories should be required to live within one-fourth mile (and I would add downwind), and his inverted pyramid to portray the Evolution of Ethics made a deep impression on the large General Session audience. A few effective slides graphically reinforced his dictum that conservation must be a matter of ethics, of right and wrong, not economics.

David Sive, speaking on "Legal Instruments to Protect the Environment," reviewed the rise of environmental law, especially in the private sector, since the epochal recognition six years ago of the Scenic Hudson Preservation Committee as an aggrieved party with the right to appear before the Federal Power Commission. He emphasized the importance of conservation or citizens groups acting in the public interest, in non-pecuniary status, being allowed to appear in adversary proceedings before a court or regulatory agency, with opportunity to question witnesses. He mentioned other legal niceties such as "sovereign unity" and courts allowing the query "whether" a jetport is needed, not just "where," but since he didn't file a brief—abstract to you—this non-lawyer can't do his presentation justice.

Although a professor himself, Norman Pearson lambasted universities in a paper read in his absence by the Chairman of the Session Ernest W. Hartung. "One of the worst barriers to human progress in environmental education is the academic department and its attendant bureaucracy. Nature presents us with whole problems and we respond with partial answers." He called for a "Darwin of the environment" to synthesize knowledge about the world of man and his surroundings. "Unless we learn to work together, we may pass the point of no return" in "the race between education and disaster."

Michael F. Brewer argued forcefully that it is impossible to think of environmental problems today without a healthy dose of economics. "Extended, perfected, and properly applied," he said, "economics is the stalwart companion of the conservationists. Its use has helped

reduce the vague and subjective elements of management decisions. If people contemplate its rejection in toto, they should contemplate what they will use in its absence. . . . If you don't like the tune, don't shoot the piano player."

Chairman S. J. Schulman opened Technical Session No. 1, "Controlling Land Use," with the statement that the afternoon program would deal with the real issue, the land itself, and how to get things done. Joseph J. Shomon, having made available copies of his paper, showed slides depicting absence of planning in this country and good planning in Europe (a conclusion with which David Brower was not in complete agreement during the discussion period). Shomon ended on the strong note, "What seems most needed in America is a clear national land policy—a policy where land is viewed no longer as a commodity but a community finite resource in which the public has a vital stake."

Peter Q. Eschweiler asked, "Is conservation without planning better than planning without conservation?" He explained in detail the techniques and experiences of the planning profession in controlling land use to reach an objective.

Lawrence S. Hamilton told us that, "Even the professional planners have been woefully slow in recognizing that there are such things as natural determinants of land use." He paid tribute to the pioneering contributions to ecological land use planning by Bartelli, Hills, and McHarg, and noted that one of his graduate students, Lacate, had synthesized the approaches of the three pioneers in determining the best location for a highway near Ithaca. Further, a multi-disciplinary seminar at Cornell looked at a watershed in Central New York, identified 57 processes in the ecosystem, and portrayed increase or decrease interactions in a matrix table. This visual presentation, although needing further refinement, has proved useful in discussions with citizens about community resource development.

William K. Reilly described the President's proposed national land use policy which is intended to bring about State involvement in the regulation of land. He contrasted this proposal with Senator Jackson's proposed national land use policy bill. I believe, however, that he forgot about a few of Uncle's acres that are still lying around without protective planning.

J. Martin Winton detailed the steps leading to the very recent creation of a vast migratory waterfowl habitat of 72,000 man-controlled acres, as a co-operative endeavor of private landowners and federal agencies in Merced County, California. A Grassland Water District was organized, a Cooperative Agreement and Habitat Management Plan was worked out with the Bureau of Spot Fisheries and

Wildlife and the Bureau of Reclamation, and conservation easements were obtained from over 90 percent of the private landowners in 1970, the first year! In exchange for water supply for wildlife and native pasture, some 297 landholders agreed to keep their lands in wildlife habitat (or pay penalties in case of change of land use), to maintain a water distribution system, and to permit access by wildlife personnel and government agents. Winton's report was most heartening evidence that local residents can achieve important environmental goals by taking the initiative in developing an action program and then obtaining governmental co-operation.

I recall that one of the recommendations adopted at the First World Conference on National Parks in Seattle in 1962 was a plea for establishment of underwater parks. I was gratified to hear O. L. Wallis' report, therefore, that the United States now has eight national underwater areas, that five or more states have protected submerged areas, and that fifteen foreign countries have developed, or are planning, undersea parks. Japan has completed a nationwide study of its unique marine areas; there is need for a detailed inventory in this country. There is also a need for imaginative development of new underwater observation devices for improved viewing and to minimize disturbance of the environment by hiding snoopers from the denizens. I would add that some snorkelers are enough to frighten a moray eel!

In Technical Session No. 2, "Chemical Contamination," Chairman J. Anthony Keith's speakers offered further documentation of the effects of ecological sinning. Barely six weeks ago, I observed a colony of brown pelicans on a point of land on San Martin Island, off Baha California. These pelicans appeared healthy to the casual observer, but the colony was not, for their bodies were tainted with PCB, DDT, or some other noxious contaminant, and no young were being produced.

Eugene H. Dustman reported development of a simple method of detecting and measuring quantities of PCB in animal tissues and recorded the finding of these polychlorinated biphenyls in all eagles, ospreys, and pelicans examined.

Richard J. Ronk described development of a heavy metals survey and presented tabular data of trace metal levels in Atlantic Coast shellfish.

K. Vermeer reported mercury residues in 21 aquatic bird species in the Prairie Provinces and indicated how differences in feeding might affect mercury levels.

T. A. Barber and J. G. Nagy, upon the basis of *in vitro* studies of mule deer rumen bacteria, concluded that certain chemical pesticides

have the potential for harming wild ruminants by decreasing their rumen function.

P. A. Pearce spoke sadly but explicitly of the adverse effects upon Atlantic salmon, aquatic insects, birds, and mammals of various pesticides used to control the indigenous spruce budworm in New Brunswick, and concluded with a forecast of still greater ecological disruption by stating, "In magnitude, the operation planned for 1971 may match or exceed any of its predecessors." Studies of biological controls are underway but not yet operational.

T. W. Duke and four associates reported upon laboratory studies to evaluate the effects of mirex, a chlorinated hydrocarbon insecticide, on shrimp, crabs, and fish. Various shrimps and crabs were poisoned by *single particles* of mirex fire and bait, and over one-third of the mirex in bait samples was still present after nine months of soaking in open sea water. One wonders how long Southerners, who are both intelligent and politically experienced, will allow continued disruption of terrestrial and estuarine food chain bases by continuation of the fire ant witch hunt.

On Tuesday morning the Technical Session devoted to "Oil, Fish and Wildlife," chaired by Philip A. Douglas, was one of the most educational parts of the Conference for delegates from the continental interior. Each of the six speakers showed where our present fears were ill-founded, but pinpointed new areas where concern was justified. Donald J. Zinn stressed that Atlantic Coast oil spills "have been costly in dollars and cents, in esthetic values, in lost recreational opportunities and in wiped out faunal nurseries and algal pastures." He recommended planning to the point of coastal zonation, backed with strict and uniform intra- and inter-state law enforcement. Lyle S. St. Amant emphasized that on the Gulf Coast long-term chronic pollution is more of an ecological problem than short duration accidents, and that dredging and filling, drilling, and other operational activities may be very destructive of marsh habitats. He said that it was not necessarily the fact of wells, but rather the concentration of them that might be critical. Lake Pontchartrain has wells virtually unnoticed in its 700-square-mile area, but it must not be allowed to become a Lake Maracaibo. Dale Straughan's accent and presentation were so pleasing that delegates expressed the hope for more women on next year's program. Her pictures and discussion of natural oil seeps in the Santa Barbara Channel were of especial interest. She reported high post-spill mortality of pelagic birds but lack of evidence of damage to marine mammals there. On the invited panel, Geoffrey Larmainie gave an excellent introduction to the Arctic, circumpolar in scope, and showed slides of the North Slope steps being taken by the

oil companies to prevent further damage to the fragile ecosystem. Angus Gavin stressed the blasé acceptance of oil operations by caribou, a higher grizzly population in 1970 than in 1969, and maintenance of waterfowl numbers. He stated that movement of vehicles across the thawed tundra is not permitted and that oil company personnel are not allowed firearms on the North Slope.

Professor Robert Weeden, presenting the biologists' viewpoint on the panel, said that, "What is unknown about Alaskan ecosystems is as much cause for concern as what is known about petroleum industry operations." He admitted that in the face of the quandary whether to "cry wolf" or "play ostrich," he thought it might be best to be a "sentinel raven." He viewed with alarm how Alaska, with pioneer psychology, would spend its oil revenues; certainly multimillions would go for roads to open up the wilderness to exploitation. A number of listeners remarked upon the agility of the panelists in presenting such informative material without even mentioning the fighting word "pipeline." In the question period Dave Brower asked the question on the lips of many, "What's the hurry?" Unfortunately, a splendid session had to be adjourned for scheduled luncheons with many questions unasked.

