TRANSACTIONS

of the

THIRTY-FIFTH
NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCE

Conference Theme:
MAN'S STAKE IN A GOOD ENVIRONMENT

MARCH 22, 23, 24, 25, 1970

Palmer House

Chicago, Illinois

Published by the
WILDLIFE MANAGEMENT INSTITUTE
WIRE BUILDING
WASHINGTON, D. C. 20005
1970

Additional copies may be procured from
WILDLIFE MANAGEMENT INSTITUTE
Wire Building, Washington, D. C. 20005
for $5.00 Postpaid

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

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The Wildlife Management Institute expresses its appreciation to The Wildlife Society and the many organizations and individuals who contributed to the success of the 35th North American Wildlife and Natural Resources Conference.

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PART I

OPENING GENERAL SESSION

GENERAL SESSION

Monday Morning—March 23

Chairman: FREDERICK C. PULLMAN
Vice President, Northern Trust Company, Chicago, Illinois

Vice Chairman: GEORGE CROSSETTE
Chief of Geographic Research, National Geographic Society, Washington, D.C.

WHAT'S HAPPENING TO THE ENVIRONMENT?

FORMAL OPENING

IRA N. GABRIELSON
Board Chairman, Wildlife Management Institute, Washington, D.C.

I am pleased to open this 35th North American Wildlife and Natural Resources Conference. This is the third of these international conferences to meet in Chicago. The last, the 19th Conference, convened in this same room in 1954. That meeting, like this one, was held shortly after the close of the first year of a new Republican Administration. In reviewing my comments then, I find that I said:

> The new administration has had a year to find itself and to establish a conservation program. In general, it can only be said that no constructive, progressive program for advancing conservation activities has yet been developed, and little interest has been shown by the two great departments responsible for the most important of our conservation estates in protecting the gains in the past.

I found it interesting to review these words written sixteen years ago. In contrast to the situation then, President Nixon has been in the forefront of the present great wave of environmental concern. Scarcely a day passes without some statement of official concern from the White House or one of the Executive offices. The President also has taken an encouraging approach to the attack on environmental ills by appointing to the new Council on Environmental Quality my good friend and one of our distinguished speakers this morning, Russell E. Train. This important new office is in good hands.

I also applaud the President for his initiative and for his promises that his administration is about to launch an all-out attack on the abuses of the American land. But in spite of these many heartening expressions, I remain apprehensive about the future. There have been some disturbing administrative decisions, and there is a growing gap between talk and the significant factors of urgently needed action and the funding of programs.

For example, in the closing months of the previous administration, the government, at the suggestion of the Bureau of the Budget and after long study, initiated an orderly system of increases in grazing fees on the national forests and public domain to bring the prices gradually up to fair market value. The first of these modest increases was adopted in 1969. The second step, scheduled to go into effect this year, was killed by Secretary Hickel. To save the Administration any political embarrassment from Hickel's precipitant decision, Agriculture Secretary Hardin was forced to go along.

This action probably originated with the Assistant Secretary of the Interior for Public Land Management, Harrison Loesch. In his first meeting with conservationists, Loesch flatly proclaimed that his goal was to roll back the grazing fee schedule.

As long as the ridiculously low grazing fees remain in effect, the American public will continue to be shortchanged. The Administration's decision favors the livestock minority over the larger interests of the public in this matter.

Another attempt to curry favor at public expense was embodied in the High Yield Timber Bill, the national forest cut-out and get-out proposal, which was endorsed by Secretaries Hardin and Romney.

Although it was amended in committee—to provide lip service to watershed protection, recreation and wildlife—its primary thrust was to give timber priority over all other national forest uses.

You may know by now that the House of Representatives refused even to consider this bad bill. It is not to its credit that the Administration supported the bill. The Forest Service can easily improve national forest management under existing authority without harming other forest values if given the money and manpower. The Administration shows no sign of seeking the funds, however.

Then again, the Administration has not shone brightly in its handling of the Music and Hualapai Mountains case in Arizona where the Interior Department initially denied state selection of 40,000 acres of recreation and wildlife lands. The Bureau of Land Management, with the support of the Arizona Game and Fish Department, rejected the first application—which was upheld by the former Secretary of the Interior, himself an Arizonan. It was common knowledge that the state intended to lease the lands to ranchers. State lands leased for grazing in Arizona give most privileges to the lessees and virtually none to the public.

With a new administration in Washington, Arizona renewed its application. This time the Administration—again represented by Assistant Secretary Loesch—saw no need for foot-dragging. It ordered BLM to proceed with the transfers to the state.

Only the intervention of Congressman Henry S. Reuss's Subcommittee on Conservation and Natural Resources halted this give-away. While the subcommittee action is not permanent, it will at least afford an opportunity for the affair to be investigated. Secretary Loesch also is involved in a similar case in Wyoming.

In striking contrast to these decisions are Secretary Hickel's strong stand for the protection of the Everglades National Park from almost certain destruction by a proposed jetport, his determined effort to protect Biscayne Bay from thermal pollution, and comparable strong action against pollution elsewhere.

President Nixon's address before the National Governors Conference last month dealt largely with environmental problems. In general, the speech was an excellent summation of the conservation challenge in the critical days ahead.

The President noted that he had met with representatives of the conservation organizations. His impression was that "there is an irreconcilable conflict between economic growth and happiness. . . and a decent life," and that the goal of the conservationists seemed to him to be "to return man basically to his natural state. . ."

The President's statement causes me to fear that preservationist activities may have distorted the meaning of an old and honorable Republican word, "conservation"—even in the mind of our leading Republican.

I know few if any conservationists—even among the preservationist groups—who want to revert to the simple life eulogized by Thoreau and Rousseau, even if that were possible. What conservationists want is a decent environment—the same thing, I am certain, desired by the President.

We hope that President Nixon does not equate conservation either with outright preservation or with turning over to industry or special-interest groups public resources that have been husbanded for the public good. If the President's words are backed up by firm action and adequate funding, a good deal of the conservationists' long battle to reverse the degradation of the human environment will be won.

In closing, I have a few brief announcements. For the benefit of those of you who are attending your first Conference, I want to point out the few ground rules. First, the Conference is not a convention nor an action body. It cannot adopt resolutions or take action of any kind either against or in support of any issue. The Conference is basically intended as a clearing house for the exchange of 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 discussion will be published in the Transactions of the Conference, and we request, for the benefit of the reporter, 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. The program committee and the session chairmen have developed interesting sessions, and I am sure that you will find the next three days rewarding.

The Ladies Luncheon will be held in the Crystal 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 at the Society's desk in the registration area before noon, since the hotel requires a guarantee on the number to be served.

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 be the largest ever.

I now wish to introduce the chairman of this session, Mr. Frederick C. Pullman, a banker by profession and vice president of the Northern Trust Company here in Chicago. He is a sportsman, big-game hunter, explorer and traveler and chairman of the Conservation Committee of the Boone and Crockett Club. Fred, I now place the meeting in your hands.

REMARKS OF THE CHAIRMAN

FREDERICK C. PULLMAN

Gabe, thank you very much. Who told you all those nice things about me?

I am at least a banker and I think perhaps it may be symptomatic of the times that you have a banker chairing this opening session, the first in the decade of the Seventies, of a conference for which the theme is "Man's Stake in a Good Environment".

If you think back a decade to 1960, you will recall that people who were concerned about the quality of our natural environment were in a distinct minority. We were fighting an apparently almost hopeless battle against an apathetic general public, a disinterested Congress and a resistant business community.

Today, ten years later, we are seeing a dramatic change in these attitudes. An aroused public is expressing its concern to Congress and to President Nixon, who are responding with progressive new environmental legislation. The business community has made substantial and significant commitments to air and water pollution control. In short, the balance of power seems to have shifted our way.

I believe that today the majority of Americans, if put to a vote, would chose to pay a few dollars a year more for their electricity than to flood the Grand Canyon or the Hell's Canyon of the Middle Snake, or to have the Columbia River running hot water into the Pacific.

Furthermore, I think it is safe to predict that a few years from now we will be talking more about population control than pollution control, more about people management than wildlife management.

This morning it is my privilege to introduce our four distinguished speakers who will address themselves to the theme of this General Session, "What's Happening to the Environment?"

Each of our panelists has been invited to take just thirty minutes to make his presentation. He will then be followed by ten minutes of discussion. If we are to get the most out of this excellent program, obviously we must all respect the clock.

I would now like to introduce the Vice Chairman of this session, Mr. George Crossette, Chief of Geographic Research, National Geographic Society, who will conduct the discussion periods.

Now, our first speaker, Professor George Borgstrom, Department of Food Science, College of Agriculture, Michigan State University, is a recognized authority on world food resources. His major research has been directed toward fish, fruit and vegetables and his studies in the geographic field cover various aspects of the balance between population and resources. He has written a number of papers and books on these subjects, including *Japan's Success in World Fishing, The Soviet Fishing Revolution*, and his important two-volume university text book, *Principles of Food Science.*

Prior to his coming to Michigan State University in 1966, Professor Borgstrom was a professor in his native Sweden where he organized and headed two major food research institutes.

Professor Borgstrom is perhaps most well known for his study

The Hungry Planet, which was listed by the American Library Association as one of the fifty most important books published in 1965.

In 1969 he was the recipient of the highest distinction given by Michigan State University—the Distinguished Faculty Award—in recognition of outstanding contributions to the intellectual development of the university.

Dr. Borgstrom participated in the program but did not submit a paper for publication. The Editor.

FILTH IN LAKE AND SEA

E. W. SEABROOK HULL
Editor, Ocean Science News, World Ecology 2000, Washington, D.C.

When I first asked to talk here this morning, the suggested title for my presentation was "Filth in Lake and Sea." I thought for a while of changing it, for it implies an extreme polarization of viewpoint, and polarization *in extremis* is not going to resolve the problems of the environment. No one ever produces mutual understanding and agreement standing at shouting distance and shouting . . . . However, filth is what it is. So, I left it.

The rising level of man's adverse impact on his environment is *in part* the result of sheer inconsideration of the capacity of that environment to fulfill his needs for food and water; to provide his industrial raw materials; and to receive and dissipate his wastes. Until a very few years ago, the earth was literally an open-ended ecology; neither man's consumption nor his effluence could exceed its capacity to provide. Now, suddenly everything is turned about; earth is a closed ecology, like a space ship . . . and man can, indeed, exceed its capacity to provide and to absorb. More than that, he can cause a cataclysmic failure of its life support system.

But inconsideration of the way in which he uses his planet is only a part of the problem . . . and in some respects a comparatively minor part. For once having recognized the need for management, that management will be forthcoming. Man is sometimes reckless and careless, but he is not knowingly suicidal; and when he recognizes that his survival depends on sound management, then manage he will.

No, the core of the problem is not recognition of the problem or an appreciation of the kind of approach it will take to solve it. The first we have done; the second we are doing. The core of the problem is sheer volume, the volume both of man's needs and of his wastes.

We might also add: The volume of ignorance, for we really know very little of the mechanisms of our planet as a life-support system. We know it in simple outline, and we can describe some of the mechanisms reasonably well in qualitative terms. We can say what they are and how, in general, they function. The carbonate buffering system in the ocean and its relationship to carbon dioxide reconversion into oxygen is an example.

But in quantitative terms, we know virtually nothing of these systems—how much we can strain them before they malfunction, or cease to function altogether. And, there are, we suspect, life-critical mechanisms that we don't even know about. So, we have a research problem of such magnitude that it is quite doubtful if any single nation can undertake it at an adequate level of effort or even in time. By this, I suggest that if man is to survive, all men and all nations must work together towards sound ecological management. Otherwise, they all will perish together.

Meanwhile, the problems are with us, and even if it must be in partial ignorance, we must nevertheless deal with them . . . promptly and effectively. It is one of these problem areas to which I address myself this morning, namely the matter of the effluence of man's affluence, the rising volume of waste being spewed forth into the air, on the land, and into the waters of our rivers, lakes and oceans.

Before getting into the business of startling statistics, however, I want to make a brief excursion into a subject area which is not only close to my heart and profession, but which I also feel to be key to the success of man's present efforts to resolve his conflicts with his environment.

The subject area is information, and the sub-title of my abiding concern might be called "the sound and the fury." It's a matter, simply, of information pollution. No arena of human concern, perhaps, is so susceptible to emotional involvement and unreasoned response as "environment," "ecology," "conservation" and the like.

Add to this the burgeoning horde of "instant ecologists," and you have a problem of truly frightening magnitude for, in their desire to impress or simply out of appalling ignorance, these individuals are inclined to take real facts out of context, half-truths and hearsay and recount them in an emotion-packed harangue to an eager and likewise emotional audience.

It is especially important that the high school and college age population realize this and be given access to sound information. Not only is this group a potent force today, but in the years immediately ahead this is the generation which will most determine what we do and how well. Unfortunately, among the campus environmental activist groups, some college professors turn out to be among the most outrageous of the information litterbugs. They seem to curry adulation rather than to try to encourage progress.

It is easy to pick up the clarion cry, to coin a nifty phrase and blazon it on a fiery banner and therewith to whip up the frenzy of a great crusade. It is more difficult to ascertain the real facts and then to deal unemotionally, but deliberately and effectively therewith . . . more difficult but vastly more useful.

I drive a lot, and when I drive I listen to the car radio. Recently, I heard a lady commentator describe how quaint it is to shop for groceries in England, how the English housewife leaves every morning with her shopping bag or basket to make her rounds to the butcher, the baker, the greengrocer and, perhaps, the fish monger. Our lady of the airways was amazed at how nothing was prepackaged, how only the fish and the meat and maybe the bread were wrapped before being dumped unceremoniously and communally into the shopping bag.

Quaint or not, for the environment, at least, it has its advantages—for when our English housewife gets home and empties her shopping bag, she has the food and other materials she is actually going to use—and very little else. The "little else" to which I refer are the minor mountains of discarded packaging materials which each of us in America accumulates each week. . . and which then must be disposed of somewhere, somehow. As the problems and cost of disposing of such materials mount, what is quaint today in England may become the latest "in" thing in America. Purely as an aside, our lady commentator also noted that food costs about half as much in England as it does here—which sets me wondering as to how much we pay for fancy packaging, other than the cost of disposal.

The statistics of pollution are simply staggering. They are so big in fact that to most of us, they are little more than "shock coefficients" we tack onto phenomena which we see mainly as constantly dirty air around our major metropolitan areas, stinking polluted lakes and streams, mounting piles of smouldering rubbish, poisoned shellfish beds and oil-covered beaches.

Once we are able to apply them in proven relationships, the statistics may turn out to be significant in terms of just how much uncontrolled dumping the environment can stand. For the moment, however, we don't know what the limits are—what volumes of carbon dioxide, sulfur dioxide, and other noxious gases the atmosphere can absorb without permanent damage to the global life support system. We don't know how much industrial waste and municipal sewage we can dump into our internal and coastal waters before we completely destroy their productivity. We don't know how much DDT and other organo-chloride pesticides, how much spilled oil, how much dredged spoil and municipal sludge we can pipe and barge out into the ocean before it, too, suffers permanent harm.

In some cases, we can see where we have exceeded localized "safe limits." Lake Erie is an obvious example. So are some of our more notorious rivers—the Cuyahoga, so foul it's a fire hazard; the Ohio, Houston Ship Channel, Hudson, Rouge River, Buffalo, Passaic, Merrimack, and others. Thousands of acres of shellfish beds are so polluted they are unsafe for harvesting. Each year more beds are added to this list than are taken off. The culprit is untreated or poorly treated municipal sewage.

Ever wonder what happens when the volume of sewage exceeds the capacity of your local treatment plant? An automatic overflow dumps it into the local stream or estuary. Swimming anyone? Or, oysters on the half-shell?

Lately, ecologists have been talking about the permanent blue haze that covers much of the country, a constant sign of air pollution. In some localized areas, the emission from stack gases, cars, and the like produces a dirty orange haze. I come from the Baltimore-Washington area. . . Often in the summer, early in the morning, from the air these two cities look like two fried eggs, sunny-side up: In the suburbs, modified smog has provided the basis for widespread ground fog; from the midst of this white rise two dirty orange globs—pure smog marking the location of the cities proper.

Thus, we have examples of where, locally, things have gone too far, but in the majority of cases we don't know how far was too far, how far we will have to cut back—what else we might have to do—before the process of degradation begins to reverse itself. And, more frightening, perhaps, is the fact that we don't know how far things can go before the process of degradation becomes irreversible. Can Lake Erie be saved, for example, or is it too late? How far can the process of environmental degradation be pushed before the domino principle takes over, and the process of poison and malfunction spreads relentessly and finally throughout the entire planet? The answer, of course, is that we don't know.

It may take a lot less than we think, however. Let me trace briefly through one example of how a total earth systems failure could occur. It is an example which shows how tenuous is the ecological web upon which all life on earth depends.

Everyone is familiar with the fact that animals breathe in oxygen and exhale carbon dioxide, and that—under the influence of sunlight and photosynthesis—plants take in carbon dioxide and breath out pure oxygen. It's earth's own air purification system without which life as we know it could not exist.

What many of you may not know is that, quantitatively speaking, sea plants rather than land plants constitute the largest capacity on earth for the conversion of carbon dioxide back into oxygen. The greatest oxygen production center on land is the verdant and lush Amazon basin. Its capacity, however, is only a fraction of that of the sea. Additionally the ocean has a fantastic capacity for absorbing and holding carbon dioxide in solution until the ocean plants get their job done.

But when we say ocean plants, we don't mean the large seaweeds and giant kelps with which most of us are familiar. Rather, we are talking about plankton, specifically the phytoplankton—tiny microscopic plants which populate the sea in incredible numbers. If the phytoplankton die, all life in the ocean dies, for they are also the base of the marine food chain. More important, however, the planet dies. Some estimates claim that all life would disappear from the face of the earth within months, or a very few years at the most.

The critical factor is that phytoplankton are extremely sensitive to the acidity (what scientitsts call the pH factor) of the ocean and to the presence of trace elements. Add to this the fact that carbon dioxide absorbed in the ocean tends to move its pH to the left, *i.e.*, to make it go acid, and you can see the nature of the danger we face. The ocean has a built-in, natural buffering system. As more carbon dioxide is absorbed into the ocean, calcium carbonate acts to remove the carbon dioxide from solution until the phytoplankton get around to processing it back into oxygen.

This is a delicate system which works only within very narrow limits of pH. If these are exceeded by too rapid absorption of carbon dioxide, the buffering system itself fails. There may be another back-up silicate buffering system, but we're not sure.

If the buffering system fails, the pH will then go hard to the left—strongly acid. The phytoplankton will perish, and so will we. I might add: There are many other ways to kill the phytoplankton—or to so reduce their number and effectiveness as to have much the same effect. Among the ways are DDT and its sister organo-chlorides, lead from gasoline, cyanide and industrial chemicals, poisons absorbed from polluted air, over-nutrification, etc. Incidentally, once the carbon-dioxide reconversion mechanism failed, the earth—already dead—would fall prey to the greenhouse effect about which we've heard so much in the past. Sealing the lid on the tomb, so to speak. Venus may be such a case.

As I said earlier, it is the volume of the problem which is so frightening. Even though we decide we must cut back on the levels of our air, land and water pollution . . . even if we could define the precise nature of the problem in quantitative as well as qualitative terms, which we cannot yet do, we are still faced with the task, simply, of how to cope. In that connection, let's look at some figures. I'm sure you're all familiar with most of them. Lately, it seems they've been getting a bigger play in the press than the New York Mets, sex, or politics.

AIR POLLUTION

Filth in lake and sea finds its way there via air pollution and solid waste disposal, as well as through direct water pollution. Sometimes this is unintended; sometimes it is intentional. Usually it is harmful, though as we shall see, it need not be. Let's start out with the air we breath.