In advance of the other Tuesday morning Technical Session, I puzzled over the position of Walter E. Howard's hard-hitting paper, "Our Population Environment Problems," as the lead-off under "Field and Forest." Then I realized that bumper stickers are only clever generalizations—not all overpopulation begins at home! Later, I learned that Chairman Glenn D. Chambers positioned the paper to emphasize the impact of too many people on fields and forests. Howard spoke lucidly and forcefully but did not follow his text. I have chosen to brief the latter because it is more inclusive. It begins with the now familiar population story, including some fresh examples, "The population of the world is growing by about two percent per year. At this seemingly low rate of growth . . . each one of us could have 300,000,000 living descendants" a thousand years from now. Howard merits further approbation for being, I believe, the only speaker at the Conference to insist upon the recycling of wastes—we in the United States, although only six percent of the world's population, produce 70 percent of its solid wastes. I applaud also his mention of the tragic case if the Aswan Dam, a tragedy that has proven even more rapid and extensive than the dire predictions of ecologists before the dam was constructed. As an American, I am glad that we had no part in the irreversible ruination of the floodplain agriculture and offshore fishing that sustained a great civilization for four thousand years. I hope that every decision maker pressured to

discount the warnings of ecologists will be impelled to write on the blackboard a hundred times: "Remember the Aswan Dam." As Howard said, "Ecological ethics must replace ecological atrocities."

A Canada goose tagging program in Wisconsin, that relied heavily on automatic data processing, was described by senior author George K. Brakhage. The kill was brought under control, hunting pressure spread out, and the quality of the hunting experience improved. Alexander T. Cringan felt that great increases in beaver and pileated woodpecker populations in Ontario were contributory factors in the great rise in wood ducks. Data derived from banding provided information on age, sex, and migratory patterns.

C. J. Martinka reported on the grizzly population of Glacier National Park in recent years, the number of human confrontations and injuries, and declining injury rates following an expanded information program. The injury rate reached a maximum of 1.7 per one million visitors between 1956 and 1960, never enough to challenge the ferocity of the automobile.

Donald M. Christisen proved, if I understood his statistics, that squirrel hunters are happiest shooting high squirrels for low bag limits; a high bag limit taxes the skill of the average hunter and lowers his spirits. If this confuses you, don't go squirrel hunting until you read the paper!

I was mightily pleased that endangered species made the program for a recent trend in conservation has been the widespread public interest in endangered species. Eley Denson and Harry Goodwin did not claim any credit for this, but I feel certain that the Endangered Species Act of 1966, which was discussed, contributed to public awareness. The groundswell of interest has been especially evident in the case of marine mammals, particularly whales. This may have been sparked by the critical acclaim accorded whale songs recorded off Bermuda by Payne and Watlington, incorporated in a symphonic score by Hovhaness, and played by the New York Philharmonic. The *Song of the Humpback Whale* record became a fast seller, and the *Saturday Review, Natural History,* and the *National Geographic* all published articles supporting greater efforts to save the endangered large whales. Excellent movies were made and televised and Secretary Hickel earned the plaudits of conservationists by forbidding the importation of whale products. Even non-mammalogists, like the present speaker and his wife, have gone whale watching in Baja California, on tours sponsored by the San Diego Museum of Natural History.

Although the excitement in a conference may reach peak proportions in sessions devoted to hot issues like oil, most of us, I believe,

derive real satisfaction from listening to wildlife management presentations that deepen our understanding of some aspect of nature. Like "Field and Forest" on Tuesday morning, "Inland, Coastal and Marine" on Wednesday morning was such a session, and the papers presented represented a cream of a larger number offered to Chairman David Wallace.

In a very informative opening paper, James C. Bartonek, James G. King, and Harvey K. Nelson discussed the big problems of migratory birds in our biggest state, which has one-half the nation's coastline, two-thirds of its continental shelf, and wildlife resources in proportion. Oil production, coal mining, chemical manufacture, pulp mills, lumbering, log rafts, introduced predators, and impoundments are present or potential hazards. There should be "nationwide concern for the welfare of migratory birds in Alaska," the authors contended, for whatever happens to waterfowl and non-game birds there will be felt throughout much of North America. "It would surely be a national tragedy" if such populations "are decimated during the Environmental Decade without even being properly described."

Calvin J. Barstow deplored damage to the wetland ecosystem of the Obion and Forked Deer Rivers in Tennessee caused by a Corps of Engineers channelization project. He offered reams of statistics supporting proposed restoration of wetland habitat by providing water management and acquisition of 44,425 acres. I hope the four citizens suing under the National Environmental Policy Act of 1970 win the case; a captive stream flowing between straightened banks has lost both its beauty and its varied ecology.

Again the Conference was in tune with the times in having wetlands included on the program, for one of the environmental trends of the past year has been greatly heightened activity in preserving coastal wetlands, the vitally important and irreplaceable nurseries of marine organisms and the most productive of all vegetative zones. Joseph S. Larson reported that a team of scientists at the University of Massachusetts are formulating a decision-making model for public management of fresh-water wetlands. This should prove useful not only to planners but to citizen groups that have become increasingly active in many areas, working alone or in concert with conservation agencies like The Nature Conservancy, which has been notably successful in preserving Lignumvitae Key, Shell Key, Gulf Hammock and other Florida wetlands, several Virginia Barrier Islands, further acreage around San Francisco Bay, and estuarine and fresh-water areas elsewhere.

In 1958 Dr. Kalmbach really did homework. He reported that in the preceding 29 years only three of 1777 Conference papers had

discussed people pressure. Virtually every Conference since has reflected increasing concern with human behavior considerations. John C. Hendee and Dale R. Potter reported upon an evaluation of human behavior issues in wildlife management found in more than one thousand theses, articles, bulletins, proceedings, etc. This, and related analysis, will provide direction for research into the influence of human factors of wildlife management.

I always regret that some politicians and bureaucrats find it necessary to place dollar signs on wildlife resources—I wonder how many of them would withhold love until their mother's monetary value had been established—but so long as this perversion of economics rears its gloomy head we must applaud careful and usable computations. Gale C. Jamsen and Paul V. Ellefson reported upon Michigan's salmon-trout fishery: "Approximately 200,000 licensed salmon-trout fishermen fished 1.8 million days. Over 200,000 steelhead, more than 400,000 salmon, and about one-quarter of a million lake trout were creeled. The net economic value of the salmon-trout fishery approached $700,000 for the first four months of 1970. The capitalized value of the fishery for this period is roughly $12.7 million.

As a convert to fire as an ecological tool, with considerable experience in the Georgia quail country, I was especially interested in Bruce M. Kilgore's detailed study of the use of fire to manage red fir forests. His conclusion that it would seem desirable to allow most lightning fires in red fir forests to burn without suppression if natural environmental conditions are to be maintained should, I believe, be coupled with the explanation that in the high elevation ecosystem discussed natural fires usually die out in a few acres, as noted in his paper but not in the abstract.

In Technical Session No. 2, devoted to "Conservation Communications," and chaired by George C. Halazon, Glen F. Cole said that ungulates in four RockyMountain parks maintained relatively stable populations under harsh conditions; the regulatory effects of predators have been overestimated; and free ranging, not artificially concentrated, ungulates do not overgraze their food supply. Howard Gray substituting for James A. O. Crowe, read a Washington press release announcing the good news that a large number of Youth Conservation Camps would be established across the country this summer, then read Crowe's paper describing the origin and on-going development of the Outdoor Writers Association of America's program to get the message of conservation across to young people.

Harold W. Steinhoff analyzed the economic problem of evaluating the wildlife values of the Kenai Moose Range, but I stubbornly

daydreamed about the thrill of watching a moose feed without even thinking of tangible, intangible, or incommensurable values. Steinhoff's slides were splendid, and his description of the tehniques of assessing values was informative; as nearly as I could gather the annual balance for the Kenai Moose Range was $16 million. I'd fight just as tenaciously to preserve this Range, however, if someone computed its annual value as only one million!

On the panel, "Mass Media in Keeping the Public Informed of Environmental Problems," editor Clare Conley said that *Field and Stream,* with eight million readers a month, carries more conservation material than any other commercial magazine, and also reaches many persons who do not read conservation publications. Hard-hitting Michael Frome, head of the magazine's Conservation Department, has been called the Ralph Nader of conservation. Increasingly more wildlife research results are being presented. Conley expressed his concern about the growth of anti-hunting sentiment, stimulated in part by the naivete of television.