In the United States alone, the annual rate of release of toxic materials to the atmosphere exceeds 173 million tons of carbon dioxide, carbon monoxide, nitrogen oxides, surfur oxides, lead, cyanide, other heavy metals, fly ash, photochemical oxidants, hydrocarbons, and so forth. Over a third of this noxious mess comes from our automobiles. Some official estimates, however, run as high as 200 million tons and 50 percent respectively. The volume of fly ash ranges, variously, from 20 to 50 million tons a year—which is a good example of the poor precision with which we know these things. Sulfurous gases may reach 26 million tons a year.

Of real fear to some scientists is the extent to which atmospheric chemicals find their way into the ocean—and the ever-present danger to the plankton and other living creatures of the sea. They are particularly concerned about lead and similar persistent, cumulative poisons.

Concerted efforts are being made by the Federal Government to clean up the nation's air. And though it will be costly—a cost each and every one of us must bear, incidentally—it is possible to do. In 1956, I was a correspondent in London—then considered as having one of the worst air pollution problems in the world, due in large measure to the Englishman's penchant for burning soft coal.

At that time a ruling was put into force making it illegal for anyone to burn soft coal within the City of London. The City of London, with a capital "C", is a square mile right in the middle of greater London which has a diameter of 30 to 40 miles. I really couldn't see how that would do any good, but the rule was enforced and gradually expanded outwards to encompass an ever-increasing area. London today, I understand, is crisp and sparkling by comparison. Indeed, the United Kindom appears to be about 15 years ahead of the U.S. in its fight against both air and water pollution . . . and with quite gratifying results.

WATER POLLUTION

No basic element of our ecology, probably, suffers so much from heedless assault by man as do the waters of our lakes, streams and coastal zones. Into our national waters each day, we dump some 173 billion gallons of sewage—much of it raw and untreated—industrial wastes, agricultural fertilizers, pesticides, acid run-off from mines, heat from power plants, heat from industrial processes. From those same waters, we draw our drinking water. Indeed, no longer are there many people in America who drink truly fresh water. Most of us drink water that has already passed through someone else's power plant, someone else's factory, or someone else's body.

In this country where more than anywhere else in the world, perhaps, municipal water has always been safe to drink, the Department of Health, Education and Welfare now tells us:

". . . although most Americans can drink water from public supplies with a feeling of safety, the margin of protection is decreasing, and in certain instances has vanished. The presence of pesticides and other chemicals adds a new element of uncertainty. . . . Most of our municipal water treatment plants are outmoded, not equipped to treat the kind of raw water we now have. . . . About half the community supplies in the United States receive only chlorination, which kills bacteria but does practically nothing to remove pesticides, herbicides, and other organic and inorganic chemicals from the water we drink. Our Public Health Service lists no fewer than 51 contaminants or characteristics which should be controlled—and we know there are many more that we haven't yet measured or identified. Every year more than 500 new or modified chemicals come on the market—and, of course, these can ultimately find their way into the water supply."

Among these is DDT, of which the U.S. annually uses some 27,000 tons. The problem with this and its associated pesticides dieldrin, aldrin and others is that they are persistent. They can and do survive all sorts of biological cycles intact. In nature, these chemicals accumulate in the bodies of plants and animals with adverse results. Birds lay eggs with shells so thin they break before they can be hatched. The reproductive cycle of adult birds has been shown to be inhibited. And, if it's any compensation to you, the DDT accumulated in the fatty tissues of your body makes you unsafe to eat. The same thing, I believe, is true of a mother's natural milk in many parts of the country.

Water pollution has more aspects, probably, than we yet fully appreciate. Many of our most polluted rivers are also navigation channels. They have to be dredged. The stuff dredged up is called "spoil." Where to put it? Shore areas increasingly are being filled up, and more the trend is to barge the spoil out to sea and dump it. Unfortunately, this spoil is a great concentrator of the poisons in the water above it; so local river pollution is transferred en masse into an otherwise clean estuary or offshore fishery zone.

Just 20 miles off the mouth of New York's Hudson River, for example, some six million cubic yards of such spoil plus another five million cubic yards of sludge from municipal sewerage settlement plants are dumped onto the seabed annually. On top of this, uncounted quantities of industrial waste are also dumped there. Dr. Jack Pearce of the U.S. Bureau of Sport Fisheries and Wildlife Laboratory at Sandy Hook, New Jersey, claims that if not another cubic yard of such material is dumped in this area, it would still take 10 years for natural ocean processes to restore the life-support process of this area.

"At the center of the dump," he says, "there is simply no life. The only things you find there are cigarette butts and Band-Aids and the sort of thing that's not readily broken down." He calls the area a "dead sea."

Several municipalities pipe their municipal sewage, treated and untreated out across the floor of continental slopes. This is a particularly popular procedure on the U.S. West Coast where the continental shelf is narrow-to-non-existent. Out of sight, out of mind. The theory is, of course, that the concentrated and heavy effluent will flow down into the deep ocean—there to be dissipated, perhaps, by natural processes . . . but in any event to be forgotten.

I really don't think much of this kind of approach, even if it worked as planned, which often it doesn't. The sludge coming from the Los Angeles sewer outfall, for example, doesn't always sink to the bottom of the deep ocean floor as planned, but rather rises to a neutral buoyancy depth of 200 feet, thence to drift off with the currents to no one knows exactly where. A similar system off Seattle is blamed for massive fish kills.

The number of fish killed annually from pollution causes, of course, isn't known, but one recent study shows that for calendar year 1968, 42 states sent in 438 reports of fish kills, the largest of which killed over 4 million fish. The total fish killed in this manner during the year was 15,236,000—of which 1,336,000 were gamefish and 10,300,000, commercial species. A study of the statistics shows municipal operations to be responsible for most of the kills—some 6,952,000—but with industry running a close second at 6,398,000.

One of the most insidious and dangerous types of water pollution is heat—thermal pollution from both industrial processes and electric power generation. In reasonable quantities and under circumstances where it is easily dissipated, thermal pollution may be comparatively harmless, but the mounting demand of the public for electric power poses some real problems for the decades ahead.

The estimated total average run-off of fresh water through rivers and streams in the United States is about 1,200 billion gallons per day. The present installed thermoelectric power generating capacity in the country is 272 million kilowatts. This requires approximately 200 million gallons of coolant water per minute, or nearly 29 billion gallons a day. By 1990, the nation will require about one billion kilowatts of additional capacity, resulting in a cooling water demand of 640 to 850 billion gallons per day.

Water going through such plants may have its temperature increased by 10° to 15°F, depending on design. Many aquatic plants and animals cannot stand such temperature increases, and they die. Even if the temperature is not too high for survival, it may have other adverse effects—cause plankton blooms which raise the local biological oxygen demand beyond tolerable limits; induce marine animals to spawn out of season with the complete loss of the generation; or encourage settlement of species adverse and predacious to the area.

Again, we still know comparatively little about the real long-term effects of this kind of environmental modification. One thing that particularly bothers me and about which I've heard nothing is the possible plankton kill in the cooling water through-put. Raising the temperature of the local environment is one thing. The number of creatures killed that actually pass through the cooling cycle is quite another matter.

Increasingly, these plants are being built along side the nation's coastal waters. These are the estuaries that serve as the nurseries for a very large percentage of our saltwater sport and commercial fishes. Virtually all are in the plankton at the one stage or another of their lives. I suspect that the cooling water through-put of some of the plants now in operation and abuilding has the capacity for some very high "invisible kills." I say "invisible" because many of the creatures killed would be too small to be seen except under a microscope and under conditions of constant, close monitoring.

Take one 262,000 kilowatt plant, such as Consolidated Edison's Indian Point Plant on the Hudson River. It pumps cooling water through its heat exchanger tubes at a rate of 300,000 gallons per minute. If there were several spawned but as-yet unhatched eggs or several larval fish or crabs per gallon (conservative estimates in some locations during some times a year) the number killed by this means alone could run to millions per minute—enough, perhaps, to destroy the local ecological balance.

In some parts of the country, the intake water is already warm—as in Biscayne Bay, Florida, where the summer-water temperature runs 85°F. A water temperature of 95°F is just about the limit most creatures can tolerate. Recently, Interior Secretary Hickel filed a court suit against Florida Power and Light to force that company to take steps to cool their discharge water back down to 85°; they had planned 95°. This will be an action to watch, for it should be a landmark case.

Before leaving water pollution entirely, I would like to pass on this suggestion for controlling it. It was originally offered in jest and even then gave some large-scale water users nightmares. It is:

"Require intake pipes to be placed *downstream* of discharge pipes!"

Think about it. It's no longer a joke and may well be just the kind of requirement with which we will all have to learn to live.

SOLID WASTE

If air and water pollution are monstrous problems, that of solid waste can only be described as mountainous—literally. America is generating solid waste at the rate of an incredible 3.5 billion tons a year, including 360 million tons of household, municipal and industrial wastes, two billion tons of agricultural wastes and 1.1 billion tons of mineral wastes. Personal garbage and trash amount to 190 million tons and costs $4.5 billion a year to haul away. By 1980, this is expected to total 340 million tons a year.

To get a little more specific, this gargantuan torrent includes 50 million cans, 30 billion bottles and jars, 4 million tons of plastic, 7.6 million television sets, and over 7 million cars and trucks, many of the last simply abandoned on our nation's highways and city streets.

I won't go into detail here on the nature of the problem of disposing of all this litter. Most dumps are poorly designed, inadequate and unhealthy. Spaces available for sanitary landfill are just about used up. Nor is incineration a proper answer. Even if the more obviously dangerous pollutants could be removed from the stack gases, the world is simply pouring too much carbon dioxide into the atmosphere and into the ocean. This output has to be curtailed, not expanded—which brings me to the final point of my presentation—the disposal of solid wastes in the ocean.

SOLID WASTE DISPOSAL IN THE OCEAN

There is insufficient space ashore to take all of the nation's solid wastes. It can't all be burned. Most of it has little or no scrap value. The only thing we can safely do with it is to dump it somewhere—someplace where it will do the least harm to the environment, and possibly someplace where it may actually enhance the environment.

With intelligent management, I believe one answer may be the ocean. I propose that solid waste can be disposed of in the ocean in such a manner that not only will it help preserve those diminishing natural lands which still survive, but also it will actually enhance and increase the nation's coastal wildlife habitat.

Some of you may immediately conclude that I'm talking about artificial reefs. Well, if so, you're partly right though I propose to go considerably beyond that. I would take the 48 million tons of municipal, dredging and industrial waste now being barged and dumped at sea, and I would take some of the hundreds of millions of tons of other solid wastes now being stuffed into every unused nook and cranny of our dryland countryside and I would use this material in the foundations of artificial islands.

Look at the pressure, not only on our dumps, incinerators and automobile graveyards, but also on our coastal lands. Just look at the U.S. Of a total of some 59,000 statute miles of shoreline possessed by the contiguous 48 states, 21,742 were classified in 1962 by the President's Outdoor Recreation Resources Review Commission as having "recreational potential." Of these, only 4,350 miles were beach, 11,160 miles were bluff, and 6,214 miles were saltwater marsh. Deduct private ownership, military reservations and otherwise restricted lands from the beach total, and you end up with 1,209 miles of beach in the public domain and available, potentially for recreation use by the public.

More recently, the Stratton Commission on Marine Science, Engineering & Resources—figuring 150 square feet of beach per person and only 10 percent of the population on the beach at any one time—concluded that those 1,209 miles could support a population of 21 million people. This is just about 10 percent of the nation's present population. Obviously, the pressure to destroy natural wildlife lands for the construction of beaches is great and can only increase.

The marshlands, critical to waterfowl and fish alike, would be the first to go. It is something we simply cannot permit to happen, for among the things man hasn't learned to do is to produce a salt marsh.

The technology exists for processing and compacting many types of solid waste (in particular, domestic trash and garbage, autos, appliances, and the like) into high-density billets. Beyond the limits of our prized estuaries but close enough to shore to be readily accessible and in reasonable water depth, these billets can be patterned on the ocean floor of the continental shelf lands. Sand and gravel can be dredged from the sea bed to cover the trash. Conventional Dutch dykes can be built to protect the islands from erosion. Additional compacted trash can be deployed as artificial reefs to protect the island from the action of the sea and to encourage the settlement of sport and other fishes.

If you want to know how such an island might look in cross section, I refer you to page 122 of the February, 1970 issue of *Fortune Magazine*. There you will see a drawing of "Mount Trashmore" going up in Du Page County just outside this city (Chicago). This is on dry land, but the principle is the same. Mt. Trashmore, incidentally, will be used for winter sports recreation.

Nor is the concept of artificial islands in any way revolutionary. The Japanese mine coal from several offshore islands built in over 150 feet of water. Fully a dozen artificial islands, some to have permanent populations in excess of 1,000 people, are being constructed or are soon to be begun in the North Sea offshore of Belgium, France, the Netherlands, Britain, and West Germany. They are being built, variously, as offshore oil tanker ports, industrial parks, jet ports, harbor expansion, wildlife refuges, and as "suburban" living and recreational areas. The first of the French islands will be completed this year. Some are as much as 30 miles offshore. The Dutch are old hands at this sort of thing; they cite a cost for such islands of $6 per square yard of surface area produced. This compares with $7 being paid in Amsterdam for prime industrial land.

There will be objections, obviously, to meddling with the continental shelves, but we're already meddling with them by dumping on them. Artificial islands built in an organized manner and only after careful ecological surveys would certainly be better than present dumping methods. And, in the case of artificial islands, the waste would be forever removed from the ocean environment, for it would be completely covered with many yards of soil.

In the final analysis, what the question really boils down to is this: Do we want to turn every last acre of coastal wetlands and wildlife refuges over to the Coney Island approach to recreation? I suggest that we can build Coney Islands superb, super-Coney Islands, 21st Century oceanic Disneylands, or whatever suits the public's fancy. But we cannot build the *natural* ecology of our coastlands. Build man his playground on offshore artificial islands, and use his trash to do it. But leave the coastal marshlands and the wilderness areas to the animals . . . and to man and his children and their children after them.

AGRICULTURAL POLLUTION

CECIL H. WADLEIGH
Director, Soil and Water Conservation Research Division, Agricultural Research Service, USDA, Beltsville, Maryland.

I deeply appreciate the invitation of the Wildlife Management Institute to appear before this conference as a representative of the Department of Agriculture. Both of our groups have deep interests in the great outdoors.

As one who grew up in the woods of New England, as a trail supervisor of the Appalachian Trail Club, and as the spouse of the most ardent bird watcher in Prince Georges County, Maryland, I have an abiding devotion to the wild country with its entrancing flora and fauna.

There are no end of cases wherein agriculture has been sorely afflicted by the prevalence of pollutants in the countryside. We must also face the fact that agricultural endeavor does contribute to environmental pollution.

President Nixon set forth a terse statement of the situation a few weeks ago:

> Water pollution has three principal sources: municipal, industrial, and agricultural wastes. . . . Of these three, the most troublesome to control are those from agricultural sources: animal wastes, eroded soil, fertilizers and pesticides. Effective control will take time, and will require action on many fronts: modified agricultural practices, greater care in the disposal of animal wastes, better soil conservation methods, new kinds of fertilizers, new chemical pesticides, and more widespread use of natural pest control techniques.

People ask: If farming and ranching are known to contribute pollutants to our environment, why do we not take steps to stop such pollution?

In meeting this question, we must first consider some of the harsh constraints that weigh upon our stewards of the land. Tweeten points out that 75 percent of our farmers have annual labor incomes of $3,000 or less. Some of them have other sources of income, but their return from farming is strictly at or below the poverty level. Only about 3 percent have good labor incomes—$12,000 plus; and only about 10 percent have $6,500 plus.

Our top producers have an average investment of $300,000 in relation to their average net income of $17,400. The great mass of farmers have very modest investments indeed.

This means that most farmers are too poor to do much on their land that would benefit only offsite conditions and people.

Appalachia, the Ozarks, and the Lake States' cut-over areas are particularly afflicted with rural poverty. These marginal farmers often try to eke out a living from impoverished crops on droughty and eroded soils.

Many of our rural homes shelter families who know nothing of the meaning of affluence. This has an effect on the vigor of their social institutions.

The average farm in the South has a relatively low income. Even in the Great Plains, the farms and ranches are not overburdened with prosperity.

Senator Dole has pointed out that the average farm in Kansas had a net income of only $5,200 in 1967, $2,200 of which came from federal payments. Average income from farming *per se* was at the poverty level.

If you folks were wearing the shoes of the average Kansas farmer, would you oppose federal assistance? Would you use available technology to try to boost your income? How much expense would you go to on your land solely for the benefit of urban people miles downstream in the drainage basin?

There is much public concern about urban poverty. There should be. But net income of farm people has always lagged far behind that of nonfarm folks. Rural poverty must also have public concern. We must face the fact that there are hundreds of thousands of farmers who completely lack the means of curbing polluted runoff from their lands—regardless of their good intentions.

What about the top echelon of farmers who are making reasonably good incomes from their farms and are enabled to have nice homesteads?

A few months ago, *Executive Magazine* published a chart showing that the rate of increase in efficiency of labor use in agriculture was far exceeding the rate of increase in all other phases of the economy. Since this chart shows the average for all farmers, it is obvious that the top producers have attained a truly remarkable rate of increase in efficiency.

In 1950, each farm worker produced enough for 15 persons. Today, he produces enough for about 45 persons. This tremendous average change is due to about 20 percent of our farmers who are most efficient.

This great increase in production efficiency occurred because of rapid increase in mechanization, more effectively meeting soil fertility needs, much better control of crop pests, and use of better varieties.

Crops are planted with 8-row equipment precisely dropping superior seed, needed plant nutrients, and pest control chemicals in one fell swoop.

However, use of 6-to 12-row equipment has incurred a constraint on land treatment practices.

The old system of erosion control using contour terraces with their point rows and meandering terraces is out.

Where mechanical treatments for erosion abatement are necessary, parallel strips must be adjusted to size of field machinery. The terraces should be broad based so as to incur minimal interference with machine operations.

Sediment is by far the major water pollutant in terms of mass. Four billion tons of sediment move from the land to watercourses in the average year.

We can still see tremendous sediment delivery from the Blacklands of Texas, the Brown Loam soil of Mississippi, and the Cross Timbers areas of Oklahoma. We can see wheatfields in northeastern Montana where erosion has removed all of the topsoil. We find tremendous gullies with high sediment delivery in the deep loess soils of western Iowa.

Cooperative research on experimental watersheds at Treynor, Iowa, is showing that level terraces are highly effective in curbing sediment delivery. Unterraced lands deliver 20 tons of sediment per acre per year as compared to 1 ton on the terraced watershed. Although surface runoff from the terraced land is only one-fourth of that from the unterraced, downstream water yield is not reduced by terracing. This finding is important.

Tobacco is still grown in Maryland with rows running down the slopes. Water running across a field is completely nondiscriminate. It will move whatever is movable, including soil, manure, plant residues, pesticides, plant nutrients, and infectious organisms. Tobacco is also grown effectively under sound soil conservation methods that minimize land runoff.

Fifteen years ago, Carroll County, Georgia, was characterized by eroded fields and rundown farms. A watershed protection program on the Little Tallapoosa River has now converted many of the impoverished fields into Bermudagrass pasture that produces fat, sleek cattle.

Use of large multirow equipment imposes other constraints. The prevalence of wet spots in low places cannot be tolerated under mechanization.

Many farmers use enormous land planes to eliminate low spots and provide good surface drainage. Efficiency in using tillage, planting, and harvesting machinery is enhanced. Does improved surface drainage increase pollution from land runoff?

High water tables seriously hurt crop growth as well as impede use of machinery. This is a serious problem on 90 million acres of our cropland. Subsurface drains are often essential for good crops. Do water pollutants go out through the drains?

Efficient crop production has been greatly enhanced by better control of crop pests. Estimates 10 years ago indicated that weeds cause crop losses of $2 billion a year. We are now using herbicides on 140 million acres of cropland and insecticides on about 90 million acres.

Use of these chemicals does cause problems; at least, the suspicion of problems.

A heavy rain immediately after an application of 2,4-D can incur serious washoff of this chemical if the ester form was applied.

A rainstorm immediately after an atrazine application may incur significant washoff. A dry spell following application abates the seriousness of the washoff of atrazine.

DDT is so tightly adsorbed on fine soil particles that it does not leach downward even in very sandy soils. Lindane will move down with percolating water.

Chlorinated hydrocarbon insecticides in soil distill into the atmosphere. Vaporization increases with increasing temperature. Soil moisture has no effect except at extreme dryness.

We must be concerned over pesticides in the environment and need much more information.

Let us return to plant nutrients. Some people are alarmed that we are applying 6.8 million tons of nitrogen and 2 million tons of phosphorus as chemical fertilizer to our lands. They note the serious eutrophication in the canals of southern Florida, the Patuxent River in Maryland, and roadside ditches in western Minnesota. One can see eutrophication in Minnesota's lakes that are surrounded by farms. It is simple to indict agricultural runoff as the cause.

CHANGE RINGS

Let us consider the region of Lake Erie where agriculture is being castigated because of alleged pollution from land runoff. The "Lake Erie Report" estimates that agriculture contributes 250 pounds of phosphorus per square mile per year to the lake. This means 6 million pounds of phosphorus are contributed each year by farming operations. The Report also states that nitrogen contribution by agriculture is 10 times as much. I seriously question these estimates.

The U.S. Department of Agriculture has been conducting research at the North Appalachian Experimental Watershed near Coshocton, Ohio, since 1937. Differently treated watersheds were instrumented to accurately measure runoff and sediment delivery. Five years ago, highly automated sampling devices were installed in the gaging flumes to sample for water quality.

The watersheds lost from 0.03 to 0.06 pound of phosphorus per acre per year. Cropland that had been fertilized with 40 pounds of phosphorus per acre per year showed the same low level of phosphorus yield as the woodland watershed that had never been fertilized.

Moisture in the woodland flume became highly eutrophic during the summer.

Nutrient losses from field plots at Morris. Minnesota, were also relatively low except under the fallow treatment where nitrogen losses were really serious. Soil scientists have known for years that fallowing is very effective in dissipating soil nitrogen.

Lysimeter data have confirmed this. Using a sandy soil in South Carolina, lysimeters that were kept fallow with no nitrogen applied lost 154 pounds of nitrogen per acre in 5 years' time. Cropped lysimeters receiving 680 pounds of nitrogen per acre lost only 18 pounds in five years. This is highly important information in evaluating nutrient pollution from farmland.

C. F. Marbut found that our virgin soils in the prairies contained 8 tons of organic nitrogen per acre. Even the relatively poor Coastal Plains soils contained 2 tons per acre. Contiguous United States had a wealth of nearly 10 billion tons of organic nitrogen in its soils when Europeans first came here.

Schreiner found that our soils lose nearly 40 percent of their organic nitrogen over 50 years of cultivation. George Stanford has studied this nitrogen loss and finds that 1.75 billion tons have been depleted from our cultivated soils over the last hundred years. Against this loss, we have added only 90 million tons of chemical nitrogen to our soils since the turn of the century.

During 1968, just four of our crops removed 8 million tons of nitrogen from our soils. Six million tons of nitrogen as fertilizer were added to cropland that year. It seems that there is far more justification to be alarmed over serious nitrogen depletion of our soils than the alleged excess in nitrogen use.

Let us return to the lakes of Minnesota. Two years ago the University of Minnesota graciously provided me with a plane and pilot to fly over the lake country. One can see lakes among woodland with advanced eutrophication, with a nearby lake among farmland being perfectly clear. In fact, one can see all stages of eutrophy. And there is no relation to kind of cover or use of associated land. One can see areas where the eutrophication process was completed hundreds of years ago. What was once a lake is now a peat bog.

Minnesota is a monument to the process of eutrophication. There are 7.5 million acres of peat bogs in the State, which contain 6.8 billion tons of peat, dry weight. This great deposition of plant detritus contains 102 million tons of nitrogen and 5.5 million tons of phosphorus. None of the latter came from agriculture, municipalities, or industry. We have no alternative than to blame Paul Bunyan's blue ox, "Babe."

And now we must say a few words about the contribution of bovine critters and other farm livestock to environmental pollution.

Americans are carnivorous. The dinner plates of our average citizen account for 238 pounds of flesh a year. Nearly half of the meat we eat is beef. In fact, we've nearly doubled our per capita consumption of beef over the past 20 years; and our population of beef cattle has nearly tripled in the past 30 years.

Our production of broilers has increased 26-fold in 30 years; and the price of frying chicken to the consumer (in 1968 dollars) has had a sharp downward trend. How could you folks have a better example of what agricultural research means to the consumer?

The average 1,000-pound steer will excrete 110 pounds of nitrogen, 22 pounds of phosphorus, 125 pounds of potassium, and 365 pounds of biochemical oxygen demand in a year.

Some feedlots stock at nearly 400 head per acre. At 200-head stocking, there will be excreted on an acre of feedlot in a year's time about 11 tons of nitrogen, over 2 tons of phosphorus, 12 tons of potassium, and nearly 37 tons of BOD. One might suspect that such an acre could become polluted.

It has not been unusual for feedlots to be located on slopes so that there would be good drainage into a passing stream. And manure drainage can cause serious fish kills.

In fact, three of the eight major fish kills in 1967 were caused by manure drainage. Pesticides did not make the top eight.

Smith and Miner made a study of water quality in the Fox River of Kansas at a point one mile below a feedlot after a 1-inch storm in November. BOD went up to 90 ppm for a brief period, with dissolved oxygen going down to nearly zero. Low oxygen level asphyxiates fish. We need much more of this kind of information on rural streams.

It was customary for the fine dairy farms in the Northeast to be arranged so that the barnyard would drain directly into a nearby stream. The problems are pocket-sized editions of those in the large feedlots.

The dairy farmer often spreads manure in the wintertime, even upon an accumulation of snow. The application does not add much to environmental beauty, but winter is the time when labor demands upon the farmer for other chores are at a minimum. If snowmelt comes slowly, the manure stays in the field; but if the melt is rapid, there can be appreciable runoff of seriously polluted water.

Water quality restrictions will probably require that a diversion be built above and below a barnyard or feedlot so that runoff will not enter directly into a natural water channel, but into a series of oxidation lagoons. Effluent from a lagoon into a stream should not exceed 20 ppm BOD.

A good soil conservationist feels in his bones that manure should be returned to the land. It constitutes recycling of wastes. This must be a prime objective.

The Monfort feedlot near Greeley, Colorado, has an excellent recycling system. The manure is picked up by conventional front-end loaders and applied to corn land that is under contract. The corn is cut and ensiled in trench silos; and the ensilage fed to the cattle with steam-cooked grain. Incidentally, Monfort cannot meet the demand by neighboring farmers for manure.

Highly technical American agriculture may have incurred an increased degree of water pollution from cultivated land. But there has been a trade-off. The relative cost of food to the average family has gone down continuously over past decades even though sophistication in preparing and packaging retailed food has increased. There is no law requiring the average housewife to allocate only 18 percent of spendable income for food. She has a right to spend 40 percent of her budget for food. This happens in other countries. Going back to horse and buggy technology on the farm will do it here.

Finally, let us not forget for one moment that agriculture has done more to improve the quality of our environment over the past three decades than any other group one can name. Consider the horrible dust storms of the thirties. This was air pollution at its worst.

—And then look down on conservation farming in Kansas today with the land well protected from wind and water erosion.

—Look upon the poetic harmony of parallel strip-cropping on the vast wheatlands of Montana. Soil blowing is effectively curbed.

—Drive through the millions of acres of Texas ranglands where past overgrazing has given rise to ugly shrubs.

—Compare this to Bermudagrass pastures in Texas where the brush has been eliminated and the cattle are fat and sassy.

—Look upon the thousands of miles of hedgerows established in the Northern Plains to shelter homesteads.

—Consider the practice of conservationists in leaving strips of grain for wildlife.

—The millions of farm ponds that have been constructed are welcomed by wildlife. The ponds also provide fishing and recreation.

—Agrostologists and agronomists have developed grasses and crop management that give complete protection to agricultural watersheds, particularly above the conservation pools.

I'm sure most of you will agree that a rural scene dominated by excellent conservation farming attains the quintessence of environmental beauty and quality in addition to abating runoff of polluted water. Let us not forget that, ideally, the conservation job will not be done in these United States until every stream runs clear and uncontaminated; and until other esthetic values such as rural beauty and wildlife protection are amply emphasized. Let us accentuate the positive.

PROGRAM OF THE COUNCIL ON ENVIRONMENTAL QUALITY

RUSSELL E. TRAIN
Chairman, Council on Environmental Quality, Washington, D.C.

The Council on Environmental Quality is nothing less than a new experiment in government—an experiment which will test whether we are wise enough to manage our affairs in a way which recognizes the essential interdependence of man and his environment.

The responsibilities of the Council cut across the entire fabric of the Federal Government. It provides an integrative force in a critical area of policy making. At the same time, the Council's mandate recognizes that the problems and needs of the environment are tremendously complex, that they do not lend themselves to either simple or instant solutions—a fact which some current pleaders for the environment tend to overlook.

A basic thrust of the National Environmental Policy Act is to insure to the greatest extent practical that environmental considerations are given careful attention at all stages of the planning and decision-making process in every agency of the Federal Government. This requirement is not intended to be a mere formality. Nor is it intended to receive mere lip service. It demands no less than a revolution in the way we approach problems and make decisions. It is an objective to which the Council attaches the highest priority. If we can, in fact, cause some fundamental changes in the decision-making process within the Federal Government, I can think of no greater contribution that our Council could make. Furthermore, it could have a pervasive influence at other levels of government, in the private sector, and, perhaps most important of all, in our education institutions.

Already the Council has begun work on a variety of environmental problems. The Congress, in passing the National Environmental Policy Act of 1969, gave us a very broad mandate. The declaration of policy is clear. One of the major purposes of the Act is: "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment . . ."

The President recognized and expanded upon that sentence when he commented while signing the Act on January 1st that we are engaged in a "now or never" battle for a natural environment of quality. The very fact that he made his approval of the Act his first official act of the decade of the Seventies was dramatic evidence of his commitment to environmental improvement.

On March 5, the President clarified our Council's authority and expanded upon our responsibilities to carry out our mandate. The Executive Order of that date directs the Council to evaluate existing and proposed policies and activities of the entire Federal Government to assure full consideration of environmental values. In so doing, it directs the Council to recommend to the President and the various agencies program priorities for the control of pollution and improvement of our environment.

During this review, the Council will not hesitate to recommend changes to correct deficiencies and to provide adequate responses to potential environmental problems.

We may on occasion conduct hearings as the need arises so that you, in what now might be termed the "fifth estate," will have sufficient opportunity to present your views and give us your counsel.

The Council will exert its influence to coordinate more closely the vast multitude of Federal programs which either relate directly to environmental quality, or which have a significant impact on environment.

An important aspect of this authority is the requirement of the new statute that all agencies file detailed statements concerning all proposals for major legislation and other actions which significantly affect the environment. The Council will recommend guidelines for carrying out this responsibility.

The Act provides the criteria on which the reviews are based, and our "guidelines" will supplement those criteria. The Act provides that included in every recommendation or report on proposals for legislation and other federal actions, the detailed statement shall discuss:

(1) the environmental impact of the proposal;
(2) any adverse impacts which cannot be avoided should the proposal be implemented;
(3) alternatives to the proposal;
(4) the relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity; and
(5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Let me give you an illustration of how this might work. I am sure that all of you are by now familiar with the Florida jetport controversy. For a moment, let us imagine that Florida authorities had just filed their first application, which probably would have been for air-space rights or authority to designate aircraft traffic patterns. Or, perhaps the first state-to-federal contact would be an application for grant assistance.

At this point, using the guidelines developed by the Council, the Federal Aviation Administration would be required to examine not only the air safety aspects of the application, but the entire range of environmental considerations.

As part of this agency review process, all other federal agencies with special expertise in the subject matter would be contacted. Presumably, in this instance, F.A.A. would contact the National Park Service, Bureau of Sport Fisheries and Wildlife, and other resource managing agencies.

The agency's statement of environmental impact of the proposed project would be part of the entire project file from the outset, would be available to the President and to the Council on Environmental Quality, and on request to the public. It would accompany the proposal throughout the decision-making process, including consideration by Congress as part of the authorization process.

In short, there will be the greatest possible evaluation of short-term benefits and their long-term impact upon the environment.

I think this gives you an idea of the mechanics of one of our most important functions. It will be up to you, as part of the conservation conscience of America, to see that environmental impact studies are read and studied and talked about. There should be no shroud of secrecy around these reports, which will be available under the Freedom of Information Act.

I have emphasized that our Council hopes to be in a position to exert a fundamental influence on the way decisions which affect the environment are made. I have described one of our most important tools in this respect. At the same time, I think that it is important to keep in mind that our Council will never have the staff capability to re-examine every single on-going activity of the Federal Government, nor should it. We expect to be selective in our review process. Moreover, it is also important to remember that fundamental changes, particularly those which involve changes in attitude and in values, seldom occur overnight. The objectives which we will be pursuing necessarily will involve a process of education—education of our policy makers, education of our bureaucracy, education in our professional and other schools, and finally, education of the ordinary citizen toward a better understanding of the world around him and his relationship to it.

I sincerely believe that our new Council possesses tremendous potential for improved environmental management. At the same time, let us not delude ourselves into thinking that any single device will solve our environmental problems. The problems are enormously complex, and they will not give way to simplistic approaches. We Americans tend to think that any problem can be solved, no matter how great, if we can only find the right technological handle and put enough money into the job. Our goal of a high-quality environment will not be achieved by following this route. Indeed, it may well be just this kind of thinking which has led us to our present environmental crisis. Far more than technology and money are involved, although these are important. Human values, attitudes, and behavior are even more basic to the equation we must solve.

Our new Council on Environmental Quality hopes to play a leading role in the years ahead. However, if we are to be truly successful in our search for environmental quality, there will need to be a commitment and an effective action at all levels of government—federal, state and local; in industry; among private organizations; and finally in communities and homes throughout the country.

DISCUSSION

DR. CLARENCE COTTAM (WELDER Wildlife Foundation, Texas.) I would like the Judge to know we very much appreciate his approach to this problem but I think I can still see one or two problems ahead. Maybe it is because I don't understand the kind of report that you state will be called for, where they must give an appraisal of the effects that the activity may have on the environment.

I think some of these agencies that I can think of, especially in relation to some experience that I have in the past, will see no evil and hear no evil and report no evil. They will not see any damage in what they are doing.

For example, I saw a letter just within the last month in relation to a big agency that has been doing a great deal of pesticide work and they were doing some damage. In fact, the letter in relation to this to a particular congressman said that it was confident that they could not be doing any damage, that it hasn't done any damage. Well, my conclusion was that the gentleman at the head of that department hasn't learned anything in the last 26 years since DDT has been used.

A person who files this type of report cannot believe or see any damage that is going to accrue. I am just curious to know what sort of follow-up you can have to obtain the truth.

MR. TRAIN: Doctor Cottam, there is no easy answer to that. You know as well as I that there is necessary and very basic reeducation of our bureaucracy. This is very important and it is something we can work on. However, as I said, we do not expect to accomplish this overnight.

I think that the process of focusing on these statements can be very useful.

I would venture to say that at the present time I just don't expect most individuals in government probably know what is actually going to be required. Therefore, it is going to take a bit of time before this gets built in as a normal part of the process. This is the same as budget review in connction with any legislative proposal. However, I think it will come and I have had the opportunity to discuss this with the full Cabinet and they all know about it. They have all given their support. Likewise, the President knows about this. He has given his whole support, and I think this is the way we have to work at it. Of course, we may have to beat a few people over the head. I think one law suit has already been filed down in the South somewhere with an injunctive process by private citizens because somebody failed to prepare or file one of these statements.

I don't know whether this is going to be a useful device or not, and I don't even know what the case is. However, I believe that if this requirement of the statute is not complied with, then the public will have an opportunity to raise a little cain about it and, most certainly, our Council will.

MR. NICK FRITZ (Texas Committee on Natural Resources): Let me say that we are the ones that obtained that injunction and a part of it had to do with its standing in court.

Now, first I would like to ask you to what extent, if any, will the Administration consult the new Council for some information and advice on legislation?

MR. TRAIN: I think very extensively. We have had discussions with the Bureau of the Budget at the staff level. I met with Director Mayo and discussed this operation directly with him. The intention is that the Bureau of the Budget will build us into the consultation process from the beginning In other words, our hope is, and what we have talked with the Budget about is that we will not simply be reporting as one other agency. As you know, every agency has a conceivable interest in a legislative proposal. Each is asked by the Bureau of the Budget to give its views. We are already doing that and we would fully expect that we will continue to build into that.

We are working, I think, on a closer relationship with the Bureau of the Budget than simply another agency kind of representation.

MR. FRITZ: Very good, I am happy to hear that.

MR. TRAIN: We see ourselves as a sort of Bureau of the Budget environmental arm in this review of legislation.

MR. FRITZ: They need one badly.

Now, my next question has to do with Senator Jackson's proposal to reinstate into the Environmental Policy Act the inalienable rights clause, one that would recognize for every citizen the inalienable right to a quality environment and to the protection of this act. This has to do, of course, with the right to sue as one of its big points, so that citizens can help if the agencies do not react. In other words, the citizens could bring a lawsuit and not make it necessary for your Council to do all of the policing itself.

Now, I know that you cannot comment on what the Council will recommend but I would like to have your personal views on Senator Jackson's inalienable rights clause.

MR. TRAIN: I have discovered that it is very difficult for me to give personal views that can be disassociated from the views of the Council.

I appreciate your thoughtfullness in relation to your question. However, I frankly do not believe I know the answer, either personally or officially.

I think this will have to be indicated in practice—to see to what extent the courts use it and if it comes to be a useful tool.

MR. THOMAS KIMBALL (National Wildlife Federation): I am not sure, Judge, that I fully understood your comments about technology and money to solve some of our environmental problems and that the committee may be dealing more with attitude and behavior.

MR. TRAIN: I did not say that.

MR. KIMBALL: That is what I had hoped to clarify because recently, in reviewing the 1971 budget recommended by the Bureau of the Budget, there was listed there 13 functional categories, regardless of where they are located in the Federal Government. Out of all of the expenditures in the federal establishment, beginning, of course, with National Defense, the thirteenth dealt with resources and, further, a good portion allocated for that was in water development, primarily by the Corps of Engineers and Bureau of Reclamation.

Do you think that in your responsibility as the Chairman of this Environmental Council we can look for at least an upgrading of this fiscal policy of the Administration to bring our resources program up out of the thirteenth sub-basement of fiscal priority?

MR. TRAIN: Well, Tom, I think we are looking for a larger share of the federal budget being devoted to natural resource development and management. I think it is badly needed. I don't know how indicative that particular thirteenth category is.

You and I probably think of it in a resource area, which is not included in that. There are a great many other things involved. For example, the atomic energy field is not included. Therefore, I don't know what is happening here but, on the other hand, I would agree with you—that we are not at the present time spending as much as we would like to in relation to these programs. There is no question about it.

I certainly did not intend to convey any idea that I do not believe technology and money are important in these jobs, because they are. However, I think there is a tendency to feel that in technology and in money lies a solution to all of our problems. I very definitely think that is not the case.

MR. CHESTER RITTOFF (University of Kansas): The Nixon Administration has brought up the issue of overpopulation in the United States by setting up a committee instead of proposing tax reforms or any other reforms and the Secretary of Health, Education and Welfare backed down from this statement on a two-child family as being advisable in the United States.

What positive steps will your organization take to stem the one and a half percent per year increase in population in the United States?

MR. TRAIN: Mainly we view human population in both the terms of absolute numbers and in terms of distribution as having a critical relevance to environmental quality. All the members of our Council give the matter of population policy a very high priority.