Robert Northshield, of NBC News Division, disclaimed having had anything to do with "Say Goodbye," in fact, he hadn't even seen it. He approved rise of interest in the environment, but not the reason for it—a mistaken belief that environmental matters were simple, and, therefore, appealing in this day of unsolvable complexities. Environmental interests even bridge the generation gap. The last documentary he did was "Man's Thumb on Nature's Balance," which cost about $150,000 to produce and was a dead loss since it was a sustaining program. He reported that public response was overwhelmingly negative, but the Conference audience vociferously expressed approbation. He ended, "We have nothing less than a world to save, and it won't be cheap. But we have to keep telling the people."

The Corporation for Broadcasting Environmental Projects failed to keep the public informed because neither Wayne Miller, nor his text, arrived. This sole Conference "no show" left time, however, for lively discussion of the role of both printed media and commercial television.

The concluding General Session, like the opening one, was chaired by a distinguished educator. Cornelius H. Siemens, President of Humbolt State College, introduced the speakers who addressed themselves to the theme "National Well-being Demands Solutions."

Dr. G. W. Irving, Administrator of the Agricultural Research Service, of the U.S. Department of Agriculture, presented the Service's B. Y. Morrison Memorial Award, a bronze commemorative medal named for the first director of the National Arboretum, to Professor Ian L. McHarg, of the University of Pennsylvania. Dr.

Irving thanked the Wildlife Management Institute for co-sponsoring the B. Y. Morrison Memorial Lecture and expressed gratitude to the Conference for providing such an outstanding audience for such a distinguished lecturer—a teacher, practicing landscape architect, planner, writer, and lecturer, who is in the vanguard of ecological planning in the United States. Mr. McHarg then proved the correctness of his title, "Man: Planetary Disease." He had arrived but minutes earlier, having come from Philadelphia by jet, finally by helicopter tossed about by high velocity winds. He spoke in similar tempo so I certainly missed some wisdom and witticisms. All who enjoyed his incisive listing of men the planet could live without, his Scottish accent, and his provocative humor would agree that his talk defied summarization. His message was clear and did not need shock words for emphasis: "We cannot indulge the despoiler any longer . . . Yet growth is inevitable and must be accommodated. What should guide the nature and location of development, the preservation of natural processes, and beauty? Certainly not the prevailing thinking which, observed dispassionately, would seem to suggest that water is made to be fouled, air to be polluted, marshes to be filled, streams to be culverted, rivers to be dammed, farms subdivided, forests felled, flood plains occupied, and wildlife eradicated."

James W. Moorman had the difficult task of bringing the audience back to sober consideration of undramatic but crucial legal questions of individual rights and responsibilities in the quest for a quality environment. After reviewing some of the difficulties of individual action—in most cases of air pollution you "don't know how you are being assaulted and you don't know who to sue"—he concluded, "The individual, I contend, can have an impact on environmental problems only to the extent that he is able to influence the decisions of government and business." In my opinion, Mr. Moorman's paper was so significant that it should be read by everyone concerned about what can actually be done to influence the great decisions of government. He characterized the National Environmental Policy Act as "a powerful tool for the reconstruction of our environment but not self-executing." He pointed out that, "We are involved now in some knock-down drag-out fights and expect more. The SST and the Alaska pipeline are examples. The people who work in our federal agencies may be forced to make a choice; many may find their very jobs dependent on the choices they make. Much may depend on how many are willing to place the environment above salaries, to put wildlife above pensions." In addition to courage on the part of civil servants, he stated, "Upon men of knowledge rests, today, perhaps the heaviest responsibility of all. Those who have a stake in decisions often ignore

the data or information which would call for the defeat of their pet projects. Yet we must all believe that the best decisions are based on full knowledge. . . . The responsibility that falls on those involved, such as scientists, because of their special knowledge and abilities, may entail some serious sacrifices. Job security, research programs and high pay are hard to turn one's back on."

Dennis Hayes, National Coordinator of Environmental Action, spoke forcefully on the question "Youth Cares—Do you?" He said that the youth of this country are angry, impatient, scared to death, and seeking concrete evidence that adults are seriously committed to doing whatever may be necessary to bring our planet back from the brink. He emphasized that: "They aren't in the least bit interested in what you say. EVERYBODY *says* the right things. . . . We still have the capacity to ensure a future worth having for our children. We will not be able to do it without sacrifice; we will not be able to do it without militance and courage and stamina. But—if we don't let one another down—it can still be done."

The program committee must be thanked for its perspicacity in selecting Shirley A. Briggs, of the Rachel Carson Trust for the Living Environment, to end the Conference. She described her role as an "intermediary, trying to keep up with your discoveries and ideas, and bringing them to public notice." Her talk must be read in its entirety to be appreciated fully; a few vignettes may stimulate such perusal: "The experience of living, even briefly, in harmony with nature, must be a direct personal one. Two ways in which a great many people can experience this are gardening and the recreational use of natural areas, where there are many possibilities for learning ecological principles. . . . If we consider the highest mental potential of man, we might attain a way of life with environmental health instead of gross national product as our goal, and with the ultimate status symbol in personal achievements and satisfactions rather than material consumption. . . . Aldo Leopold said, 'One of the penalties of an ecological education is that one lives alone in a world of wounds.' Perhaps the first task of those so afflicted is to try to become less alone—to show our fellow citizens how to recognize the wounds, the reasons for them, and the possible cures. The present furor over environmental pollution has come from some successes in teaching this lesson."

At the end it has become traditional for summarizers to comment upon the format of the Conference. On several matters there has been unanimity. "Pink" Gutermuth for many years, and now Dan Poole, and their staff have consistently achieved a peak of smooth arrangements the envy of all every involved in a convention responsibility. Of

the three major aspects of the meeting—(1) General Sessions, (2) Technical Sessions, and (3) personal contacts—no one ever complains about the third, and the high noise level in the corridors offers testimony that communication is not a problem area.

The General Sessions appear to meet with general approval. The speakers for these are carefully selected by the large and widely representative Program Committee and usually offer fresh insights and new ideas instead of belaboring the obvious. Certainly this year the General Sessions were exceptionally stimulating. I would mention only one note of nostalgia—no speech by Gabe! Over the years his knack for saying what needed to be said and saying it forcefully and colorfully endeared him to all. Remember 1968 when he warned against playing "brinkmanship" with pollution . . . "of slamming the door on the horse's tail," and won the summarizer's MacMullan award for the most succinct statement of the Conference, "I know of no case where delay resulted in more efficiency or greater economy."

The unsung heroes of each Conference are the session chairman and the vice chairmen or discussion leaders, who assist them. Few delegates realize, I believe, that the chairmen of the Technical Sessions are responsible for implementation of the session theme; they have the unenviable task of selecting only six papers from a much larger number of proferred contributions to knowledge. In one instance at this Conference, I was told that selection had to be made from 25 good offerings.

For many years there were seven papers at each Technical Session and many objected that there was insufficient time for discussion. The number was reduced to six this year and I heard complaints that there were not enough technical papers! There is no possibility of lengthening the meeting; many arrive on Thursday or Friday for related meetings and are broke or exhausted, or both, by the following Wednesday afternoon. Yet the related meetings, both prior to the opening of the Conference and on Tuesday afternoon, contribute mightily to the large audience and to the interest of the Conference. I know that I am always distressed that there are so many competing attractions that I would enjoy taking in, especially on Tuesday afternoon. The only possibility for adding more technical papers would be to schedule three concurrent sessions at certain times; I believe that the Program Committee might give serious consideration to experimenting along these lines next year. I have mentioned my frustration at not being able to attend two sessions at once; three would be sheer hell for the summarizer, but the room-packed audiences at Technical Sessions this year may be additional argument for added sessions.

Staff consideration has been given to allocating some program time to contributions related to the region in which the meeting is being held—specific environmental problems, management of typical local species, etc. This idea appeals strongly to me; there would be both practical and sentimental appeal to hearing about jaguar biology *in Mexico.*

A single note of advice to those preparing abstracts of their papers may be in order. Your abstract is not only useful to the summarizer, but is also the usual basis for news releases prepared for distribution in the Press Room. The abstract should, therefore, be as informative as possible, actually giving the results of your research and not just saying that you are going to describe the results. Any qualifications of the conclusion reached should be included; otherwise a news story lacking an essential disclaimer of this sort may place you in a bad light publicly.

The banquet on Tuesday evening was well attended as always and everyone present, I feel sure, approved the Wildlife Society's choice for the coveted Aldo Leopold Memorial Award, which was presented by Society Vice President Ralph A. MacMullan to Dr. Stanley A. Cain, professor of conservation and director of the Institute for Environmental Quality at the University of Michigan. It was the impression of many of those present that Dr. Cain was truly taken by surprise, something which is hard to achieve but adds a special quality to the presentation when it does occur. The long tradition of good entertainment and no speeches was adhered to as I hope it will be for long to come.