As to what action programs we specifically will be proposing, I believe that the new commission is going to have to have far more expertise than our Council does. We are made up of myself—a tax lawyer—an environmental reporter and a physicist. I would hope that the population commission would have a far more demographic competence and general competence in the field of population than we can possibly hope to have.

I would expect that for the life of that commission, which is fixed by statute at two years, it would be the major focal point for population policy development in the Federal Government.

I would also rather expect that, as it phases out, unless it is continued, that function would be taken over by our Council. We will continually have a deep interest in what the Commission is doing and expect to work very closely with it but I don't think we would expect to pre-empt its functions.

MR. JERRY GRANT: You cited that under your selective policy you probably would not review many projects which are now under way. By announcing this policy, are you not giving a carte blanche to irreversible projects now under way by the government?

MR. TRAIN: Why?

MR. GRANT: Because they cannot be reviewed by your Council.

MR. TRAIN: I did not say they could not be reviewed. I said that we cannot review everything going on in government and that we would be selective. We are directed by the statute to review current activities and programs.

Let me amplify on that just a moment. I do worry over the fact that no matter how we get set up, how we are budgeted, we are always going to be a fairly small outfit. At present I have a staff of three or four. Therefore, while we expect this to expand and expand quite rapidly, once you get beyond a certain critical point—and I don't know what this is but I suspect that it might be around twenty-five to thirty-five professionals—you begin to lose your capacity to be a policy group and become another cog of the bureaucracy.

With a small staff it is mechanically impossible and I think entirely improper for us to pretend we are going to be taking a look at every single activity within the Federal Government. It simply cannot be done.

MR. GRANT: You almost answered my question.

Realizing how small the Council now is, I wonder if you can address yourself to the group here with respect to their role as a constituency in relation to what you are going to have to do as a Council for the environment? I remember quite well what you organized in the Conservation Foundation and the extreme value of those programs. However, what do you think this group, represented here by all of these organizations, can do to assist you directly by addressing you and the people in the various departments who should be hit with some mail before you are?

MR. TRAIN: That is a very important question. However, I don't fully see my way to a clear answer.

PART II
TECHNICAL SESSIONS

TECHNICAL SESSION

Monday Afternoon—March 23

Chairman: WALTER W. DYKSTRA
Research Staff Specialist, Division of Wildlife Research, Bureau of Sport Fisheries and Wildlife, Washington, D.C.

Discussion Leader: ELDRIDGE G. HUNT
Wildlife Research Biologist, California Department of Fish and Game, Sacramento, California

DISEASE, NUTRITION, AND CONTROLS

EVALUATING WINTER DEER USE OF ORCHARDS IN WESTERN COLORADO[1]

JOHN D. HARDER[2]
Cooperative Wildlife Research Unit, Columbus, Ohio

Man has probably experienced depredation by game animals since he first planted his crops within wildlife habitat. An important aspect of this problem is damage by deer (hereafter called deer damage) to orchards. White-tailed deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*) are the two most abundant and widespread big game species, and their use of orchards constitutes one of the leading game depredation problems in the United States today (McDowell and Pillsbury, 1959).

The relatively large population of mule deer and the frequent juxtaposition of agricultural areas and deer habitat make Colorado one of the leading states in the deer damage picture. The problem is further complicated by statutes which make the Game, Fish and Park Division responsible for all damage to real or personal property by wild animals protected by state laws.

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[1]Contribution of the Colorado Cooperative Wildlife Research Unit; Colorado State University; Colorado Game, Fish and Parks Division; Wildlife Management Institute; and Bureau of Sport Fisheries and Wildlife, cooperating.

[2]Formerly Graduate Research Assistant, Colorado Cooperative Wildlife Research Unit, Fort Collins, Colorado.

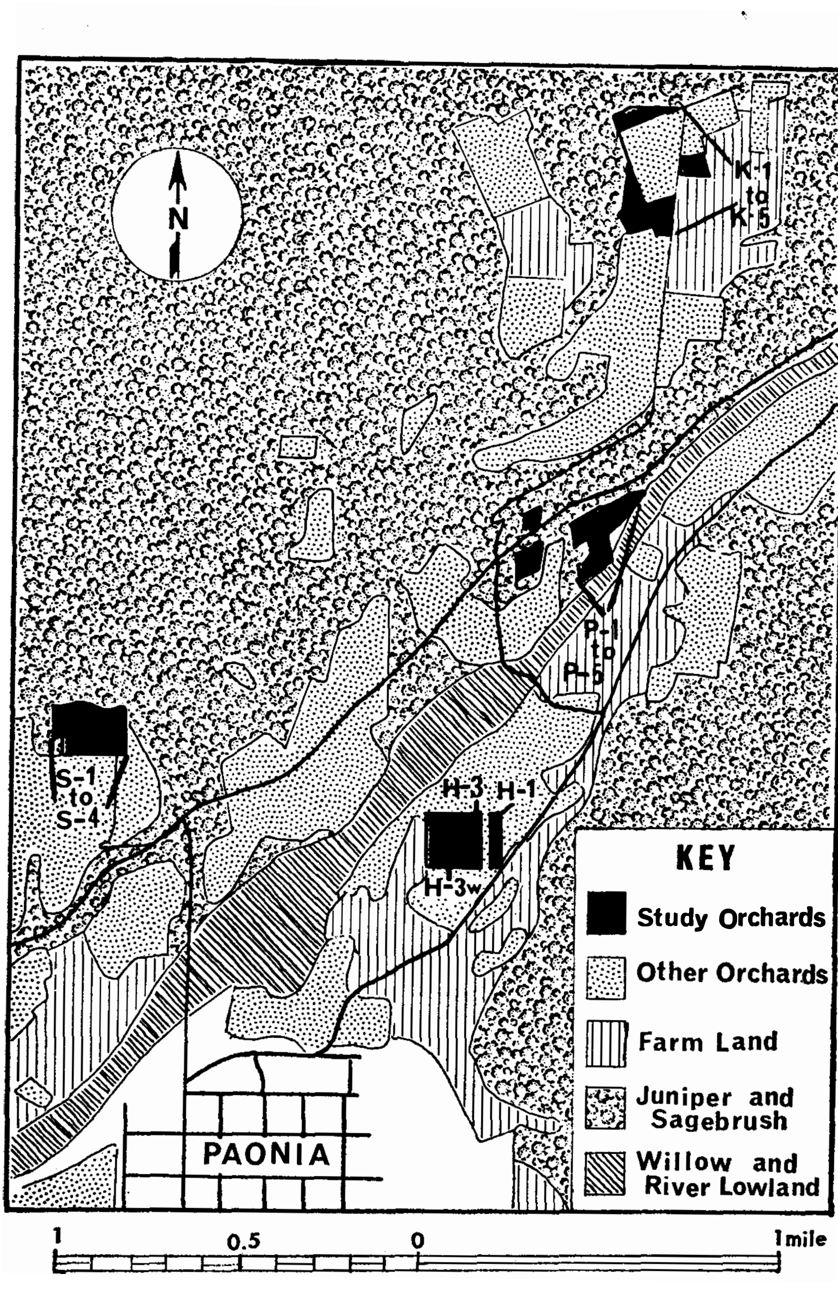

Figure 1.—Land use and vegetation in the Paonia study area, 1965-1967.

Obviously, a means of reducing deer damage to orchards would be mutually beneficial to orchardists and game agencies, and for many years the Bureau of Sport Fisheries and Wildlife and most states with deer damage problems have tried a variety of methods and devices to reduce deer damage. Yet, in all this effort the damage itself was seldom studied. Thus, the purpose of this study was to set forth criteria for field evaluation of mule deer damage to orchards and to investigate several factors relating to deer use of orchards in winter.

STUDY AREA

Orchards used in the study were located within a 3-mile radius of Paonia, in west central Colorado. The area lies at the confluence of the North Fork of the Gunnison River and Minnesota Creek and is located in a transition zone between the dry plains and mesas to the west and the mountains to the east. Two topographical areas were important in this study: the valley floor (5600 to 5800 feet elevation) and the surrounding mesas (5800 to 6400 feet elevation). Mesa orchard areas are separated by ravines and are often adjacent to nonagricultural land (Figure 1). Lennox Mesa is a major topographical feature of the study area providing juxtaposition of valley orchards and deer habitat (Figure 2).

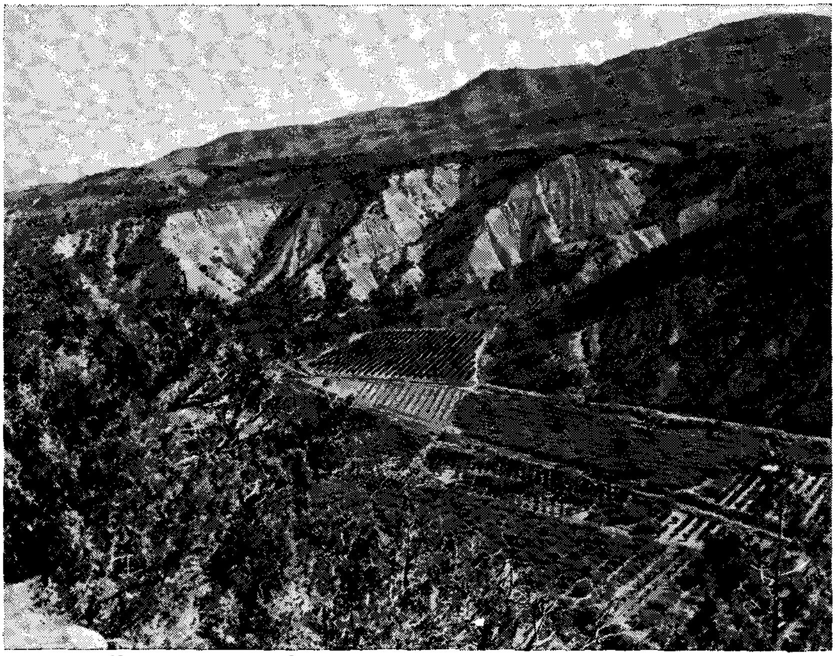

Figure 2.—Northwest side of Lennox Mesa showing juxtaposition of orchard and non-agricultural areas, October, 1966.

As might be expected in a fruit-growing region, the winters are relatively mild. In the two winters (December-March) of the study, there were only 16 days during which the temperature did not rise above 32°F. Snow usually melted within two or three days and the area was generally devoid of snow except on the higher mesas.

The dominant vegetation of the hills surrounding Paonia orchard areas is Utah juniper (*Juniperus osteosperma*) and big sagebrush (*Artemisia tridentata*). Approximately 75 percent of the agricultural land is devoted to orchards with the remainder in improved pastures and alfalfa (*Medicago sativa*). Apple (*Malus pumila*) is the primary fruit crop with peach (*Prunus persica*) secondary. Other important fruit crops are cherry (*Prunus avium*), pear (*Pyrus communis*), prune (*Prunus americana*), and apricot (*Prunus armenica*). All were represented in one or more of the test orchards.

METHODS

Browse Utilization

Test orchards were selected to represent the main topographical features of the study area and to include the major fruit species. In early fall and winter samples of test orchard populations were selected by random numbers in a serial count of the trees. In most cases a 10 percent sample was used, which yielded 327 trees tagged in 1965-1966 and 430 in 1966-1967. On each sample tree, three to five (10 to 25 percent) of the terminal shoots below a browse line of 5 feet were marked at a point 30 centimeters from the tip with a piece of black plastic adhesive tape. The first terminal tagged on a given tree was also marked with red surveying tape. Tagging operations always proceeded in a counterclockwise direction around the tree, and data were recorded in sequence. In this way tagged terminals could be identified individually for subsequent remeasurement.

The first measurement of linear browse removal by deer was taken during mid-January followed by two additional measurements at 25-day intervals. The length (tip to tape) of each terminal was measured to the nearest 0.5 centimeters, and any reduction from the previously recorded length was recorded as loss due to browsing. In conjunction with measurement of linear browse removal in 1967, a count was made of browsed terminals on each sample tree and recorded over the total number of terminals below the browse line.

Antler Rubbing

Antler rubbing damaged orchard trees in two ways: (1) removal of bark from limbs and trunk and (2) breakage of limbs. The two were frequently found together on a rubbed tree. Bark removal from antler rubbing was identified easily. The injury was usually at a height of 0.6 to 1.0 meter, and bark was shredded and removed along the vertical axis of the limb. The most distinctive characteristic of antler rubbing was the presence of irregular furrows along the wound. All trees in each test orchard were inspected for antler rubbing damage during each browse-measuring operation. The height and trunk diameter of each rubbed tree were recorded. In March, 1967 the length and maximum circumference of area de-barked (to the nearest 10 percent of the total circumference) on each rubbed branch were measured and the appearance of the wound and terminal shoots recorded. A total of 435 branches on 220 trees were inspected. In May, 1967 after the trees had leafed, the same branches were inspected and placed in one of three categories: (1) not affected, (2) stunted (not fully leafed), or (3) dead.

The number of deer using various orchards was estimated in three ways: (1) photoelectric cell system (Loveless *et al.,* 1963 and Harder, 1969), (2) track counts, and (3) visual observation. Most of the data were collected by visual observation. Time spent touring test orchards and observing deer was approximately one hour per night. These nightly tours were distributed equally between the hours of 7:00 p.m. and 12:00 midnight. All observations were made from a pickup truck by driving slowly along a lane or road adjacent to the orchard and shining a spotlight between each row of trees.

RESULTS AND DISCUSSION

Browse Utilization

Browsing has been charged with everything from alteration of growth habit to killing young fruit trees (Boyce, 1950; Morse and Ledin, 1958; and Eadie, 1961). Of these effects, mortality was most easily investigated in a two-year study. In September, 1965 a 10 percent sample was taken of an orchard containing 1600 one-year-old apple trees. Of the 160 trees inspected, 12.5 percent were placed in the heavily browsed category, having five or more terminal shoots browsed 3-5 centimeters beyond the terminal bud and/or having 50 percent or more of the foliage removed (Figure 3). In May, 1966 eight trees were found dead from bark removal as a result of antler rubbing and two were dead from unknown causes. However, I could not attribute the death of a single tree solely to browsing.

To investigate changes in tree vigor resulting from browsing, 10 pairs of 1-year-old apple trees were randomly selected from a total of 325, a browsed and unbrowsed tree in each pair. In February, 1966 maximum trunk diameters were measured with a vernier caliper 5 centimeters above the grafting scar and recorded to the nearest 0.05 centimeter. Trunk diameters were remeasured in January, 1967 and increments recorded as one year's growth. Variability was reduced by using only trees with a single leader or trunk and no side branches.

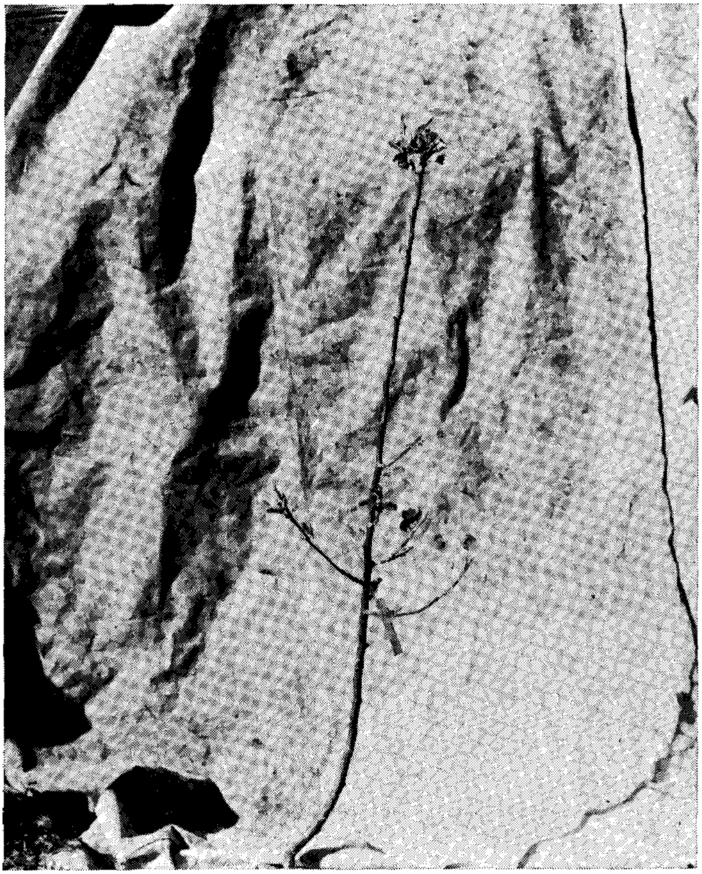

Figure 3.—Heavily browsed, one-year-old apple tree used in mortality test.

Thus, browsing was limited to removal of 5-15 centimeters of current annual growth from a single terminal. Ultimately one pair became unsuitable for the test, but the browsed tree in each remaining pair grew more in trunk diameter than the unbrowsed tree in seven of nine cases. The difference was not significant (paired t-test, $P > .05$). Thus, browsing apparently did not affect tree vigor significantly as expressed in trunk diameter growth.

Probably the most detrimental effect of browsing was its interference with the development of strong, well-formed branches during the first 2 or 3 years of a tree's life. Verner (1955) found auxin produced in the growing shoots and leaves of young apple trees modified the growth of branches in lower parts of the tree by inhibiting the growth of lateral buds, causing wide crotch angles, and producing a spreading type of growth. A system of training known as the modified leader system makes use of this principle. The central shoot is allowed to grow for several years, encouraging the development of strong, wide-angled branches below (Scheer and Juergenson, 1964). Thus, if the terminal bud of the central leader is browsed, the supply of auxin is reduced, and narrow-angled scaffolds may develop. In addition, terminal browsing of individual scaffold branches reduced apical dominance and produced undesirable, bushy growth.

Pruning involved removal of branches from all parts of the tree, and browsed branches were often comparable to those pruned. Even in young orchards (3-5 years old), 28 to 50 percent of the terminals below the browse line were pruned. The selective removal of branches in pruning was much different from the random browsing by deer. Nevertheless, browsing often occurred on nonessential branches, those branches that were later removed by the orchardists themselves.

For the purpose of estimating browse utilization, counting browsed terminals was superior to a measurement of length reduction. The count method was more sensitive to various intensities of browsing, because it involved 100 percent of the terminals below the browse line and not merely a 10 to 25 percent sample. Since alteration of growth habit occurred through removal of the terminal bud, the number browsed seemed more important than the length removed, which averaged 3.2 centimeters per browsed terminal per year.

The count method would be ideal for routine evaluation of browse utilization. It would be a one-step operation, and work would be limited to orchards receiving browsing. The data could be collected at the time of complaint, and they would be objective and easily understood by all concerned. In addition, records kept on a yearly basis would provide criteria for evaluating damage control programs.

Three factors relative to evaluating browse damage were brought out in this study: (1) Once the scaffolds of a young tree had established a favorable angle with the trunk and had their terminal buds beyond the reach of deer, the ill effects of winter browsing were reduced considerably. This size was reached in 3 to 5 years. (2) Browsing did not appear to affect mortality or vigor of young fruit trees. (3) The detrimental effects of browsing were produced primarily through alteration of scaffold training programs. Thus, when browse damage is investigated, the extent of browsing on developing scaffolds rather than general frequency of browsed terminals should be considered.

Antler Rubbing

In this study, antler rubbing was more detrimental to young orchard trees than was browsing. Rubbing removed bark and cambium and exposed the xylem to drying winter weather. This was especially serious, since most of the antler rubbing occurred in late fall and early winter when there was little sap flow to heal the wound. As with browsing damage, trees 1 to 3 years old were most often rubbed, averaging 4.0 centimeters in trunk diameter and 2.0 meters in height. Of the 2,914 trees inspected for antler rubbing in 1966, 130 or 4.5 percent were rubbed. In 1967, 220 or 6.7 percent of 3,282 trees inspected were rubbed. The highest incidence of rubbing in any orchard was 28 percent.

Although relatively few trees were rubbed, the effects of this activity were quite pronounced. In 1966, 15.4 percent of the rubbed trees died, and in 1967, 9.1 percent died. Occasionally a tree was broken at the ground or died from limb breakage. However, in most cases, death from antler rubbing resulted from bark removal. Of the trees dying of antler rubbing, 84.6 percent had bark removed from their trunks. The average percent of trunk circumference de-barked on these trees was 53.8. The average trunk diameter of trees dying of antler rubbing was considerably smaller (2.2 centimeters) than the average rubbed tree (4.0 centimeters), and trees 1 to 2 years of age were most likely to die.

Severely rubbed trees were often cut off at the ground. However, this did not necessarily represent a total loss to the orchardist. The stumps would usually send up a new leader the following spring, and the well-developed root system permitted rapid growth. Providing they were not rubbed the following years, such trees might reach maturity as rapidly as undamaged trees.

Approximately 57 percent of the antler-rubbed trees survived with dead or stunted branches. Severely rubbed branches were cut off at the trunk. If the removed branch was a developing scaffold, a replacement, usually much smaller, had to be selected and trained. On the other hand, many rubbed branches were not important to the scaffold training program and would have been pruned regardless of their condition.

Evaluation of antler rubbing damage would be easier if it were known which branches would live and which would die. The maximum percent of circumference bark removed from antler-rubbed limbs varied from 5 to 100. It was assumed that at lower percentages the wound would heal, and that at percentages approaching 100 the limb would die. However, it seemed necessary to know the point in this range of percentages that would consistently separate dead limbs from those able to survive. With limbs 1.25 centimeters or more in diameter, the separation was pronounced. Ninety percent of the limbs with more than 50 percent circumference bark removal died, compared to only 46 percent mortality for limbs below this point (Table 1). The percentages of branches with shriveled terminals were closely correlated to the percentage of dead branches in each bark removal class ($r = 0.09$, $P < .01$). Thus, regardless of extent of bark removal, the occurrence of shriveled terminals on a limb was a reliable indicator of death during the dormant season.

TABLE 1. PERCENTAGE OF CIRCUMFERENCE BARK REMOVAL AND ITS EFFECT ON FRUIT TREE LIMBS 1.25 CENTIMETERS OR MORE IN DIAMETER

Bark Removal Class		Initial Appearance	Spring Condition		
Maximum percentage of circumference bark removed		Percentage of branches in each bark removal class with shriveled terminals	Percentage of branches in each bark removal class		
			Dead	Stunted	Not Affected
*(26)	10	4	4	8	88
(50)	20	10	14	4	82
(33)	30	12	18	12	70
(22)	40	18	27	37	36
(39)	50	36	46	36	18
(20)	60	90	90	10	0
(13)	70	85	92	8	0
(9)	80	89	100	0	0
(3)	90	100	100	0	0
(5)	100	100	100	0	0

* Number of limbs in each bark removal class. Total number of limbs inspected: 220.

From observations taken in this study, certain criteria for field evaluation of antler rubbing damage can be set forth. Trees broken at the trunk or ground level are usually replaced, but if the trunk is cut off below the break and the wound sealed, the well-developed root system will provide for rapid growth of a new leader the following year. If over 50 percent of the circumference bark is removed from the trunk of a small tree (trunk diameter of less than 2.5 centimeters), it will probably die. Most young trees that have the majority of their scaffolds rubbed for several successive years become stunted and require replacement. The major problem in evaluating antler-rubbing damage is deciding how the development of a tree will be altered or delayed because of bark removal on scaffold limbs. Data presented in Table 1 should be useful, but a trained pomologist should be present when inspections are made and should be consulted on such matters.

FACTORS AFFECTING DEER USE OF ORCHARDS

This study was designed under the assumption that deer used orchards in the Paonia area primarily during the fall and winter months, and nothing was found to disprove this basic assumption. The onset and perhaps the peak of antler rubbing occurred in mid-November, and it was 90 percent completed by the first part of January, the period corresponding to the mule deer rut. With one exception, no browsing was observed before October, and it appeared that browsing intensity remained relatively low until after mid-January. In 10 of 14 orchards, centimeters of growth removed per terminal per day was greatest during mid-January to early February.

During severe winters orchardists in the Paonia area have seen deer in the orchards at every hour of the day, but during the course of this study, deer use of orchards was limited to the period from one hour after sunset to one hour before sunrise. The number of deer observed in the orchards increased rapidly between 7:00 and 8:00 p.m. and continued to increase with considerable fluctuation until a high was reached between 10:00 and 11:00 p.m. A photoelectric-cell system was established between a nonagricultural area and an orchard containing 1200 prune trees 1-10 years old. Deer entered this orchard soon after dark (7:00 to 9:00 p.m.) as evidenced by an early peak in counts and the fact that 49 percent of the light-beam interruptions were recorded before 10:00 p.m. Evidently most deer moved back to the nonagricultural area by 3:00 a.m., as only 14 percent of the light-beam interruptions were recorded after this time (Harder, 1969).

Most methods of controlling browse damage are based on reducing the number of deer in a given orchard area. Thus, it is important to know something of the relationship between deer numbers and browse utilization. A nightly count of deer was made in each test orchard. The highest total count for all areas in a single night was 69. An orchard containing 475 80-year-old apple trees (designated H-3w) usually had the most deer and had a high of 45 in one evening.

The orchards in Table 2 are listed in order of increasing number of deer observed. In general, the percentage of terminals browsed on trees in each area followed this order, giving a positive relationship between deer numbers and browse utilization. But, an increase in deer did not always bring a proportionate increase in browsing. For example, the number of deer per observation in H-1 to H-3W was much higher than in K-1 to K-5, and yet the browse utilization in H-1 to H-3w was lower. For reasons to be discussed later, deer were particularly attracted to H-3w which was adjacent to H-1 and H-3. This elevated the count for the area without a proportionate rise in

TABLE 2. COMPARISON OF BROWSE UTILIZATION AND ESTIMATED NUMBER OF DEER USING TEST ORCHARDS PER NIGHT, JANUARY TO MARCH, 1967

Orchard No.	Mean number of Deer observed per night	Number of trees	Browse Utilization: Trees browsed (per cent)	Browse Utilization: Number of terminals below the browse line (Average)	Browse Utilization: Terminals below browse line browsed (per cent)
P-1	0.17	250	34	39	10.0
P-2	(P-1 to P-5)	200	25	47	09.2
P-3		160	07	16	08.8
P-4		200	00	8	00.0
P-5		400	75	10	31.0
S-1	1.63	500	96	31	27.0
S-2	(S-1 to S-4)	350	91	31	29.4
S-3		200	40	11	15.0
K-1	3.69	112	95	30	54.0
K-3	(K-1 to K-5)	200	100	32	42.0
H-1	16.65	93	80	22	32.0
H-3	(H-1 to H-3w)	69	100	23	29.0

browsing, because deer spent most of their time grazing and bedding down in the cover crop of H-3w (Fig. 1). In short, the nature and intensity of deer use varied according to the physical characteristics of a given orchard, and it was not possible to describe a simple relationship between deer numbers and browse utilization.

Age, composition, and distribution of orchards had an effect on deer activity within the study area. Old apple orchards received the heaviest use. These orchards usualy had an abundant supply of cull apples on the ground, which deer apparently relished. At times, they would seek the apples by pawing through several inches of snow, and nearly all cull apples were consumed by the end of winter.

The older apple orchards required heavy pruning every winter to maintain vitality in the producing parts of the trees, and thus there was a large number of branches on some orchard floors most of the winter. These branches were attractive to deer. For example, after four rows of old apple trees were felled and cut in the K-1 to K-5 area, the average number of deer observed per night increased from 0.5 to 10.0. Sixty-eight percent of the latter were seen among the felled trees.

The presence of older orchards also affected deer use of younger orchards nearby. Orchards H-1 and H-3 were composed of a small number (180) of 3-7-year-old trees lying near the popular H-3w. These orchards received heavier browsing than P-1 to P-5 which consisted of a uniform stand of 1210 3-year-old trees distributed over 30 acres (Table 2). The exceptionally high browse utilization for the area in P-5 was due in part to frequency of deer travel and proximity to natural cover, and browse utilization of the rest of the area was low. Orchards P-1 to P-5 were cultivated regularly, and brush control was practiced on the bordering land. Thus, it was an area largely devoid of cover, and deer spent little time there. The extent of browse utilization in K-1 and K-3 illustrated the added effect of natural cover (Table 2). K-1 was next to a large expanse of old apple trees (similar to H-3w), and K-3 was situated between an old apple orchard and a brush-covered ravine frequented by deer (Figure 1).

Mule deer in the Paonia area were not noticeably disturbed by human activity. During spotlight counts deer were usually within 75 yards of the pickup; often they were no more than 20 yards away. In addition, deer used orchards near human habitation. Nevertheless, deer activity appeared to be strongly influenced by cover provided by natural vegetation and older orchards. Deer use of orchards varied from almost zero in wide expanses of young trees to a high where small blocks of young trees were surrounded by older orchards or natural cover.

ACKNOWLEDGMENTS

This study was sponsored by the Colorado Cooperative Wildlife Research Unit and financed by the Colorado Game, Fish and Parks Division. I wish to express deep appreciation to Dr. Fred A. Glover, Leader, Colorado Cooperative Wildlife Research Unit, for the opportunity to pursue this study and for guidance and encouragement to publish the results. Mr. Raymond J. Boyd, Wildlife Researcher, Colorado Game, Fish and Parks Division and Dr. Harold W. Steinhoff, Professor of Wildlife Biology, Colorado State University, gave valuable advice throughout the course of the study.

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DISCUSSION

FROM THE FLOOR: We also had serious problems of deer damage last year to our orchards and agricultural crops. Mr. Harder stated that the purpose of his study was to develop criteria for damage, and I am wondering about the application of those criteria, particularly when the greater damage was done by the formation of structure rather than by simple browsing.

Can you tell me if the Colorado Department offers or will have available services of the type that will make these kinds of determinations available and, further, if they include consideration of future loss of crops; or, on the other hand, is this simply a matter of dead or non-dead trees or do they take into consideration that the 58 percent figure that you mentioned in relation to scaffold damage?

MR. HARDER: I would like to think that some of this information that I brought out has not been used before. There is an agricultural experiment station near the study area and in extreme cases other specialists were called in to collaborate.

Primarily it is a matter of dead trees. Now, with regard to tree damage, nobody really knows how to evaluate what it means to set back a tree one year in its development or to select another branch to grow in place of one deformed.

One consideration I would stress is that not all branches on a tree are valuable. In the very young trees, three to five years old, it was found that as high as 50 percent of the terminals below the browse line were pruned by orchardists. It is not a simple matter of how many deer are in an orchard or how many branches they browse.

FROM THE AUDIENCE: How did you obtain your count of deer that frequented the orchard during the night and also how many nights did you go out in the study area?

MR. HARDER: I used three methods. One was the photo-electric cell system on a limited basis. I also used track counts, particularly if there was a passage from the deer habitat back and forth to the orchard. The data I presented was based on visual observations during a two-month period. In other words, I went out each night between the hours of 7:00 (immediately after darkness) to about 12:00 o'clock midnight. I tried to distribute the counts over that time period. I spent about an hour driving from one orchard to the next. I would drive down the lane and count with a spotlight. Occasionally a deer would panic but it was quite easy to check them. I tallied them on a meter. This gave an observed count and, of course, I did not see all the deer, but the tracks could give me a higher count. However, I wasn't exactly sure as to their accuracy.

CHEMICAL CONTROL OF PIGEON REPRODUCTION

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INTRODUCTION

Recently, there has been an increased effort to develop chemical embryocides or chemosterilants to control populations of various pest animals. The chemical "Ornitrol"[1], developed by G. D. Searle & Co., Chicago, is the first chemosterilant to be registered by the U.S. Department of Agriculture. This drug coated on whole kernel corn is now available for use in controlling feral pigeon populations.

Initial research on the effectiveness of Ornitrol was conducted by Elder (1964) who found that the drug was 100 percent effective in inhibiting reproduction in pigeons for three months and 75 percent effective from four to six months after treatment. Field trials were conducted in northern cities by Wofford and Elder (1967). Further

[1]Ornitrol (SC-12937) 20,25- diazocholesterol dihydrochloride.

field trials were conducted in Bangor, Maine by Gramlich and Woulfe (undated). The current study involves field trials in three southern cities, all in Florida. Field work was begun in April, 1969 and will be continued until June, 1970. Therefore, this report is not final and does not reflect final results of the experiment.

TECHNIQUES

To determine the effects of Ornitrol three cities in northern peninsular Florida were chosen as study areas. These cities were Jacksonville (population 201,000),[2] Ocala (population 14,700) and St. Augustine (population 13,600). Jacksonville and Ocala were designated treatment areas; St. Augustine was designated the control area.

In Jacksonville two sites were selected for treatment. One was the city-owned Water Works at 1000 N. Main Street, in downtown Jacksonville. The second site was located about 2.4 miles west, adjacent to a railroad yard. This site was the City Products Corporation Ice Plant. In Ocala, the site selected was the Seminole Mills feed plant, about 0.3 mile northeast of the downtown area. The site chosen in St. Augustine was Keterlinus Junior High School, about 0.5 mile north of the downtown area.

Treated sites were prebaited for a period of ten days to two weeks with whole kernel corn. After this, corn treated with Ornitrol at the rate of 0.1 percent by weight was put out at each site for a period of ten days. The total amount put out and consumed each day was recorded by weight. In each of the treated cities Ornitrol was administered three times, *i.e.* April and September, 1969, and again in March, 1970.

In September, 1969, the number of treatment sites in Jacksonville was increased from two to five. The number of treatment sites in Ocala was increased from one to three in February, 1970.

In order to monitor the effect of Ornitrol, trapping was conducted at each of the four sites immediately following the first treatment. Trapping continued for the duration of the experiment on the average of 2.2 times monthly at each site. The number of birds at each site was calculated by the Schnabel method of estimating populations.

Birds which were trapped and banded were grouped according to age into the following classes: (1) less than two months, (2) two to four months, (3) four to six months, and (4) greater than six months. For the purpose of this paper, the first three classes were grouped together and considered young birds while the remaining class of

[2]Populations for the year 1960.

birds over six months was designated the adult class. In this manner, the ratio of young birds to total number of birds was recorded.

In November adult males were weighed at four sites: Ocala, St. Augustine, Gainesville and at the Ice Plant in Jacksonville. Average weights were calculated for each city and compared to each other.

In addition to the field data, a cage study was conducted to determine the consumption of treated corn when it was the only food available for a ten-day period.

RESULTS

Bait Consumption

The amount of treated corn placed at each site was measured and the average consumption per bird was calculated based upon the population estimates (Table 1). Average consumption per bird was also calculated for the cage study.

TABLE 1. CONSUMPTION PER BIRD OF TREATED CORN ACCORDING TO LOCATION, APRIL 1969

Ice Plant	Water Works	Ocala	Caged Birds
5.0*	6.6	10.5	6.6

* Ounces for 10-day period.

Consumption varied from 5.0 ounces per bird at the Ice Plant in Jacksonville to 10.5 ounces at the feed mill in Ocala. There are three factors which might explain the differences in bait consumption between the various sites. First, average consumption was determined by dividing the total amount of treated corn consumed by the estimated number of birds. While the total amount of treated corn consumed can be accurately measured, the number of birds present can only be approximated. An error of reasonable size will drastically affect the estimate of per bird consumption. Secondly, the feeding habits of the birds can determine the amount of bait consumed. In Ocala, where the birds fed primarily at the feed mill, relatively high consumption levels would be expected. Birds at the Ice Plant in Jacksonville, however, which had been observed to feed at four primary sites, would be expected to have a somewhat lower consumption level at any one site. Finally, the size of individual birds would affect the average consumption level. For example, birds in Ocala, which were the largest in size, also had the highest bait consumption.

A comparison of consumption data by feral pigeons and caged birds showed that caged birds consumed an amount somewhere in the mid-range of values for feral pigeons. This would seem to indicate that intrinsic site factors determined per bird consumption, and, furthermore, that the consumption at all sites was satisfactory.

Population dynamics

Jacksonville—Ice Plant.—This site had the largest pigeon population of the four study sites. The original population calculated from data gathered in April, May and June of 1969 was estimated at 1220 birds (See Table 2). This population declined steadily and for January and February, 1970, was estimated at 530, a 57 percent reduction in the number of birds originally present.

TABLE 2. SUMMARY OF TRAPPING DATA, APRIL 1969 TO MARCH 1970

Location	No. banded	Total captured	Recaptures (%)	Total populations Initial	Final
Ice Plant	1228	1834	33.0	1220 (1023–1615)*	530 (518–667)
Water Works	301	928	67.5	220 (207–234)	170 (159–204)
Ocala	437	1082	59.7	420 (352–437)	180 (170–207)
St. Augustine	131	649	79.9	110 (103–122)	73 (69–78)

* Confidence limits at 95% confidence level.

Movements of birds in Jacksonville show that there is a certain amount of intermixing between flocks. From data obtained at the Ice Plant it appears that this area is primarily a loafing place for young birds and that after reaching four to six months of age they emigrate to other areas of the city. This is supported by the low frequency of recapture of marked birds (33 percent) and also by the relatively large number of young in the population, which was 84.1 percent at the start of the experiment and remained as high as 35.6 percent at the conclusion of this phase of the experiment (Table 3).

TABLE 3. PERCENTAGES OF YOUNG ACCORDING TO LOCATION AND TIME OF YEAR

Period	Location: Ice Plant	Water Works	Ocala	St. Augustine
Initial (April–May 1969)	84.1	71.8	47.1	58.2
Final (Jan.–Feb. 1970)	35.6	10.8	20.4	19.9

Jacksonville—Water Works.—This flock was estimated at 220 birds for the initial trapping period. This number was reduced to 170 for the period October, 1969 through February, 1970, a 23 percent reduction.

Adults in this population appear to be fairly well confined to the general vicinity of the study site. There was a tendency for young birds to be more mobile, since 5.3 percent of them (12 of the 224 young trapped) were later caught at the Ice Plant, 2.4 miles away. Recaptures averaged 67.5 percent at this site and the percentages of young at the beginning and end of the trapping period were 71.8 percent and 10.8 percent respectively.

Ocala.—The number of birds at Ocala was estimated to be 420 for the period April and May of 1969. This population also decreased as evidenced by the estimated 180 birds present for the period October, 1969, through March, 1970. These values indicate a reduction of 57 percent. There was also a reduction in the percent young in the population from 47.1 percent initially to 20.4 percent for January to February, 1970. The recapture ratio at this site averaged 59.7 percent.

The movements of the birds in this flock seem to be restricted to the area of the feed mill, their primary source of food, and to the downtown area, their primary roosting and nesting location.

St. Augustine.—The flock located in St. Augustine showed a population of 110 birds for May through June, 1969. Although this was the control flock, it showed a 34 percent reduction in population to 73 birds for the period October, 1969 through February, 1970.

These birds seem to be confined to an area within 0.5 mile of the school and the adjacent ball park. This fact was verified by several observations on a flock of pigeons located at the downtown park 0.5 mile to the south. These observations failed to reveal any marked birds from the Keterlinus Junior High School at this site, although four birds caught and marked at the park were repeatedly observed in company with the 40 to 50 birds normally present at that location.

Weights of Adult Males:

Weights of individual birds showed that the largest birds occurred in Ocala where the average weight was 399 grams (see Table 4). Jacksonville birds formed a middle class with an average weight of 372 grams while birds in Gainesville and St. Augustine averaged 359 and 357 grams respectively. These weights are considerably less than those given by Levi (1963) which range from 14 ounces (403 grams) to 30 ounces (864 grams) for various breeds of pigeons.

TABLE 4. COMPARISON OF WEIGHTS OF ADULT MALES IN GRAMS ACCORDING TO LOCATION

Ocala	Ice Plant	Gainesville	St. Augustine
399	372	359	357

Note: Underlined values not significantly different at 95% confidence level.