I have never subscribed to the dictum that all Hilton hotels are the epitome of fine innkeeping, but I must record that the Portland Hilton impressed me as being unusually efficient in registering guests and in caring for their needs, that the meals were good to outstanding in its various restaurants, and that the employes were far more pleasant and courteous than in most eastern hostelries.

So what's new that the Conference didn't include? Actually very little when it is remembered that the eagerly sought places on technical sessions must be applied for about nine months in advance. There were a few 1970 biological discoveries, only partly North American, that merit mention: bats of several species were shown to have keen sight; lion's whiskers were found to be arranged in patterns as individually diagnostic as fingerprints; Australian coral reefs decimated by the Crown of Thorns starfish evidenced recovery far faster than predicted; saimangs were recorded singing duets; and it was proved that birds in V-flight achieve maximum aerodynamic efficiency.

A biological surprise with great potential for good and evil was the accidental discovery that PCPA (para-chlorophenylalanine), a drug used to reduce blood pressure, was apparently a true aphrodisiac. This offers the possibility of facilitating the propagation of endangered species, such as the cheetah, that have rarely been bred in captivity. Unfortunately, PCPA may have wider application of adverse environmental effect; people breed too successfully now!

An environmental matter that should occasion future discussion is air pollution, in which 1970 set unenviable new records, not only in the United States, but also in Japan, Germany, Scandinavia and Chile. In July, smog blanketed the East Coast from Boston to Atlanta for a week. In California, the Forest Service began cutting some of the million plus pines killed by smog; in the San Bernardino Forest alone, 46,000 acres of pine were reported as nearly dead. Strangely, although there have been many studies of air pollution effects on vegetation, I have encountered none devoted to animals, other than man. Research on this is urgently needed.

Did the Conference live up to its grand theme, "Resource Use and Quality of Life?" My answer must be that it made a valiant attempt to do so, but that the ferment engendered by "Earth Day" could not fully infiltrate a program settled last autumn. The record attendance of 1,571 registered, and an estimated 1,700 in attendance at one time or another, was a vote of approval for the Conference offerings, the session attendance was uniformly SRO, and for the first time in my memory, five to seven questioners stood in line at several sessions awaiting their turns at the microphone. Two women gave excellent presentations; there should be more next year.

High school and college students attended many sessions in goodly numbers and several of them contributed effectively in the discussion periods. My only original recommendation to the Wildlife Management Institute is that one or two students who indicate keen interest at a Conference be selected to attend next year's Conference at Institute expense and to appear on a panel discussion. The young man who reported at Portland that he had sold his car to avoid contribution to air pollution and then had found great difficulties on the morning of the meeting finding a place to park his bicycle that wasn't restricted to automobile use might have something equally pertinent to report in Mexico City. We must, I submit, enroll the aid of youth in the attempt to answer the prime question that surfaced frequently at Portland, "Where do we start to recycle ourselves to a less consumptive standard of living?"

And now I end my summary of an unusually vital and relevant Conference. It began on the high note of Dr. Nash's plea for a

conservation ethic and ended appropriately with Shirley Briggs' apt quotation from Irston Barnes, "Is there not room for a conservation ethic that would be concerned with the conservation of what is best in the human personality and spirit?"

Travel safely on your return migration,

AND KEEP YOUR ECOLOGIC CONSCIENCES CLEAN

CLOSING REMARKS

C. R. GUTERMUTH

Chairman, Program Committee, 36th North American Wildlife and Natural Resources Conference

First of all, I am going to again thank Mr. Siemens and Mr. Woods for taking charge and handling this program.

Now then, starting a quarter of a century ago, since these large conferences are so comprehensive and so difficult for people to hear all of the papers, we adopted a practice of having a program summary and appraisal. This has been our attempt to draw together the many things that have been presented in this large international conference.

And as you can imagine, it has been quite difficult, year in and year out, to get an outstanding person to take on this thankless job because, after all, it is a difficult one.

This year we were extremely fortunate in having a very distinguished scientist, a friend of mine of many years standing, and an extremely active conservationist, the director of perhaps the most outstanding museum in this country, take on this important assignment.

Thank you very much, Dr. Netting. That was a truly outstanding summarization and critique of the program. We are most appreciative to you, Dr. Netting, for taking the time from your busy schedule to do this and I am sure that everyone appreciated your presentation very much.

We are near the close of another highly successful conference and at this time, I want to express thanks to those who have again helped to make this such an outstanding success.

Our sincere thanks go to Keith G. Hay of the American Petroleum Institute, who represented The Wildlife Society as the Vice Chairman of the Program Committee this year. Keith was exceedingly helpful and very perceptive and highly constructive throughout the formulat-

ing of the program. We are indebted to him and to Dr. Fred G. Evenden for their cooperation and assistance.

I also wish to recognize the splendid assistance that was received this year from the Institute's new vice president, Dr. Laurence R. Jahn, especially since Larry really served his apprenticeship in program planning this year.

The Institute also owes much to all of the other national conservation organization and professional societies and to the state, provincial and federal agencies that have made this conference the tremendously successful annual affair that it has become in its 56 years of existence. Thanks to all of the cooperators for their continued participation.

We likewise are grateful to the working press. While I seldom get to see a newspaper during the conference, I am confident that we had good coverage this year. Surely some of the outstanding talks that were presented here will be featured by the newspapers and magazines throughout the country. The new editor of the Institute's *Outdoor News Bulletin,* Lonnie L. Williamson, has done an excellent job in putting out press releases on the conference and on the papers that have been prepared and presented in both the general and technical sessions. I wish to thank him, along with the wire services for their cooperation.

We are grateful to the Convention Bureau of the Portland Chamber of Commerce for providing the efficient and courteous personnel to handle the conference registration desk. Local clercical services are needed for this important function and this assistance is greatly appreciated.

Before going any further, I would like to recognize a few of the old-timers here in the audience, since it always is inspiring to see so many present at this closing hour.

Normally, in closing, I have introduced several very patient wives who also contribute much to the success of these meetings and it is my privilege this year to introduce them and ask them to rise: Mrs. Gabrielson, my wife Bess, Mrs. Poole, and Mrs. Jahn.

Among some of the old-timers and faithful workers whom I miss seeing here now, and in one case in particular, it really grieved him since this is the first conference that he has missed in about 35 years, is Dr. Daniel L. Leedy. He was the program summarizer last year and did an outstanding job. Dan has been in and out of the hospital with a serious spinal operation.

Another absentee is Henry Clepper, the retired secretary of the Society of American Foresters, who has been a tremendous help to us in formulating the conference program for a quarter century.

Well, this probably will be my last time to publicly express thanks to the members of the Institute field staff, who, for many years, have been a great help to me in staging these conferences. This also includes their wives, who always have pitched in whenever emergencies arose and helped with the conference registration and with other chores. I am pleased to express my personal thanks and that of the Institute to all of these co-workers.

Time is fleeting, so I had better bring this to a close. We wish to thank the Portland Hilton Hotel for its good service, good food and because it has been an excellent host hotel. Also, our thanks to the Congress Hotel, no complaints there either.

We now are down to the subject of registration. I am pleased to say that we had the largest registered attendance in the history of this conference. The last figure indicates that there were some 1,571 registered. This means, of course, that we must have had in the neighborhood of 1700 people present. When you say all of the youngsters and other people going in and out of the meetings without badges, it does indicate that the attendance was way up this year.

I also wish to thank the Jack Morton Productions because they have been putting on the banquet show for many years and I thought last night's entertainment was again up to standard.

Now, then, friends, I was the program chairman of the Conference in 1946 in New York City, so this completes 26 of these large international meetings that I have staged. This is somewhat of a record.

I was just doing some figuring, Larry, and if you stay around and do the job as long as I have, it will take you up to around the year 2,000. Therefore, you have a record to work for.

Friends, I am most grateful for the splendid cooperation that I have received from all of you people, the Institute staff, members of The Wildlife Society and all of the other organizations throughout the years. I think these have been highly successful meetings despite some of the criticisms we have heard, people wanting to change things.

As I brought out at The Wildlife Society meeting last Sunday, we always are interested in improving and bettering the program and the meetings and I think we have been most progressive.

I believe that the conference will continue to improve. We like, for example, to have your views and such recommendations as having more ladies on the program. I think that the Program Committee, which will have its first meeting next month in order to make plans for next year's conference, will give careful consideration to all of these suggestions that have been proposed at this meeting, along with other recommendations.

With that, I am pleased to say that the next conference will be held south of the border, in Mexico City, in the beautiful, new, Camino Real Hotel on March 12-15, 1972.

I hope that none of you will find it too difficult in getting travel authority to attend that meeting. Also, take your wives along and plan a visit to Mexico, both before and after the conference.

With this, I wish all of you a safe journey home. Happy landings.

The conference is now adjourned.

* * *

REGISTERED ATTENDANCE

ALABAMA

W. L. Holland, Charles D. Kelly, Earl F. Kennamer, James Earl Kennamer, Art Kennedy, Raymond D. Moody, Dan W. Speake, R. B. Williams III, Mrs. R. B. Williams III.

ALASKA

Rupe Andrews, James C. Bartonek, Ed Bellringer, Bud Boddy, Thelma Boddy, Darwin S. Braden, Frederick C. Dean, Salvatore DeLeonardis, John L. Hall, Charles Iruine, James G. King, David R. Klein, Geoffrey Larminie, Don McKnight, Alex McRea, William R. Meehan, Urban C. Nelson, Mrs. Urban C. Nelson, Wallace H. Noerenberg, Sig Olson, Robert A. Rausch, Lt. Thomas Ray, Harry L. Rietze, George F. Roskie, Howard S. Sears, Ltc. W. C. Tomsen, Lt. Kenton D. Wahl, Gordon W. Watson, Robert B. Weeden.

ARIZONA

Ron Batchelor, Steve Black, Kenneth Brown, Nan Clemons, Phil Clemons, Phil Cosper, Polly Davs, Ray Davis, Lawrence J. Ethelbah, C. Roger Hudgerford, Robert A. Jantzen, Lawrence E. Powell, DeWayne Smith, Lyle K. Sowls, Nancy Sullivan, Tom Sullivan, N. A. Winter.

ARKANSAS

William J. Allen, Mrs. William J. Allen, Randy Boone, Richard W. Broach, Dave Donaldson, Robert M. Jenkins, Don Jones, John C. Sunderland, Randall G. Taylor.

CALIFORNIA

Philip H. Arend, Ray Arnett, Mr. and Mrs. Bob Behme, Jack Bernard, Jim Blaisdell, John C. Borneman, David R. Brower, Stanley A. Cain, Guy Connolly, Christian Day, George D. Difani, Chris Difani, Jonathan P. Ela, Frank F. Farley, Mr. and Mrs. Edward M. Gaines, Tom Gaines, Mr. and Mrs. Seth Gordon, Milton Haderlie, Harold Harper, Dr. John G. Hewston, Marvin C. Hoffer, Gerald V. Howard, Paul Howard, Dr. and Mrs. Walter E. Howard, Richard L. Hubbard, Leonard G. Hummel, Eric V. Johnson, Huey D. Johnson, Garnet Johnson, Bob Jones, Marion Jones, Lt. Col. N. Kavakich, Bruce M. Kilgore, Fred Kindel, James R. Koplin, Frank M. Kozlik, Bob Latimore, Steven C. Lattarine, Howard R. Leach, Douglas R. Leisz, A. Starker Leopold, Kenton C. Lint, W. M. Longhurst, W. G. Macgregor, Joan McIntyre, Albert B. McKee, Jr., John S. McLaughlin, Patrick J. Marley, Elwood R. Maunder, Wendell Miller, Monty E. Montagne, Ray Nesbit, Robert L. Nevin, Thomas W. Riley, James B. Ruch, Earl D. Sandvig, Al Schiavon, C. H. Siemens, Tod Sloan, Vern Smitch, A. Edwin Smith, Dr. Dale Straughan, Donald Swain, Gene R. Trapp, F. John Ward, George W. Webber, Barbar Westree, Sanford R. Wilbur, J. Marton Winton, Ruth Winton, Lillian Witt, Dr. Charles F. Yocom.

COLORADO

Maurice D. Arnold, James Bailey, Thomas A. Barber, Joan N. Barrows, Pete Barrows, Delwin E. Benson, Clait E. Braun, Marshall S. Carter, Mr. and Mrs. Alex Cringan, James C. Cruse, Mr. and Mrs. Joseph Dado, Eugene Decker, R. N. Denney, Richard B. Eggen, Robert R. Elliott, James Enderson, Robin H. Fields, Charles A. Gebauer, Fred A. Glover, A. F. C. Greene, Jack R. Grieb, Dale Hein, Mr. and Mrs. Ralph R. Hill, Dale A. Hoffman, Jack Hogue, Gilbert N. Hunter, R. C. James, Mrs. C. M. LaLonda, Alfred T. Lewis, Charles M. Loveless, Charles L. Mahoney, Clifton Merritt, Ruth Ann Monson, Eldie Mustard, Leslie Oliver, Gary G. W. Robinson, Wayne W. Sandort, Chuck Schwartz, Dwight R. Smith, Harold W. Steinhoff, Dean Suttle, G. A. Swanson, James M. Sweeney, John R. Sweeney, Joe Townsend, George H. Wallen, David E. Wesley, Harry R. Woodward.

CONNECTICUT

John M. (Frosty) Anderson, Roland C. Clement, Peter A. Jordan.

DELAWARE

William K. DuPont, Austin Heller, Anthony Higgins, Robert E. Jones, Wilbert Rawley, Norman Wilder, George R. Wright.

DISTRICT OF COLUMBIA

Stewart Brandborg, Michael Brewer, J. A. Brownridge, Tom Carver, John Chattin, Louis S. Clapper, Harold J. Coolidge, Harry Crandell, George Crossette, Frank Daniel, Stuart Davey, Jim Davis, Robert K. Davis, Philip A. Douglas, William J. Duddleson, Fred Evenden, F. H. "Pete" Farrar, Jack Fauntleroy, Mrs. Claudelle Gaddis, H. R. Glascock, Jr., C. R. Gutermuth, Mrs. C. R. Gutermuth, Keith Hay, Martha T. Henderson, Robert F. Hutton, George W. Irving, Jr., Robert E. Jones, Thomas L. Kimball, Willis King, John V. Krutilla, Paul A. Lenzini, Joe Linduska, Dr. Richard T. Marks,

James W. Moorman, Cliff Morrow, William J. Napier, Gene Oren, Daniel A. Poole, Mrs. Daniel A. Poole, Nancy Pratico, Hamilton K. Pyles, Boyd L. Rasmussen, Robert B. Rathbone, William L. Reauley, William K. Reilly, Maj. Gen. Maxwell E. Rich (Ret.), P. M. Roedel, Richard J. Ronk, George C. Ruhle, Pete Samsell, Joseph F. Silbaugh, W. M. Spaulding, Jr., W. W. Steiner, Don Strode, Dick Stroud, Dottie Taylor, Bill Towell, James B. Trefethen, O. L. Wallis, Lonnie L. Williamson, Mrs. Lonnie Williamson, Mrs. Adele N. Wilson, Gordon K. Zimmerman.

FLORIDA

Eugene Knoder, Jack Lowe, Don Southwell, Doris Southwell, George P. Spinner, Julie Spinner, Gordon Spratt, Alexander Sprunt, H. E. Wallace, Richard Whiteleather.

GEORGIA

C. Edward Carlson, Jack Crockford, Duff Holbrook, Mr. and Mrs. Jim Morrison, Jr., Carroll J. Perkins, Paul A. Shrauder.

HAWAII

Eugene Kridler, Jerry Pratt.

IDAHO

Duane A. Asherin, Elwood G. Bizeau, Bruce Bowler, Arnold Coleman, Paul Cuplin, Paul D. Dalke, H. Tom Davis, L. Dean Davis, Ernest E. Day, A. W. Erickson, Ed Fournier, Al Franzmann, Paul Fritz, James R. Gilbert, Hugh Harper, E. W. Hartung, R. J. Holmes, Maurice Hornocker, Ken Hungerford, James Keating, Franklin Jones, Steven Judd, Bob Kalb, Paul C. Keeton, Dwight H. Kilgore, Jr., Dick Knight, Mrs. Richard Knight, Michael N. Kochert, Philip Laumeyer, Kent McAdoo, Herman J. McDevitt, David L. McMullen, William Mautz, John P. Messick, Don Miller Levi Mohler, William H. Mullins, H. T. Nelson, Elmer R. Norberg, Mark L. Orme, Ralph V. Pehrson, Roy Pennike, Mr. & Mrs. Liven Peterson, Pete Printz, Frank B. Renn, Monte Richards, Dorothy Sanborn, Grant Sanborn, Clyde A. Scott, Glenn Stanger, Doyal Stiles, Harry R. Stivers, Judy Sunderland, Edward E. Tilzey, Lester E. Trout, Dale Turnipseed, James L. Wallace, Lanny O. Wilson, John R. Woodworth.

ILLINOIS

Bill Anderson, Geo Arthur, Henry N. Barkhausen, Mr. and Mrs. Frank Bellrose, Andy Boehm, George V. Burger, W. D. Klimstra, Ed Kozicky, John N. Krull, Richard Liewald, John Madson, Jim Moak, Jay Neubauer, Charles E. Olmsted, John Piazza, Frederick C. Pullman, Glenn C. Sanderson, Sarah Vasse, W. D. Vasse, Dale E. Whitesell.