DISCUSSION

Ice Plant

Due to the transitional nature of the flock located in this area, it is difficult to measure the effectiveness of Ornitrol in reducing the population. Since 5.3 percent of the young trapped at the Water Works were later caught at the Ice Plant it seems reasonable to assume that this area is a loafing place for younger birds. Also the high percentage of young found in the area indicate an influx or immigration of young birds into the area. Of the first 800 birds trapped at the Ice Plant, four were later caught at the Water Works. This indicates a level of 0.5 percent emigration from the Ice Plant to the Water Works, but does not necessarily mean that there is a net increase in the number of birds at the Ice Plant.

To be in a steady state, one would expect the number of birds traveling from the Water Works to the Ice Plant to equal the number of birds traveling in the opposite direction. However, the data show that for every bird leaving the Ice Plant three birds enter this study area. Although this would indicate that the Ice Plant flock should be increasing due to immigration while the Water Works should be decreasing due to emigration, there is one set of circumstances which would give a steady state. The data indicate the majority of birds entering the Ice Plant are juveniles (less than three months old), while those leaving are adults or sub-adults (over five months old). This would give a steady state only if birds in the age class (three to five months old) in temporary residence at the Ice Plant had a mortality of 67 percent. This means that out of three birds entering the area two of these birds would be expected to die before they reach five months of age. The remaining bird would leave the area when it reached five to six months of age. If this were the case then the two sites would be in a steady state of equilibrium.

The population data show that the Ice Plant flock has undergone a reduction of 75 percent in population, 23 percent greater than that obtained in St. Augustine, the control site. This greater reduction can be attributed at least in part to the effect of Ornitrol on this and the surrounding flocks which were treated.

Jacksonville-Water Works

Movements of this flock have already been discussed in relation to the Ice Plant. With the exception of the young birds, which were noted to emigrate to the Ice Plant, this population appears to be fairly stable. This theory is further supported by the high rate of recapture (67.5 percent) which occurred at this site.

Population estimates for this site show a reduction of 23 percent, from 220 birds to 170. While this value is similar to the control area in St. Augustine there are two possible explanations for this. One factor is the high percentage of adults in the population at the end of the experiment. This would indicate that a larger proportion of this population is in the age class which has a lower mortality. The second factor which might cause this low rate of decrease would be a net influx of adult and sub-adult birds from surrounding untreated flocks.

Once again it is difficult to measure the effect of Ornitrol on reproductive success. The low percentage of young at the end of the experiment (10.8 percent) indicate that the drug is having at least some effect on reproduction in the area immediately around the Water Works.

Ocala

Results to date show that the population at this site has been reduced 57 percent. This reduction is quite large and it appears that the 23 percent reduction above that observed for the control flock in St. Augustine could well be due to the effect of Ornitrol.

St. Augustine

Although this was the control site, it also showed a marked reduction in the proportion of young in the population and also in the total population itself (34 percent). It appears that this is primarily a seasonal fluctuation. Further observations will determine if this is the case.

Weights of Adult Males

There are two possible explanations for weight differences observed in adult males. The first is that individual size is correlated with food supply. In St. Augustine and Gainesville birds depend primarily on natural seed for their food. This means that they have to search for every seed and food particle they consume, and hence they are the smallest of the three groups. On the other hand, birds in Jacksonville, which feed on spilled grain in railroad yards and around feed mills, eat the same size food particle, but their source is dispersed in four primary locations. The situation in Ocala is similar to Jacksonville except that in Ocala there is only one major source of food and that is grain spillage from the feed mill. Thus, since these birds have to go to only one source for food they are even larger than the Jacksonville birds.

A second and perhaps more obvious explanation would be that the difference in weights is due to treatment of the flocks with Ornitrol.

The most obvious possibility would be a simple increase in food supply per bird due to a decrease in the population caused by Ornitrol.

SUMMARY

To obtain effective control of feral pigeon flocks careful analysis of each local population is essential. In cities such as St. Augustine and Ocala, where there is one major flock or where the flocks are discrete, individual sites may be treated with success. In contrast, large metropolitan areas must receive treatment at all major feeding sites simultaneously if the program is to be effective.

Preliminary analysis of the data indicates that for southern cities, the first treatment should be given as early as December or January to inhibit reproduction before it starts its upward trend.

Although the St. Augustine flock underwent a 34 percent reduction in population, the 57 percent reduction at both Ocala and the Jacksonville Ice Plant are sufficiently greater to attribute a large part of the difference to the effect of Ornitrol. Furthermore, it seems reasonable to assume that the downward trend in St. Augustine is an annual fluctuation, and that by June, 1970, the control population will be back up to its original level of May, 1969. The major problem to date seems to be the fact that the first treatment was not given until April while it should have been administered as early as December, 1968, or January, 1969.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to G. D. Searle & Co., particularly to Dr. Maurice Woulfe, for providing funds that have made this study possible. Acknowledgment is also made to Mr. Vernon Cunningham and Mr. Carl Knös, both of the Bureau of Sport Fisheries and Wildlife, Gainesville, Florida, for their cooperation and assistance in this study.

Special gratitude is also extended to Mr. E. M. Smith of the Jacksonville Health Department for his assistance in locating trapping sites and aid in trapping birds in Jacksonville. Mr. Don Kaufman of the St. Johns County Health Department was instrumental in the success of the trapping program in St. Augustine.

Grateful acknowledgment is also made to personnel of Seminole Mills for their assistance in this study.

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DISCUSSION

MR. JOHN HARDER: I am afraid I missed the first part of your talk. What was the chemical used and did you see any variation? There is, of course, a problem with rodents, some of which I have seen in connection with my own work. Did you see an aversion to the feed over a period of time—in other words, did feeding start out high and drop down?

MR. SCHORTEMEYER: We did find some dropping off of feeding levels but not significantly. In fact, in the second treatment at Jacksonville, we actually had a greater amount of grain consumed. This is primarily due to the fact we increased the number of treatment sites. As populations were reduced in size, we would expect that we would run into consumption problems since other food in the area greatly augmented the treated food put out.

The name of the chemical was Ornitrol, developed by G. D. Searle.

MR. REX MARSH (University of California): In your studies did you make any attempt to obtain an analysis with regard to the cost "per bird" in reduction throughout the studies? Of course, I realize it is hard to do something like this in a research program, but do you have any idea what it would cost per bird?

MR. SCHORTEMEYER: I do have a number of figures but the closest I can come up to an annual basis would be around 70 to 75 cents per bird.

DR. M. R. WOLFE (G. D. Searle and Co., Chicago, Ill.): It depends on what you mean by "total" cost; whether you mean actual cost of the drug per pound or the cost in the distributed drug consumed. I think that as far as we are concerned we would be selling the drug at about 83 cents per pound, based, of course, on production cost. However, based on our cost of production and upon our experience and the data accumulated on existing control methods in the Middle West, namely poisoning or trapping, it runs somewhere around a dollar per bird and up to four dollars per bird in some states such as New York.

As to what the distribution costs of the material would be, I do not know. However, it should be minimal because in one recent trial in New Hampshire, one man was able to cover 19 sites in about two hours or so.

FROM THE FLOOR: I have one important question. Did you notice any other birds in the area which used the corn, and, if so, what kind?

MR. SCHORTEMEYER: About the only bird I observed eating corn in the study area was a crow.

REPRODUCTIVE FAILURE IN BROWN PELICANS ON THE PACIFIC COAST

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The plight of the brown pelican (*Pelecanus occidentalis*) on the North American continent has now been reasonably well identified. The species has drastically declined in numbers over part of its range, and reproduction is now characterized by the production of thin-shelled eggs and, in many areas, by partial to complete nesting failure. There appears to have been a progressive deterioration of local populations over time that has ultimately resulted in the disappearance of the species from certain geographical areas. Currently, remaining populations along the Atlantic seaboard and in Florida, California, and western Mexico exhibit various degrees of reproductive and population failure.

A catastrophic decline has occurred in the numbers of brown pelicans on the Gulf Coast of Mississippi, Texas, and Louisiana. An estimated population of over 50,000 birds has all but disappeared since 1961. In surveys along the Texas Coast, only 13 birds were observed in 1968, and about 100 in 1969 (Hildebrand and Blacklock, 1968, and personal communication), and numbers are perhaps even lower in Mississippi and Louisiana (Joanen and Dupuie, 1969). Reproduction in the Gulf Coast population is practically nonexistent. On the Texas Coast, only four young were observed in 1967, four in 1968, and seven in 1969 (E. L. Flickinger, personal communication). There is no evidence that pelicans have nested in Louisiana since 1961 (Williams and Martin, 1968; Joanen and Dupuie, 1969). From the scarcity of adults and their limited reproductive effort, it is quite evident that the brown pelican on the Gulf Coast is dangerously close to extinction.

The status and trend of the pelican population in Florida are not well known, but Williams and Martin (1968) found 24 active colonies containing about 6,700 birds in early May 1968. In South Carolina, pelican numbers are evidently declining; Beckett (1966) reported the breeding population there decreased from 10,000 to 2,000 birds in less than 10 years.

Using museum egg collections, Anderson and Hickey (1970) showed that the weight and thickness of brown pelican eggshells have decreased since 1947 throughout the species' range on the continent. Blus (1969), in a survey of eggs from pelican colonies in Florida and South Carolina, found that shells from Florida averaged 7.5 percent thinner than those collected before 1947, and those from South Carolina averaged 16.9 percent thinner. Such findings are of considerable importance because of the involvement of eggshell collapse in the reproductive failure at colonies in other areas.

Schreiber and DeLong (1969) thoroughly reviewed the existing information on the abundance and reproductive performance of brown pelicans in California through 1968. They concluded that the birds were having reproductive difficulties and faced possible extinction. Jehl (1970) added the observation that, although a large colony existed for decades on North Island of Los Coronados Islands, the birds have not nested there since 1963.

Observations in 1967 and 1968 stimulated concern about the status of brown pelicans in California. On March 20, 1969, Robert W. Risebrough and a group of fellow scientists visited Anacapa Island to view the progress of pelican nesting. Their trip proved to be of tremendous significance in understanding the reported reproductive failure and population decline of brown pelicans, and of other species of birds. In a colony of about 300 nests, they found almost complete loss of eggs due to extremely thin shells and shell collapse. Dehydrated remains of collapsed eggs were present in or near most nests. Only 12 nests contained intact eggs.

This catastrophic reproductive failure by brown pelicans was of extreme interest to biologists studying the effects of DDT on avian reproduction. Eggshell thinning, egg breakage, and reproductive failure have been identified as factors accompanying the spectacular decrease in populations of predatory birds in Great Britain and the United States (Ratcliffe, 1967; Hickey and Anderson, 1968; Hickey, 1969). DDT was shown to be related to impaired eggshell quality in field studies (Hickey and Anderson, 1968; Anderson *et al.,* 1969), and a cause of shell thinning and decreased reproductive success in pen experiments with mallard ducks (*Anas platyrhynchos*) and sparrow hawks (*Falso sparverius*) (Heath *et al.,* 1969; Porter and Wiemeyer, 1969). It was recognized that if DDT was associated with reproductive failure in brown pelicans, study of this colonial nesting species could provide an abundance of information that was almost impossible to obtain from isolated populations of nesting raptors. It was important, therefore, to gather information on the extent and intensity of reproductive failure in brown pelicans and the involvement of DDT residues in this failure.

PELICANS NESTING SURVEYS, 1969

After discovery of the situation on Anacapa Island, several biologists in California cooperated in determining the general reproductive performance of brown pelicans in California and northwestern Mexico. Various biologists made four more trips to Anacapa Island and to numerous island colonies along both coasts of Baja California. The findings are being reported independently, but they all contribute to the conclusion that brown pelicans on the Pacific Coast are suffering severe reproductive failure caused by DDT.

Anacapa Island—April

On April 18, the National Park Service provided transportation for James Keith, Fred Sibley, and Dean Carrier to Anacapa Island to obtain additional information on the status of pelican nesting. The colony visited by Risebrough on March 20 was deserted, but another large colony, occupied by an estimated 600 adults, was found. The birds appeared to be incubating normally, and they stayed on the nests until closely approached. When they flushed, however, it was found that only 19 of 339 nests contained intact eggs. Twenty-five eggs were present in these 19 nests. Of the remaining 320 nests, about two-thirds were empty and one-third had a collapsed, dehydrated egg in or near the nest. As some broken eggs were impaled on bushes near nests, it appeared that adults had purposely tossed the remains from nests after eggs had collapsed. Samples of both the intact and collapsed eggs were collected for insecticide residue analysis and eggshell measurement.

Anacapa Island—May

On May 27, Robert Mallette, Ron Le Valley, Fred Sibley, and Ken Baker revisited Anacapa Island. Near the site of the April colony, they found a congregation of 1,500-2,000 adults and an estimated 500 nests. They closely examined 94 nests and found only 19 intact eggs in 15 nests. Single collapsed eggs were present in 39 nests. The remaining nests were empty, but collapsed eggs were often present nearby. Five adult pelicans were shot from nests with eggs, and two other pelicans, one adult and one immature, were collected away from the colony. All birds and eggs were preserved for insecticide residue analysis and eggshell measurement.

Gulf of California—May

Between May 1 and 8, James Keith, with the support of the National Audubon Society, participated in a cruise in the Gulf of California organized by Lewis W. Walker. Several islands used by brown pelicans for nesting were visited, including four of the larger colonies in the Gulf, those at Puerto Refugio, Isla San Lorenzo Norte, Isla Salsipuedes, and Isla Piojo.

Numerous adults, nests, and intact eggs were found at all colonies; birds were incubating eggs, and the eggshells appeared sound. However, there was abundant evidence that reproduction had not proceeded normally. Many recently formed nests were empty; collapsed, dehydrated eggs were very common near both occupied and deserted nests; and many occupied nests contained only one or two eggs rather than the normal clutch of three. No abnormal eggs were found on Isla Salsipuedes, but such evidence may have been destroyed, since reproduction was further advanced than in other colonies. Forty downy young were present at Isla Salsipuedes among nests with eggs in late stages of incubation. Both intact and collapsed eggs were collected from all colonies for insecticide residue analysis and eggshell measurement.

RESULTS

Clutch Size

On Anacapa Island, the few intact eggs present appeared to represent simply those that had not yet collapsed, rather than the original, complete clutch produced by the hen. In April, only one nest contained three intact eggs, four nests contained two each, and 14 contained one each; in May, one nest contained three eggs, two nests contained two each, and 12 contained one each.

In the Mexican colonies, egg breakage may have reduced the number of eggs per nest, but shell thickness of intact eggs was nearly normal, which suggests that eggs per nest may have represented the clutch produced by the hens. In seven nesting areas, there were 2,618 eggs in 1,097 occupied nests, for an average of 2.4 eggs per nest (range, 2.2 at Isla Salsipuedes to 2.5 at Isla Piojo). However, the nests examined were only a small proportion of those present. Accurate counts were not obtained of empty nests because their possible significance was not appreciated when counts were made. If empty nests had been included, clutch size would be less than two eggs per nest. The average normal clutch of brown pelicans is three eggs.

Eggshell Thickness

All intact eggs collected from the Anacapa and Mexican colonies were emptied and the eggshells washed and allowed to air-dry for several weeks. The thickness of each shell (including the membranes)

TABLE 1. SHELL THICKNESS AND DDT RESIDUES IN BROWN PELICAN EGGS

Egg Condition	Colony	Date (1969)	Number of Eggs	Eggshell Thickness (in millimeters)		Residues of DDT and Metabolites (parts per million, lipid basis)	
				Mean ±S.E.	*Range*	*Mean ±S.E.*	*Range*
Collapsed	Anacapa Island	4/18	Composite of many	—[a]	—	1818[b]	
	Mexican colonies	5/2–7	Composite of many	—	—	1048	
Intact	Anacapa Island	4/18	4	0.38±0.01	0.37–0.42	1331±151	1060–1826
		5/27	5	0.38±0.01	0.34–0.40	1120±119	794–1378
	Isla Salispuedes	5/2	11	0.55±0.01	0.51–0.57	61	
	Isla Piojo	5/6	11	0.58±0.01	0.55–0.63	58	
	Puerto Refugio	5/7	17	0.55±0.01	0.46–0.63	105	

[a] Reliable measurement not possible.
[b] Single figure indicates only one analysis was run on composite of eggs.

was obtained by averaging four measurements around a hole drilled through the shell at the midpoint of its long axis. No attempt was made to measure the extremely thin shells of collapsed, dehydrated eggs. Eggs from Anacapa Island were either unincubated or in an early stage of incubation; those from Mexican colonies were in all stages of incubation.

The eggshell measurements obtained are summarized in Table 1. According to Anderson and Hickey (1970), normal thickness of brown pelican eggs is 0.579 millimeters in southern California and 0.569 millimeters in Baja California. On Anacapa Island, where egg breakage resulted in complete reproductive failure, the shells of the few intact eggs remaining shortly after egg laying averaged only 0.38 millimeters, 34 per cent thinner than normal. In the Mexican colonies, eggs found in nests in early May had shells of near-normal thickness (average, 0.55 millimeters).

Insecticide Residues in Pelican Eggs and Tissues

Because DDT and its metabolite DDE have been shown to cause eggshell thinning in birds, both the intact and collapsed eggs collected from all colonies were analyzed for insecticide residues. Residues in eggs do not cause eggshell thinning, but perhaps serve as an index to the degree of exposure of birds in the colony where the eggs were laid.

The collapsed eggs, which were only the partial remains of original eggs, were not analyzed individually but as composites of many egg fragments. Because of inadequate facilities for freezing and storing samples, the contents of intact eggs from the Mexican colonies were composited and dehydrated in the field by mixing them with anhydrous sodium sulfate. Intact eggs from Anacapa Island were frozen the day of collection and analyzed individually. Analyses were performed by gas-liquid chromatography with electron-capture detection at the Pesticide Investigations Laboratory of the California Department of Fish and Game.

The insecticide residues found in eggs were almost totally those of DDT and its metabolites. About 85 percent of the residues were DDE, the metabolite most commonly found in birds exposed through contamination in their foods. The residue levels found are summarized in Table 1. So that the various types of egg samples could be meaningfully compared, residues were expressed in parts per million based on micrograms of insecticide per gram of extracted lipids (whole eggs contain about four percent lipids).

Collapsed eggs from the Anacapa and Mexican colonies and the intact, thin-shelled eggs from Anacapa contained extremely high residues of DDT and metabolites (800-1,800 ppm, lipid basis). Residues in intact eggs of near-normal thickness from the Mexican colonies averaged about 72 ppm. The fact that eggs with massive residues had much thinner shells than eggs with modest residues indicates that hens carrying high levels of DDT and metabolites were those that produced eggs with abnormally thin shells.

Residues in fat and brain tissues from brown pelicans collected on Anacapa Island are shown in Table 2. Eggs listed in Table 2 are the same as those in Table 1 under Anacapa Island, 5/27, but all residues in Table 2 are expressed in milligrams of insecticide per gram of sample.

Residues of DDT, DDD, and DDMU were present at moderate levels, but DDE residues in the fat of breeding birds were extremely

TABLE 2. CHEMICAL RESIDUES IN PELICAN TISSUES COLLECTED MAY 27, 1969, ON ANACAPA ISLAND

Age and Sex	Tissue[a]	Residues (milligrams per gram of sample)[b] p, p′ DDE	p, p′ DDD	p, p′ DDT	p, p′ DDMU	Dieldrin	PCB[c]
Adult ♂	Fat	1626	27.2	4.0	54.8	0.46	124
	Brain	12.9	0.26	1.90	0.45	ND	—
	Egg from nest	178.4	8.9	7.5	13.0	—	—
Adult ♀	Fat	980	1.9	10.0	28.2	2.20	366
	Brain	7.7	ND	0.26	0.15	ND	—
	Egg from nest	183.0	9.1	8.9	13.4	—	—
Adult ♂	Fat	738	10.8	1.9	24.0	2.10	139
	Brain	3.0	ND	0.34	0.38	ND	—
	Egg from nest	55.8	1.1	1.4	2.4	—	—
Adult ♂	Fat	2603	5.0	15.9	79.5	<0.01	96
	Brain	15.0	ND	0.81	0.46	ND	—
	Egg from nest	143.4	3.0	2.9	7.4	—	—
Adult ♀	Fat	1663	8.3	1.4	27.6	2.40	113
	Brain	4.9	ND	1.12	0.54	ND	—
	Egg from nest	29.4	2.2	1.7	3.3	—	—
Adult ♂	Fat	2137	6.1	1.0	25.8	0.90	77
	Brain	8.4	ND	0.65	0.49	ND	—
Immature ♂	Fat	18.9	15.2	1.9	49.3	0.97	94
	Brain	20.4	ND	0.48	0.32	ND	—

[a] First five pelicans listed were incubating eggs when shot.
[b] ND indicates none detected; dash indicates not determined.
[c] Polychlorinated biphenyls quantitated against Aroclor 1254.

high (738-2,603 ppm), which confirms the similar implication gained from the high residue levels in eggs. DDE residues in brain tissue were high, but did not approach the 30-60 ppm considered lethal (Stickel *et al.,* 1966). Fat samples also contained low dieldrin residues, as well as polychlorinated biphenyls in amounts ranging from 77 to 366 ppm.

According to our present knowledge of the toxicological effects of these chemicals on birds, the most important finding was the massive residues of DDE. This metabolite of DDT is known to cause eggshell thinning in birds, and this was the specific effect associated with reproductive failure in brown pelicans in 1969.

DISCUSSION

Conditions at nesting colonies on Anacapa Island during each visit in 1969 clearly represented complete nesting failure. Risebrough (personal communication) concluded that, at most, only five young were produced on Anacapa Island in 1969. It was not determined whether the nesting attempts observed after March 20 represented renesting by some of the original birds or initial nesting by different groups.

Jehl (1970), who visited three colonies off the Pacific Coast of Baja California in 1969, found collapsed eggs, thin eggshells, and extremely poor reproductive performance at all colonies. He estimated that no more than 150 young were produced by some 2,000 pairs in northwestern Baja California and southern California (Anacapa Island).

The performance of pelicans in the Gulf of California was much better than on Anacapa Island and on islands off the Pacific Coast of Baja California, but was less than normal. It was not clear whether the occurrence of sound and abnormal eggs in the same colonies was the result of renesting after initial failure or of differences in performance by individual birds in the colony.

Continued reproductive failure of the degree found on Anacapa Island in 1969 would result in the rapid extinction of the local population. The impaired reproduction observed in Mexico might be severe enough to result in a gradual decline of Mexican colonies. Factors other than eggshell thinning may also be affecting pelicans. Sick pelicans have been observed, and hundreds of dead pelicans were reported along the northwestern shoreline of the Gulf of California in late 1968. Brain tissues of two pelicans obtained during a die-off in late August and early September 1969 at Malibu Beach, California, were found to contain 91 and 130 ppm of DDE—levels that definitely implicate DDE as the cause of death.

The residue analyses from the various nesting colonies confirm the relationship reported in other studies—that the greatest eggshell thinning occurs in aggregations of birds containing the highest residues of DDE. These findings, along with existing experimental evidence, clearly implicate DDE as a cause of eggshell thinning, reproductive failure, and population decline in brown pelicans.

The recurrence of this pattern in the various geographical populations of brown pelicans in North America illustrates the insidious, debilitating effects of DDT on a species population over time. It characterizes a phenomenon that undoubtedly has affected, and is continuing to affect, the abundance of numerous avian species. The evidence appears quite adequate to warrant quick, decisive action to limit any further activities that release DDT into the environment.

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ECOLOGY OF WATERFOWL BOTULISM TOXIN PRODUCTION

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During the summer, fall and winter of 1969, 141,000 ducks died of botulism in California. In 1967 100,000 plus waterfowl died from botulism. Severe botulism losses of waterfowl have occurred at varying intervals for many years.

Millions of ducks have readily found the toxin sources in the marsh. However, biologists working on the problem have had a difficult time demonstrating the toxin sources.

Botulism investigators of the 1930s (Giltner and Couch, 1930; Kalmbach, 1930; Hobmaier, 1930; Hobmaier, 1932; and Kalmbach and Gunderson, 1934) incriminated the following items as toxin sources: carcasses of birds that had died of botulism, maggots, mud, barley, insect debris, vegetation, and water. These early investigators did not emphasize which of these ingestible items were important and which were incidental. This resulted in a general confusion about the toxin sources.

In 1955, Bell *et al.* described two theories of toxin production, the older and generally accepted sludgebed hypothesis and the microenvironment concept which they originated. Summarizing the two theories:

Sludgebed hypothesis

1. *Clostridium botulinum* type C exists in the mud or soil of lakes, marshes and ponds.
2. Under certain conditions large quantities of decaying organic matter are made available to the bacteria.
3. Dissolved oxygen in ponds is absent, temperature and pH are high.

Bell's miscroenvironment concept holds that

1. *C. botulinum* type C germinates, reproduces and synthesizes its toxin in small discrete substances—possibly invertebrate carcasses.
2. The bacteria are not dependent upon the ambient medium for their nurture.
3. The toxin is within the bacteria which reside in the particulate materials rather than freely diffused.

[1]This study was supported by Federal Aid in Wildlife Restoration Project, California W-52-R, "Wildlife Investigations Laboratory."

Their concept was supported by the results of laboratory experiments using various animal and vegetative substrates for *C. botulinum* growth. Toxic cultures were obtained only from animal substrates.

Jensen and Allen (1960) working at the Bear River Refuge in Utah have shown a relationship between the invertebrate population level and botulism outbreaks. Their study was conducted over a five-year period, and during that time the serious outbreaks were observed after a sharp decline of a large invertebrate population. During two of the years invertebrate populations were low and stable and no significant botulism losses occurred.

Our work in California adds more support for the microenvironment concept (*i.e.* that toxin is contained within the invertebrates eaten by the waterfowl) and places emphasis on fly larvae as a major toxin source.

METHODS

Invertebrate samples were prepared and tested for toxicity as follows: sample macerated with mortar and pestle or glass triturator, sterile saline or water added so that filtration through a 0.45μ-membrane could be accomplished, the filtrate used as the inoculum in a mouse protection test. The protection test was conducted by inoculating duplicate mice with sample aliquots; half of the mice were also injected with *C. botulinum* type C antitoxin.

Food habits studies were conducted to determine the extent to which waterfowl in botulism areas utilize invertebrates. Collections were made of dead, sick and healthy waterfowl and shorebirds during botulism outbreaks. Routine analyses were made of the gizzard contents only, as there were no apparent differences in the results obtained from gizzard content or entire digestive tract content analysis.

Quortrup and Sudheimer (1943) found an apparent symbiotic relationship between *C. botulinum, Escherichia coli* and *Pseudomonas aeruginosa.* To further test such relationships and the sludgebed hypothesis we ran soil culture trials. The soil cultures were made in glass trays (45 cm $\times$ 29 cm $\times$ 5 cm) filled with sterilized mud which had been collected from chronic botulism areas. The bacterial species under consideration were then inoculated into the water and mud in the glass trays. After incubation the water was removed, filter sterilized and tested for toxicity by mouse inoculation.

Three experimental ponds were constructed by excavating three $10' \times 13' \times 9''$ slots and lining them with black plastic (Visquine). The ponds had a soil lining from the following California locations:

1. Soil from the southern San Joaquin Valley—where a severe outbreak occurred in 1967-68 (Parrish and Hunter 1969).
2. Soil from the Sacramento Valley—taken from a sewer pond that has had annual botulism outbreaks.
3. Soil from the Sacramento Valley—river bottom sandy soil not associated with botulism.

The soil linings of the ponds were placed so that feather edge and open water areas resulted when the ponds were flooded (Fig. 1).

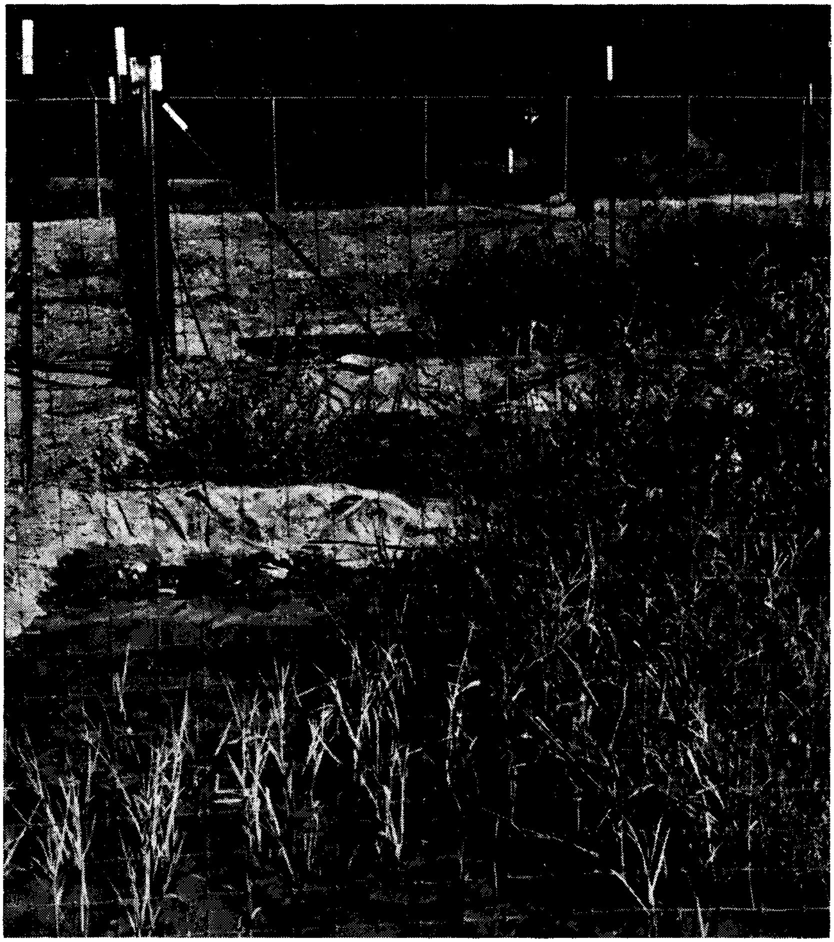

Figure 1.—Experimental ponds showing simulated marsh environment developed. Photograph by Phillip R. Coleman.

The ponds were managed and maintained in a manner that resulted in shallow, warm, algae-laden water. Mallards (*Anas platyrhynchos*) were kept on the individual ponds by fences and were used as natural indicators of toxin production.

Duck and cockroach (*Periplaneta americana*) carcasses were placed in the ponds to determine if their carcasses would support clostridial growth and toxin production.

RESULTS

Since 1924 (Bengston) it has been known that the larvae of blowflies frequently contain type C toxin. However, it was not until 1934 (Kalmbach and Gunderson) that a correlation between blowfly larvae and waterfowl botulism was established. At that time it was stated that a green-winged teal had contracted botulism from eating maggots. No emphasis was placed on the maggots as a significant toxin source.

During recent outbreaks in California it became apparent from observations that fly larvae must represent a significant toxin source. Blowfly eggs, larvae, pupae and adults were collected at waterfowl marshes in the San Joaquin Valley, Sacramento Valley and the Klamath Basin. Toxin was detected in 33 of the 37 samples collected (Table 1). Invertebrates (Table 1) were concurrently collected in the same areas and 9 of the 24 samples were toxic.

TABLE 1. SAMPLES COLLECTED FROM WATERFOWL MARSHES AND TESTED FOR TYPE C BOTULISM TOXIN

	Nontoxic samples	Toxic samples
Maggots from duck carcasses	1	17
" from fish carcasses	0	4
" from pheasant carcasses	0	1
" from mammal carcasses	1	1
" from gizzards and crops	0	2
" found free-floating in water	0	5
Blowfly eggs from duck feathers	0	1
" adults	2	2
" pupae	0	1
Hemiptera—adults and nymphs	6	4
Orthoptera adults	4	3
Coleoptera adults	3	1
Odonata adults	1	0
Ephemeroptera naiad	1	0
Notostraca	0	1

Food habits data, summarized in Table 2 indicate that invertebrates occurred in the diet of 65 percent of the birds collected in a botulism outbreak area. Such data provide circumstantial evidence that invertebrates could serve as toxin sources.

TABLE 2. NUMERICAL SUMMARY OF FOOD HABITS DATA

Species	Number analyzed	Number without animal material in digestive tract	Number with animal material in digestive tract	Number empty
Pintail (*Anas acuta*)	37	18	16	3
Mallard (*Anas platyrhynchos*)	5	0	5	0
Greenwinged teal (*Anas carolinensis*)	4	1	3	0
Cinnamon teal (*Anas cyanoptera*)	5	1	4	0
Gadwall (*Anas strepera*)	6	0	6	0
Widgeon (*Mareca americana*)	2	0	1	1
Shoveler (*Spatula clypeata*)	3	0	2	1
Canvasback (*Aythya valisineria*)	1	1	0	0
Redhead (*Aythya americana*)	1	1	0	0
Coot (*Fulica americana*)	14	2	11	1
Avocet (*Recurvirostra americana*)	1	0	1	0
Black necked stilt (*Himantopus mexicanus*)	7	0	7	0
Total	86	24	56	6
% of Total		28	65	7

Soil cultures were negative for toxin production when filter sterilized rather than centrifuged prior to injection into mice. When all the *C. botulinum* cells were not removed by centrifugation they were lethal. One other culture was positive for toxin but the inoculum of *C. botulinum* cells was too large, and the positive test was due to preformed toxin put in as part of the inoculum and not toxin production in the soil substrate.

Further tests were carried out on material from soil culture trays with liver added. These trials were positive for toxin; presumably due to the presence of animal protein utilization as the bacterial substrate.

The experimental ponds did not become toxic to ducks even though the ponds looked very similar to areas of natural outbreaks. Invertebrates of the following taxa were present: Ephemeridae, Corixidae, Notonectidae, Dytiscidae, Hydrophilidae, Calicidae and Chironomidae. These invertebrates were all natural invaders in the ponds.

Botulism could be produced at will by adding a duck carcass to the pond. Carcasses from ducks affected by botulism or from other causes similarly resulted in development of toxic maggots (Fig. 2). Maggots of the blowfiies and fish flies (*Phenicia* sp., *Phorma* sp. and *Sarcophaga* sp.) developed in the decaying duck carcasses. The penned ducks consumed the maggots and thus contracted botulism. Cause of death was confirmed by mouse protection tests.

Cockroach carcasses placed in the ponds produced toxin only if they had been fed toxigenic type C cells prior to being introduced in the ponds.

Figure 2.—Decaying duck carcass floating on a pond. Such carcasses produce thousands of toxic maggots. Photograph by Phillip R. Coleman.

DISCUSSION

The microenvironment concept of botulism is valid for recent outbreaks in California based on the following:

1. Animal matter constitutes a significant portion of the waterfowl diet.
2. Naturally occurring toxic invertebrates can be found in waterfowl marshes.
3. The ubiquitous nature of toxic maggots in California marshes during botulism outbreaks.
4. Maggots can be found in the digestive tracts of sick and dead waterfowl (Fig. 3).
5. Very frequently a decomposing maggot-laden carcass will be found with several sick or freshly dead ducks surrounding it or within the immediate vicinity, *i.e.* the affected birds are not found randomly, but rather concentrated in groups.
6. Attempts to produce toxin with vegetative or soil substrates have not been successful.

Figure 3.—A gizzard from a mallard that died from botulism showing ingested maggots. Photograph by Philip R. Coleman.

7. Invertebrates or other animals in order to become toxic must have botulism bacteria present—in many cases this is accomplished by chance. Any organism feeding in the marsh has a good chance of having the bacteria in its digestive tract. If the botulism organisms are present at the time of death the microenvironment is set for incubation.

Based on results presented in this paper and a complete review of our research in Hunter *et al.* (1970) the following summary of factors or conditions thought to be responsible for botulism are presented as a working hypothesis.

Summary of Outbreak Factors

Initiation. Because of:

1. Terrestrial invertebrates drowned as land floods during warm weather.
2. Aquatic invertebrates or their larvae that die because of unfavorable environment conditions resulting from lowered water level or inability of organisms to tolerate water conditions as it becomes stagnant.

3. Death of a bird, mammal or fish that results in the production of maggots.

Perpetuation. Because of:

1. Continued die-off of invertebrates and toxin formation within the carcasses.
2. Maggot cycle—maggots cause death of birds which produce more maggots. This cycle can greatly increase losses.
3. Persistence of toxin as the result of favorable ecological conditions, *e.g.* lower temperatures tend to preserve toxin formed during warm periods.

Subsidence. Because of:

1. Breakdown of the toxin because of hydrolysis, denaturation or microbial action.
2. Toxin sources biologically developed so that they are no longer present.
3. Toxin sources no longer available because habitat changed, such as, drained or substantially increased water levels.
4. Changed activities of waterfowl, *e.g.* migration, changed feeding areas.

CONCLUSIONS

The concepts put forth are not to be considered as absolute conclusions but rather a working hypothesis. The ideas and data presented in this paper can be used to explain summer and winter botulism phenomena. We now have much of the biological data needed to begin effective control and management technique studies.

ACKNOWLEDGMENTS

I would like to thank William E. Clark, Patricia J. Perkins and Phillip R. Coleman for their research and investigational efforts. I am indebted to Bruce M. Browning for conducting the food habits analysis. Special thanks go to Carol M. Ferrel and Merton N. Rosen for their editing expertise and to Jean Walker for knowledgeable help in manuscript preparation.

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DISCUSSION

FROM THE FLOOR: I wonder if Mr. Hunter would speak briefly about plans for this year?

MR. HUNTER: As a result of this flooding we had last year, the basin still contains a lot of water and we will again have similar problems. Based on our experience over the past two years, we will again be able to keep losses to a minimum. As I indicated, last year we lost some 40,000 birds but, on the other hand, it could have been much more serious. However, I am sure that this problem will continue for two or three years.

MR. R. MARLIN PERKINS (St. Louis Zoo): I would like to make an observation. We have had botulism in our duck lakes on quite a few occasions. Many times we have seen the ducks eat maggots right from underneath fellow ducks that had been killed.

Could you elaborate a little bit on the freshwater mouth rinse—how do you actually do this? Also I would like a little more on how we can use this in relation to captive birds.

MR. HUNTER: Very well.

The instrument that we used was a syringe that could be obtained at any automotive store, such as they use for putting water in batteries.

Then, if the situation happened during the summertime, we would pick the bird up, put it in a shaded or cool area and give the bird 30 to 40 cc. of fresh water. We have also used various additives, such as oil and sugar. I don't have too much experience as to which would be best. However, this might be something for you to experiment with.

But, mainly, give the water and provide a place where the bird can have shelter both from the sun and the remaining birds. The only thing about giving the water is to make sure you get it behind the trachea so that you do not drown the bird.

VICE CHAIRMAN HUNT: Thank you very much.

REMOTE SENSING—A PANEL

Editor's Note: *Drs. W. A. Fischer and John E. Johnston, U.S. Geological Survey who participated in this panel, did not present formal papers for publication.*

MONITORING MIGRATORY BIRD HABITAT BY REMOTE SENSING METHODS

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INTRODUCTION

The U.S. Bureau of Sport Fisheries and Wildlife (BSFW), the Canadian Wildlife Service, and various provinces and states have made annual systematic surveys of waterfowl production since 1947 (Crissey, 1957). This effort has been most intensive in the prairies and parklands of the northern states and the prairie provinces but also extends into northern Canada and Alaska. Aerial surveys, made in May and July, are used, with air-ground correction factors, to provide indices for breeding populations, habitat conditions, and waterfowl production (U.S.D.I., 1969; Geis *et al.*, 1969). These data are the basis for the establishment of annual waterfowl hunting regulations.