INDIANA

Scott Fisher, Stacy Gebhards, Mrs. Helen Wildernuth.

IOWA

Bob Barratt, W. C. Brabham, Mr. and Mrs. Arnold O. Haugen, Raymond C. Hubley, Jr., Eugene D. Klonglan, Michael K. Peterson, Fred Priewert, Max Schenpf.

KANSAS

Warren Ballard, Jr., Bill Fowler, Wa Dean Fowler, George C. Halazon, Jack Haley, Geo. C. Moor, Alice Robel, R. J. Robel, Fred Sears.

KENTUCKY

F. R. Scroggin, Mrs. Jane Scroggin.

LOUISIANA

Joe L. Herring, Clark M. Hoffpauer, Janice S. Hughes, Robert L. Jarvis, John D. Newsom, Lyle S. St. Amant, Richard K. Yancey.

MAINE

George W. Buckman, David E. Capen, Malcolm Coulter, H. L. Mendall, Mrs. H. L. Mendall, Howard E. Spencer, Jr., James R. Vilkitis.

MARYLAND

C. E. Addy, Martha Jean Addy, Thomas S. Baskett, Ralph A. Bitely, Shirley A. Briggs, Esther Burghardt, Walter F. Crissey, Frank L. Davido, Arthur A. Davis, E. H. Dustman, Brenda Galbreath, Hugh Galbreath, Alfred D. Geis, Mr. & Mrs. Harry A Goodwin, Duncan MacDonald, Albert E. Sanderson, Jr., Robert F. Scott, Lt. Col. Richard H. Wagner, Dr. James W. Watham, Clark G. Webster, Helen L. Webster.

MASSACHUSETTS

Douglas W. Beach, Frederick Greeley, Joseph S. Larson, Russell T. Norris, Bill Sheldon, James M. Sheperd, Robert D. Simpson, Les Smitch, Jack Ward Thomas.

MICHIGAN

Charles Abbey, John A. Bissonette, Carol Cornell, Donald W. Douglass, Joseph Engelhard, R. J. Erickson, Gene Gazlay, Orin Gelderloos, Charles D. Harris, Mr. & Mrs. Gale C. Jamesen, Mr. & Mrs. David Jenkins, John Kadlec, John Kitchel, Ralph A. MacMullan, Martin Magnuson, Stanley Marcus, Tony Marks, Dale McCullough, Clyde McIntire, Edward J. Mikula, Charles Monan, M. L. Petroskey. George A. Petrides, Bud Purcell, Branch L. Ryan, Jr., Mildred Ryan, Lawrence A. Ryel, Mrs. L. A. Ryel, Joe Strait, Irene Strait, Paul H. Wendler, Phoebe Wendler.

MINNESOTA

George Brakhage, Edward S. Crozier, C. E. Faulkner, Lewis R. Garlick, Maxine M. Garlick, Mr. & Mrs. Gordon Gullion, Joe Harn, Arthur S. Hawkins, James Jack, Sam Jorgenson, Ron Schara, Donald B. Siniff, William Stevens, John Tester, James Thompson, Mrs. J. S. Thompson, David B. Vesall, Dick Wettersten.

MISSISSIPPI

James L. Baker, Glenn D. Chambers, Billy Joe Cross, Sherman Kelly, Ross Shelton.

MISSOURI

Mrs. Allen Brohn, Mr. & Mrs. Allen Brown, G. Edward Buddle, Robert S. Campbell, Glenn D. Chambers, D. M. Christisen, Earl P. Coleman, Wm. H. Elder, Leigh H. Frederickson ,Larry R. Gale, W. Reid Goforth, Ray A. Heady, A. B. Jackson, Jr., Leroy J. Korschgen, Don Lamb, Harry Mills, Mrs. Harry Mills, Carl R. Noren, Charles Purkett, C. W. Schwartz, Elizabeth R. Schwartz, Vern Sievert.

MONTANA

Roger Bumstead, Mrs. Patty Calcaterra, Robert L. Eng, H. Frank Evans, Bebe Fitzgerald, Howard Foulger, H. William Gabriel, John T. Harris, Donald A. Jenni, David W. Kitchen, Richard J. Mackie, James Malkowski, C. J. Martinka, Don McIntosh, Tom Mussehl, Mrs. Tom Mussehl, Bart O'Gara, Leslie W. Pengelly, Robert Ream, William Tomlinson.

NEBRASKA

Curt Abdouch, Phil Agee, Bill Bailey, Willord R. Barbee, Bruce Cowgill, Frank Deatrich, Mr. & Mrs. Wade Hamor, Charles L. Homolka, Ken Johnson, Gary Schlichtenmeier, Carl W. Wolfe.

NEVADA

Robert Adair, Ted J. Angle, Thomas A. Atkinson, Les Boni, Walter N. Campbell, Joseph C. Greenley, Frank W. Groves, Richard Heap, Donald Seibert, Clarence M. Skau, Ronald Stroh, Kay Sylvester, Vernon E. Sylvester, Paul T. Teuller, John E. Wood, Jim Yoakum.

NEW HAMPSHIRE

Hilbert R. Siegler.

NEW JERSEY

William Gusey, E. Budd Marter III, Martha M. Marter, Ted S. Pettit, Calvin W. Stillman, Car H. Thomas, Walter J. Wenzel.

NEW MEXICO

Raymond J. Buller, John E. Crawford, Ladd Gordon, Volney W. Howard Jr., Bill Humphries, Wm. D. Hurst, Dale A. Jones, Doyle Kline, Max Linn, W. O. Nelson, Jr., Walter A. Snyder, E. A. Swenson.

NEW YORK

John Bain, Tom J. Cade, Charles H. Callison, Peter Q. Eschweiler, Lawrence Hamilton, Harry Hampton, William Hilts, Mrs. William Hilts, Doris Jenkins, W. K. Jenkins, Robert Northshield, S. J. Schulman, Joseph J. Shoman, David Sive, Elvis J. Stahr, Daniel Q. Thompson, Richard S. Thorsell, David H. Wallace, Bruce Wilkins, Ted Zern.

NORTH CAROLINA

Clyce P. Patton, Eugene Schwall.

NORTH DAKOTA

Wilbur Boldt, Dale Henegar, Betty Morgan, H. R. Bud Morgan, Harvey K. Nelson, Paul F. Springer, Russell W. Stuart.

OHIO

Dan Armbruster, Theodore A. Bookhout, E. E. Good, George Laycock, Tony Peterle, Charles V. Riley.

OKLAHOMA

Bill Altman, John S. Barclay, Roy Boatner, Farrell Copelin, Ralph Ellis, Jack Hines, Clete Hodge, Jim D. Hodge, Fred P. Lewis, Bob Machlanburg, Ted D. McKinney, Robert Meeks, John A. Morrison, Chuck Palmer, Glenn Titus, Leslie Vanderwork, Elmer A. Vieth, Mrs. Elmer Vieth.

OREGON

Mrs. Suzanne Abram, A. W. "Bud" Adams, Mrs. Katherine Adams, Lauren Aimonetto, Den Allison, Barbara Anderson, Bill Anderson, Earl C. Anderson, Mrs. Earl Anderson, Frank M. Anderson, Gary A. Anderson, Jim Anderson, John W. Anderson, Pearl Anderson, Dale K. Arhart, Jerry Arnold, Scott Arighi, J. F. As ley, Frank Backus, Col. J. B. Baker, Wesley M. Batterson, Robert Baum, Dorthy Behm, Fred Behm, James Belknap, John E. Benneth, Phillip Benson, Dan P. Berghuis, Hugh Black, Kenneth Black, Jim Bond, Dick Bonn, Paul Bonn, Alan C. Bonsack, Roger E. Borderstrasse, Robert L. Borovicka, Richard M. Bowe, F. Y. Boweet, Quentin Bowman, Shirl C. Boyce Jr., Jim Bradley, Lynn A. Bremer, Philip A. Briegleb, Larry R. Bright, Frank L. Brooks, John W. Broome, Robert E. Brown, Will H. Brown, Louis A. Bruner, Raymond L. Bruntmyer, Sharon Bruton, Larry D. Bryant, Garvan Bucaria, R. D. Buell, Daniel F. Burroughs, Barbara Butterfield, Karren Calvin, C. J. Campbell, Gordon H. Campbell, Homer Campbell, Rod Canutt, Joe Capizzi, Patricia Carpio, Donald F. Carr, Pete Carter, Robert Casey, Bert Caster, Earl J. Caylor, David B. Charlton, Alan G. Christensen, Stanley Christensen, Gordon K. Clark, Harry L. Clark, Errol Clazae, Bert Cleary, Rusty Clifford, Kenneth L. Coble, Kenneth Cochrun, Larry C. Coe, Victor L. Coggins, Berry Coleman, Charles S. Collins, James Collins, Shirley Collins, Tim Collins, Larkin Conatser, Chas. A. Connaughton, Fred Cook, Richard M. Coote, Don Corn, Robert A. Corthall, Leo K. Couch, Larry Cown, Clay Crawford, Gene R. Cripe, Mel Cummings, Barbara Cyrus, C. Girard Davidson, Frederick A. Davidson, Edward J. Dealy, Russ DeGroat, Charles L. Deibert, Wm. J. Deibert, John Dietrich, Ralph Denney, R. E. Dimich, David Dodge, Ben Donley, Donald S. Douglas, Nathan Douthit, Jon K. Dueker, Jos. T. Duekin, Jack Dugan, Mihail W. Dumbeliuk-Czernowicky, Dean Durgen, Paul W. Dennis, Barbara Dierker, Paul M. Dunn, Dan L. Eastman, Paul W. Ebert, Edward Edelbrock, Nancy B. Edwards, George J. Eicher, R. D. Eldredge, John F. Ely, R. J. Eppig, Larry Espey, Becky Evans, Gerald G. Farstvedt, Earle Felkins, Denzel Ferguson, John D. Findlay, H. F. Fisher, Richard Forbes, Homer S. Ford, John Forsman, Rick Forsman, Barbara Fox, Wilmer M. Froistad, Dr. Robert Fulton, Roberta J. Fulton, Michael Furtado, Maradel K. Gale, Mrs. Robert Gangware, Bryan Gearry, Gary A. Gebhardt, Andrew Gianopoulos, Christopher Gibbs, W. R. Bus Gibson, Ray M. Glarin, Sid Glover, Fred Goetz, Bob Golden, Larry C. Goldman, Mike Golden, Daniel W. Good, James C. Corter, Jeffry Gottfried, Douglas Granum, Eugene Greene, Lynn A. Greenwalt, Fred Gribble, William Gridley, Barbara S. Griffith, Milt Griffith, J. O. Griggs, Bob Grotefend, Carl J. Gruener, Milt Guymon, Wayne Gwynn Ole J. Haldorson, William C. Hall, Cliff Hamilton, J. A. Roy Hamilton, S. P. Hanna, Gene V. Hansen, Al Haroun, J m Harper, Robert Harris, Dean M. Harrison, A. A. Hasel, Greg Hattan, Irving B. Hazelt ne, James L. Heckman, Paul Heikkila, Alex L. He ndl, Jim Heintz, Gene Herb, Dick Herrig, Walter S. Hershey, Harold Hewitt, Danny Hickey, Clifford Himmel, Fred Hirseh, Richard Hook, Charles C. Hoover, Edward F. Hoover, Eleanor Horwitz, Gregory D. L. Horwitz, Robert D. Hostetter, Patricia Huam, Arthur Huey, Wayne L. Hug, Dick Humphreys, Jim Hunt, R. J. Huston, Almonzo A. Hutchins, Dayton O. Hyde, Ralph H. Imler, Rod Ingram, Harry Irons, Judie Irons, Francis Ives, Audrey Jackson, Seth Jackson, Michael J. Jacobson, Frank B. Jacox, Mrs. Alene Jacques, Chris Jensen, Eli Jinenez, David Lynn Johnson, Doug S. Johnson, K. G. Johnson, Orin Johnson, Raymond Johnson, Sr., Richard C. Johnson, Willard C. Johnson, James P. Johnston, Loyin M. Jolley, Dean L. Jones, George W. Kansky, Chester Kebble, Arlene Kelly, Katherine Kelly, Mike Kemp, Wm. Kennedy, Orin R. Kidd, Terry Killam, Robert R. Kindschy, Don N. King, Richard M. King, Dick Kithil, Elsie M. Kithil, Norman Kleehammer, Gary Kline, Fred V. Koehler, A. J. Kreft M. D., Robert L. Krein, Mark Kreman, Thomas E. Kruse, David Kuhn, Lee Kuhn, Phyllis Lancefield, Andy Landforce, Gary Lane, Ted Laughlin, Leo Laythe, Donavin A. Leckenby, Philip Lee, Phil Lehenbauer, David J. Lenhart, Clifton W. Lemons, Don Lewis, Allan B. Lichens, Mr. Jeffery Scott Lind, C. Otto Lindh, Fred E. Locke, Clint Lostetter, Dick Louthan, David Luman, Ed Lyle, James Lyle, Robert R. Maben, Bob Mace, John F. Magin, Tom Manning, Robert G. Mann, Sherri Mann, Nick Mariana, L. Dean Marriage, David B. Marshall, Voc Masson, Jodi Mathews, Len Mathisen, Robert Matsen, Vern Maw, R. H. McCoy, Lynne McGrow, Pat McCrow, Jean McIntosh, Russ McIntosh, John McKean, Eldon L. McLaury, Ginny McLaury, Paul H. Meiling, Jack Melland, Roger Mellem, David R. Miles, Tom Miles, Al Miller, Barbara Ann Miller, Ira Miller, James M. Miller, Michael L. Miller, Al Mills, Wendy Milner, Marcus D. Mims, Don Mitchell, Robert C. Mitchell, Jim Mockford, M. L. Montgomery, Frank Moore, Richard L. Morgan, Elizabeth Morse, Wm. B. Morse, Mrs. William B. Morse, Betty Morshall, E. K. Morton, Carole Moss, Ray Muller, Rod Munro, Leon Murphy, Dan Myers, Ursel C. Narver, Arlene Neer, William A. Neitro, Bab Nelson, David G. Nelson, Anthony Netcoy, Melanie Newall, Bob Newell, Don Newell, Francis D. Newkirk, Frank Newton, A. W. Niemela, K. Duane Norman, Bill Norris, Berl Oar, Betty Oft, Homer Oft, Frank O'Hare, Videt Oja, Franklin M. Oliver, William E. Olson, Jim Olterman, Harry Opp, Orine A. Opp, Ralph Opp, W. H. Opp, John C. Pansegrau, Ed Park, Paul Paulsen, Richard J. Pedersen, Wendy Pentz, Lee Perron, Clifford B. Perry, Elmer E. Peterson, E. K. "Gene" Peterson, James V. Phelps, Eleanor Phinney, William E. Pitney, George M. Potter, Jim Potter, Charles Quaintance, William W. Rand, D. H. Rasmussen, John Rayner, Brian Read, Dan

R. Reece, George Reed, Mrs. Geo. Reed, Jim Reeher, Rexford A. Resler, Elaine Rethmeier, Ed Roberts, Hadley B. Roberts, Travis S. Roberts, Richard S. Rodgers, Larry Lee Rouse, Rollie Rousseau, Fred Rugh, Frances Salinas, William O. Saltzman, Verl Sampson, Edward N. Sanchez, Dorothy Sandvig, Del Sanford, Earl D. Sanvig, Karen Satvold, Jan Saxton, Robert Sayre, Katie Scanlan, Raymond W. Scharpf, Paul M. Scheffer, Chan Schenck, Audrey Schneider, Francis Schneider, Phil Schneider, Jerry W. Schnunk, Maurice C. Scholl, Robert W. Schoning, John E. Schwartz, Larry R. Scofield, Harlan N. Scott, Warren P. Seaward, T. D. Sehorn, Paul Seifert, Warren E. Shanks, Ron E. Shay, Howard E. Shirley, Alice Shoemake, Amos Simtus, Roy Sines, Dick S. Sjostrom, Larry Slayton, Alta Smith, David F. Smith, Dr. David L. Smith, E. J. Smith, Mr. & Mrs. Felix E. Smith, Frederick J. Smith, Harold P. Smith, Hugh Smith, Justin G. Smith, Richard Snyder, Frank Stanton, Verle D. Starkey, Emma M. Starr, Herbert G. Starr, Mrs. Frank W. Station, L. R. Steeves, Dianne Stewart, Richard Stiehl, Michelle Stoltz, Herb Stone, Knute S. Stoneberg, Jerald Stroebele, Harold Sturgis, Margaret Sturza, Jacqueline Svaren, Ralph L. Swan, William D. Sweeney, Lanny Swerdlow, David Tackle, Allan D. Taylor, Maurice H. Taylor, Sanford S. Tepfer, Mark Terry, Dee D. Threlkeld, Gary Todd, Tom Toevs, Mary Lou Thomas, Jan Thompson, Daniel A. Verhagen, Leon A. Verhoeven, B. J. Verts, Kenneth Waldroff, Mrs. Kenneth Waldroff, Chas B. Waldron, Derald D. Walker, Parks Walker, Gerald Z. Wallam, Sara Ames Waller, Peggy Walsh, Glen Ward, Joe Warner, Dell M. Warren, Kim Weaver, George Weber, Dorothy M. Werner, Richard L. Werner, Jay A. Wescott, Mrs. F. G. Wessinger, Mrs. William W. Wessinger, Dean Wheeler, R. Vincent Whiting, Jim Whittaker, Bill Widk, Howard Wight, Mrs. Howard M. Wight, George W. Williams, John G. Wilson, Paul S. Wilson, Bill Wing, Don Wint, Lane R. Wintermute, Herbert Wisner, James M. Witt, Walt Wolfe, Mervin D. Wolfer, Jerry Yarbrough, William F. Yetter, Ma Young, Rey Young, Don Zeigler.

PENNSYLVANIA

Glenn L. Bowers, E. J. Brooks, Edwin L. Cooper, L. H. Cramer, Albert M. Day, Robert E. Fasnacht, Peter L. Johnson, A. G. Koenig, Ed Kuni, Channing R. Kury, R. S. Lichtenberger, James S. Lindzey, Ian McHarg, Seth L. Myers, M. Grahan Netting, John C. Oliver, Harvey A. Roberts, Dale Sheffer, Mr. & Mrs. F. M. Simpson, Sherwood S. Stutz, James A. Thompson.

RHODE ISLAND

Alfred L. Hawkes, Clarence M. Tarzwell, Donald J. Zinn, Mrs. Donald Zinn.

SOUTH DAKOTA

Jack Adams, Everett R. Brue, Raymond L. Linder, John Popowski, M. Priewert, Don Progulske, Jack K. Saunders, John L. Schmidt, Dr. J. H. Shaeffer.

TENNESSEE

John H. Bailey, Frank R. Holland, Thomas H. Ripley, Dennis N. Russell, Fred Stanberry.

TEXAS

Bob Armstrong, Eric Bolen, S. K. Carnie, Clarence Cottam, R. W. Cunningham, Olan W. Dillon, Ruth D. Dillon, John C. Foshee, Caleb Glazener, Lowell K. Halls, Hal Irby, W. H. Kiel, Jr., Donald Klebenow, Walla E. Klussman, Sidney Knight, Charles Land, James L. Powell, Charles W. Ramsey, James G. Teer, Ervin Zavalney.

UTAH

James P. Blaisdell, Mayo Call, Frank Clark, D. M. Gaufin, Don Hammer, Mr. & Mrs. Pete Hamre, Norman V. Hancock, William T. Helm, James R. Kitts, Fred Lindzey, Tom Morse, Jos. R. Murphy, Lew Nelson, Othel L. Pay, Mr. & Mrs. Joseph F. Pechanec, Bud Phelps, Edward Schlatterer, Jonathan P. Secter, Harold N. Sersland, Alex E. Smith, J. Juan Spillett, Ted L. Terrel, Frederic H. Wagner, David E. Wilson.

VIRGINIA

L. Paul Applegate, H. G. Bayserman, Jr., Jack H. Berryman, Louis Boll, Nicholas J. Chura, Lawrence V. Compton, William D. Cooper, Everett R. Doman, Gay W. Doman, Mr. & Mrs. Robert L. Eastman, Mr. & Mrs. Ira Gabrielson, John S. Gottschalk, Kenneth E. Grant, Henry A. Hansen, Jim Harlan, Nicholas R. Holler, L. R. Jahn, D. J. Jamison, Ross Leonard, Maury Lundy, M. A. Marston, Burd S. McGinnes, Jerry A. Moore, Lloyd E. Partain, Chester Phelps, Neil J. Reid, Thomas G. Scott, E. A. Seaman, Edward Shaefer, M. Gardner Smith, Mrs. Gardner Smith, R. J. Smith, Alla T. Studholme, Albert H. Swartz, A. H. Underhill, E. Floyd Yates, Mary B. Yates, C. F. (Chuck) Zirzow.

WASHINGTON

Jack Adkins, Ron N. Andrews, Maxine Banks, Jack Barber, Clayton J. Barnes, Dan C. Barnett, Earl J. Bell, Gloria A. Bates, Robert G. Bates, John Biggs, Del Blackburn, Dick H. Bower, James H. Brigham, E. Reade Brown, Thomas E. Burke, Irven O. Buss, Sue Colman, Ann R. Conn, Dr. Jim L. Cook, Glenn L. Crouch, Carl N. Crouse, Kib. Davis, Mike Dillon, Lee W. Dowel, L. L. Eberhardt, Irwin D. Ellis, Wayne Elmore, Curtis W. Erickson, Walter English, Brock Evans, Allen L. Farris, Margaret Felt, Don Field, W. J. Finnegan, Robert J. Fischer, David L. Fluharty, Ralph Fontana, Herbert F. Gaines, Glenn D. Gallison, Garry Garrison, Dr. Illo Gauditz, Mrs. Carol Gavareski, Douglas B. Gilson, Mr. & Mrs. Howard Gray, Delphine Haley, Dale Harms, John C. Hendee, Hal Henry,

Jack C. Howerton, Oliver D. Jeffords, Robert Jeffrey, D. R. Johnson, Rod Johnson, Dale Jones, Nancy Jones, Gerald C. Kettunen, John King, Frank King, Jack E. Kirkendall, Wally Kramer, W. Ellis Klett, Tom Knight, Jim Lankford, John Larsen, Burtin Lauckhart, Fred Marthinson, Mrs. C. F. Martinsen, Russell M. Maynard, Joseph P. Mazzoni, Patrick F.McMannus, Richard S. Meyer, Wilbur M. Mills, Raleigh Moreland, D. Bruce Morgan, Leontine Nappe, Carl H. Nellis, Howard E. Nelson. Walt Neubrech, Bill Noce, Brad O'Connor, Wendell Oliver, Burton T. Ostenson, Morris Owen, Richard C. Parker, Lowell D. Parsons, Eric A. Peacock, William L. Peck, Rod Peques, Richard S. Peterson, Carl Petterson, Agnes Pettie, Robert G. Pettie, Wayne W. Pointer, Richard J. Poelker, Dale R. Potter, Miles L. Raver, David F. Riley, James A. Rochells, Joan Ross, Judge Bartlett Rummel, Gary Schadolnik, Jerry J. Schotzko, Patricia L. Schultz, Vincent Schultz, LeRoy Shearer, Mrs. LeRoy Shearer, Michael D. Shockman, Clem Stearns, Paul Stenkamp, Jack Stout, Jim Stout, Richard H. Swanson, Carol Terry, Richard D. Taber, Richard H. Taylor, Kenneth E. Teter, Roger L. Thomas, Annette Tussing, Ben W. Twight, Helen Van Driel, Dr. Richard W. Van Driel, Mrs. Tim Vaughn, Tim Vaughan, Rex Van Wormer, Jack E. Waddell, Larry Wadkins, Ronald Ward, Jack W. Warren, E. A. Weymouth, Robert W. Wheeler, Frank White, Jerry Wilson, Sam Wilson, Merle G. Wischnofske, Carter Witham, Gene Witham, Wilfred R. Woods, Robert T. Zak. Allen Zulauf.

WEST VIRGINIA

Ed Michael.

WISCONSIN

F.M. Baumgartner, C. D. Besadny, Michael J. Dorrance, Robert S. Ellarson, F. N. Hamerstrom, Jr., Joseph J. Hickey, Bob Personius, Steven R. Peterson, Robert E. Radtke, Walter E. Scott, John O. Wernham, Douglas A. Yanggen.

WYOMING

Ted Baker, Glen F. Cole, George Dern, Bob Haburchak, Douglas B. Houston, Raymond D. Mapstor, Bruce Marker, Rex S. Zobell.

CANADA

Denice Baynes, Ray A. Baynes, R. T. D. Birchall, Eugene F. Bossenmaier, Lois Boyce, Dr. C. H. Buckner, C. H. D. Clarke, Donn E. Cline, Ian McTaggart Cowan, J. Blair Dawson, P. B. Dean, Ken Doan, Darrell Eagles, Dr. Robert B. Forster, George Galicz, Angus Gavin, Herb Goulden, T. A. Harper, Dave Hatler, James Hatter, J. A. Keith, Alan Loughrey, G. W. Malaher, Margaret Malaher, Hugo S. Maliepaard, Frank Manuel, Sam Miller, Stuart S. Peters, W. G. Reitch, J. C. Shaver, Don W. Simkin, Dr. Stuart B. Smith, J. J. Stamp, Lee Straight, John S. Tener, G. G. (Stan) van Zyll de Jong, Geoff Warden, R. Webb, Bruce S. Wright.

MEXICO

Dr. & Mrs. Enrique Beltran.

SOUTH AFRICA

Stanley Hirst.

SWITZERLAND

Raymond F. Dasmann, J. A. Van Der Van.

INDEX