Hunting season recommendations must be prepared by early August to meet the deadlines for the annual national waterfowl regulations meeting. In some years final waterfowl production cannot be estimated in time for formulation of final regulations. Canadian and U.S. investigators (Crissey, 1969) have suggested that a reliable production index could be derived, independently of the size of the breeding population, from an estimate of the number of ponds existing in July. The degree of wetness during the May-July period might provide a useful index for predicting annual waterfowl production. Waterfowl biologists have speculated that these indices may eventually be obtained more quickly and accurately if multispectral remote sensing techniques are used to supplement present survey procedures.

Measurements of pond density and distribution to yield subsequent estimates of annual duck production are only two examples of potential uses of multispectral techniques for monitoring extensive areas of migratory bird habitat. Other potential applications include continent-wide land use inventories; surveys to detect habitat conditions conducive to disease outbreaks, such as botulism; and surveys to monitor the progress of seasonal agricultural activities that often influence waterfowl production and create potential depredation areas.

Pioneer investigations to determine the spectral characteristics of agricultural land uses and other features of the landscape were carried out by the University of Michigan (Polcyn and Malila, 1967; Olson, 1967), Purdue University (1968), and the Berkeley Campus of the University of California (Carneggie, 1967). Salinity and soil moisture problems were studied with the multispectral approach by U.S. Department of Agriculture scientists at Weslaco, Texas (in Myers, 1967). The U.S. Forest Service has tested infrared sensing devices for detecting and mapping forest fires and tree diseases, and now uses this technique for forest fire surveillance in some western states (Hirsch, 1962; Thackrey, 1966). Recent popular articles in *National Geographic* (Weaver, 1969), *Scientific American* (Colwell, 1968), and *BioScience* (Colwell, 1967) presented well-illustrated explanations of the potential application of remote sensing techniques to natural resource management problems.

With this background of information the Bureau of Sport Fisheries and Wildlife in cooperation with the Remote Sensing Evaluation and Coordination Staff program of U.S. Geological Survey explored the possibility of testing these hypotheses on the Bureau's Woodworth Study Area in central North Dakota in 1968. The study is part of the U.S. Department of the Interior's Earth Resources Observation Satellite Program (EROS) being conducted in cooperation with the National Aeronautics and Space Administration and carried out in part under contracts with the University of Michigan, Institute of Science and Technology, Willow Run Laboratories.

OBJECTIVES

Arrangements were made with the University of Michigan to fly a multispectral remote sensing mission over the Woodworth area in May, 1968. The mission was part of a feasibility experiment to determine what characteristics of wetland habitats and adjacent uplands could be detected with multispectral techniques and to determine how certain statistics about selected features in the landscape could be measured and compiled with automatic data processing techniques. The specific kinds of information sought were:

1. Number of ponds containing water
2. Number of dry ponds
3. Number of ponds by size class and wetland type

4. Identification of major land use types
5. Distribution of ponds within different land use types
6. Area and distribution of cultural features
7. Identification of major associations of marsh plants
8. Measurement of pond depth, area and shoreline perimeter
9. Effects of increased flight altitude on accuracy of measurements

THE STUDY AREA

The topography of the test site is typical of the stagnation moraine that lies along the eastern edge of the Missouri Coteau in North Dakota. The 6-square-mile area (Figure 1) has been studied intensively by biologists from the Northern Prairie Wildlife Research Center since 1964 (Kirsch, 1968). Pond basins of various sizes and types are numerous, averaging over 100 per square mile. During the past 3 years, the breeding population of ducks has ranged from 70-112 pairs per square mile. Most of the land in private ownership is cultivated for small grains or is used for pasture. Some lands owned by the BSFW have been maintained in a variety of non-use cover types since 1963. A small percentage remains as native prairie. Ground conditions on the day of the flight presented a composite of fields in different stages of culture, wet and dry ponds, and upland and aquatic vegetation in early stages of growth.

PROCEDURES

The mission was flown with the University of Michigan C-47 aircraft using a 17 channel multispectral scanner and four aerial cameras. The scanner channels included contiguous but discrete wavelength bands in the ultraviolet, visible, and infrared regions. Thirteen runs were completed at 2,000 and 10,000 feet above the terrain between 8:30 A.M. and 10:30 A.M. on May 31, 1968. Ground measurements of air, soil, and water surface temperature; soil moisture; relative humidity; water depth; and vegetative development were made at selected study sites on the morning of the flight. Data on land use, wetland types, and cultural features were collected at different times as part of the routine monitoring of the area. These data provided the necessary background for interpreting the scanner imagery and assessing recognition success obtained with the automatic processing equipment. A number of well-documented areas were chosen for training sets. (A training set is a feature, object, or material surface which is judged to be representative of its class).

Preliminary analyses of the scanner imagery and computer recognition maps were completed at the Willow Run Laboratories in late 1969. Five of the runs were selected for processing: four from

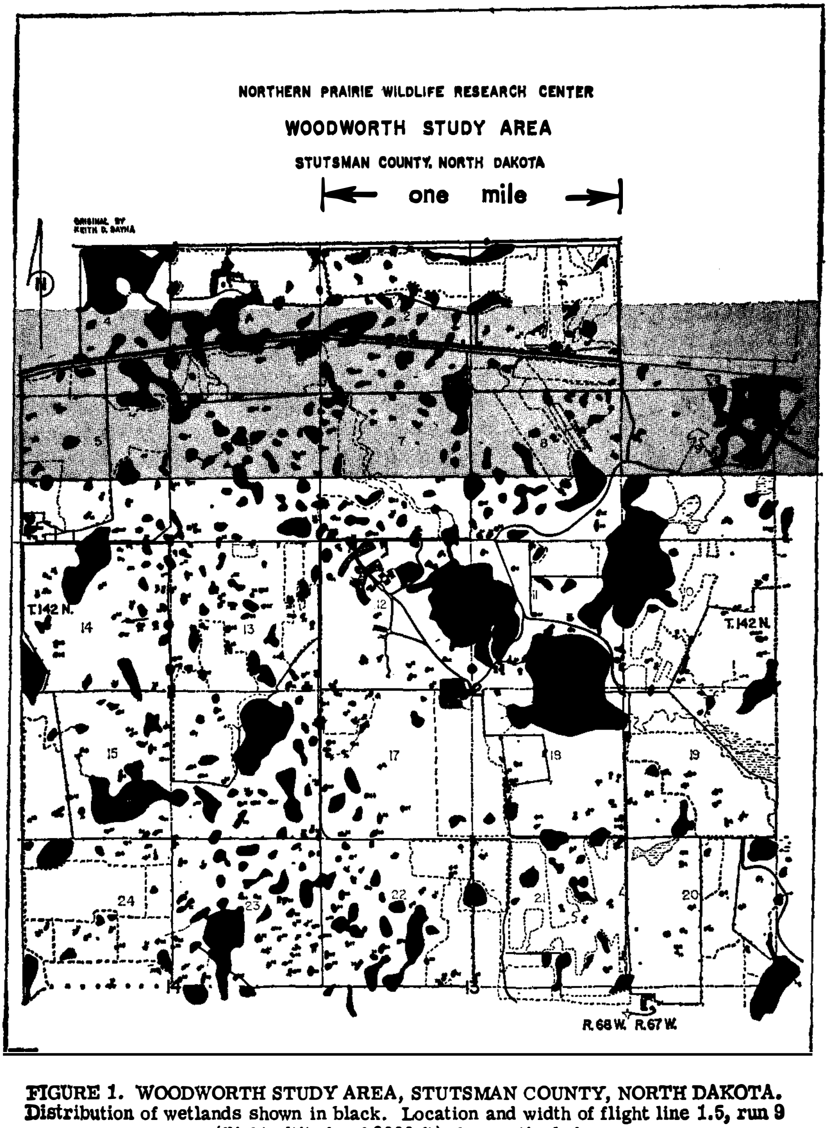

FIGURE 1. WOODWORTH STUDY AREA, STUTSMAN COUNTY, NORTH DAKOTA. Distribution of wetlands shown in black. Location and width of flight line 1.5, run 9 (flight altitude of 2000 ft) shown stippled.

2,000-foot data and one from 10,000-foot data. A segment of one 2,000-foot run over a representative part of the study area was processed most intensively. The high altitude data used was selected because it covered most of the study area and it contained the least amount of cloud shadow. Both analog and digital procedures were tested for the identification of materials; digital techniques were used to measure the perimeter, area and shape of the ponds.

Several analog processing experiments were conducted with the low altitude imagery using six data channels in the visible and near infrared region. These channels were the 0.4 to 0.44, 0.52 to 0.55, 0.58 to 0.62, 0.62 to 0.66, 0.72 to 0.80, and 0.80 to 1.00um wavelength regions. Subsequent experiments indicate that this combination of channels is less than optimum. An optimum setup as determined by digital techniques is: 0.40 to 0.44, 0.46 to 0.48, 0.66 to 0.72, 0.72 to 0.80, and 0.80 to 1.0um. Materials tested for automatic recognition included open water, marsh vegetation, croplands, pastures, idle areas, and hayland as well as cultural features. In some instances attempts were made to identify components within these broad categories, *i.e.*, standing marsh vegetation, matted marsh vegetation, and cattail. At other times materials were combined to identify a broader group, *i.e.*, open water and marsh vegetation were combined to delineate whole ponds. Spectral signatures were established by the analog computer for each training set area; the signatures were then used to recognize similar materials within the recorded field of view. Recognition results from both analog and digital processors were evaluated primarily on a qualitative basis. Quantitative evaluation is possible with the digital approach but was applied only to the pond statistics in the first phase of this study.

The high altitude data were not completely analyzed. The objective was to determine in a general way some of the advantages and disadvantages of sensing from higher altitudes and to simulate results obtainable from similar sensors aboard space craft. Three channels in the 0.62 to 1.0um region were selected because they were synchronous with one another and may have an advantage over shorter wavelength data at higher altitudes because longer wavelengths are less affected by atmospheric scattering.

One line of low altitude coverage was processed with a CDC-1604 digital computer. Outputs from this process are recognition maps that are similar to analog color-coded recognition maps. In addition to maps, the digital computer was used to produce statistics on the perimeter, area, and shape of ponds individually, by flight line segment, or by size class distribution. Five channels in the reflective wavelength region (0.4 to 1.0um) were selected for digital processing.

Shape was defined as the ratio of the perimeter to the square root of the area. The ratio was normalized so that a round pond would have a value of 1.0. Computations were compared to measurements of shorelines and area made on aerial photographs with a wheel-type map. measurer and a dot grid counter.

RESULTS

Low Altitude Recognition Analog Processing

An important objective of this project was to determine the usefulness of multispectral techniques in identifying components of migratory bird habitat. In general, the analog processing experiments with the 2,000-foot data were quite successful. The features of greatest interest were ponds, which were recognized with almost 100 percent accuracy on one line in the study area (Figure 2). Ponds less than 0.1 acre in size printed out clearly on the analog recognition maps. In order to recognize all ponds, it was necessary to combine the signatures for open water and two types of aquatic vegetation.

Technical problems prevented analysis of the data for water depth during the period of the contract. This information, however, can now be obtained for those ponds having water clear enough to permit light to penetrate to and be reflected from the bottom using a recently developed digital program.

Dry pond basins were not recognized. Only the most temporary ponds were dry at the time of the flight. The spectral signatures exhibited by dry ponds is a function of the type of vegetation in that basin. As a result, dry ponds were recognized as being similar to prairie or farm field areas. The functional class Dry Ponds does not exist when spectrally defined.

Recognition of principal aquatic vegetative associations was not too successful because differentiation of plant communities is incomplete in late May. Much of the new growth was still concealed by the remains of previous growth. Also, vegetation at or just above the water surface produced a hybrid signature that made differentiation between water and aquatic vegetation difficult. Collection of data later in the season, such as mid-July, when the vegetative communities are at peak growth should permit much more accurate differentiation.

The recognition of land use types and upland vegetation was successful. Bare soil, new growth, and dead vegetation could be separated in most cases. The bare soil areas recognized were all tilled fields. Some differentiation was obtained between fields that may have been due to soil moisture, stage of tillage, or soil type. New vegetative

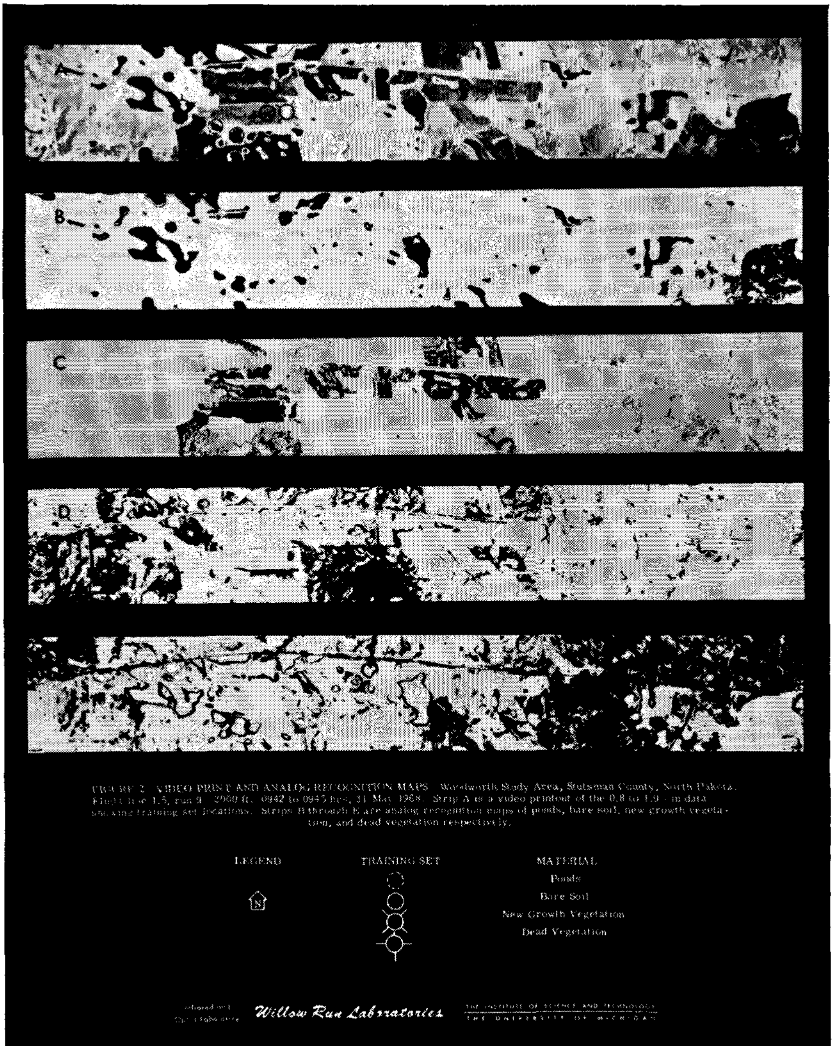

Figure 2

growth was evident in a variety of land use types where agricultural operations resulted in the removal of the dead vegetation from the previous year. Attempts to recognize wild hay, overgrazed pasture, and idle alfalfa-brome mixtures were partially successful. Areas of brush were not recognized because of the presence of grasses within the brush training sets, but the appropriate spectral signature can be developed. The result is a hybrid signature similar to the example of marsh vegetation growing in water. Considering that the original land use training sets were chosen from mapped information and not from on-site observations, these results are reasonable. The selection of more representative training sets would have eliminated much of the misclassification. This aspect can be corrected in future remote sensing work by establishing a more coordinated ground data collection effort.

No signatures were established for cultural features. For most purposes roads, towns, farm buildings, etc. can be recognized satisfactorily from photographs or spectral imagery. Automatic recognition of these features from high altitude would be difficult because of the relatively small dimensions and the great diversity of materials that would have to be detected. This conclusion is supported by findings obtained on another project at the University of Michigan (Colwell, 1970). These findings do show, however, that buildings and road materials can be mapped using data in the reflective and infrared wavelengths together.

Low Altitude Recognition Digital Processing

The digital processor can provide mapped recognition outputs which are comparable with those obtained from the analog equipment. A portion of a digital recognition map is shown in Figure 3. There is, in general, a good correlation between the materials represented by the gray levels on the digital maps and the colors on the analog maps. In some areas, the digital and analog results do not agree, due partly to differences in training sets and partly to electronic decision levels used during analog processing. For example, the analog training set for land vegetation contained primarily live plants, whereas the digital training set contained a mixture of live and dead plants. Two training sets were, in fact, established to permit digital recognition of land vegetation, but the gray levels for the two are not easily separated due to choice of typographic symbols. The analog signature called "Dead Vegetation" recognized dead vegetation around ponds as well as in the upland areas, and also recognized the railroad right-of-way and dry bare soil. The digital processor recognized dead vegetation around ponds, the railroad right-of-way, and dry bare soils. In general, the two processors were providing delineations of the brighter scene materials.

High Altitude Analog Imagery

As expected, recognition results from 10,000-foot data were of lesser

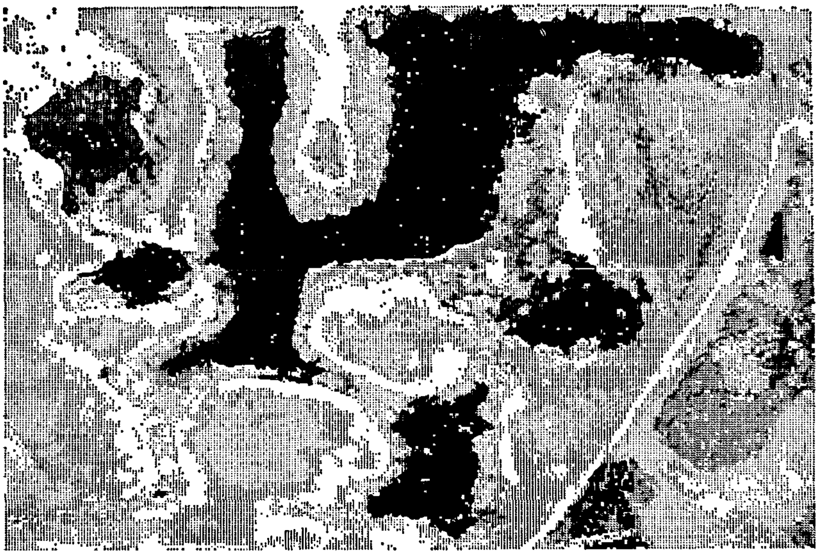

FIGURE 3. DIGITAL RECOGNITION MAP OF POND 9-1. WOODWORTH STUDY AREA, NORTH DAKOTA. Flight Line 1.5, Run 9. 2000 ft. 0942 to 0945 hrs. 31 May 1968. All data points are printed out.

Infrared and Optics Laboratory *Willow Run Laboratories* THE INSTITUTE OF SCIENCE AND TECHNOLOGY THE UNIVERSITY OF MICHIGAN

quality than those from 2,000-foot data. Aerial coverage was about five times greater from 10,000 feet than at the lower altitude. In general, the loss of spatial information did not exceed the lower size limit of features of interest, e.g., the smaller ponds. However, 10,000 feet appears to be a practicable upper limit to the altitude at which such results can be obtained given the 3 milliradian resolution capability of the Michigan scanner. Ponds larger than 3 to 5 acres will probably be resolved using instruments being designed for use in space craft by 1972 or later.

Recognition results using the high altitude data were erratic; partial cloud cover posed problems. Better results could be expected with more representative training sets and an optimum selection of synchronized channels. Fewer resolution elements cover a given area at a higher altitude and hence provide a less dense sample for a training set. Since all features are reduced in size, the probability of including extraneous or unwanted material in the training set is greatly increased. However, if large, homogeneous, and representative training sets are available, recognition of areas about four resolution elements in size (120 ft. x 30 ft.) can be achieved at the 10,000-foot altitude.

Low Altitude Quantitative Digital Processing

Quantitative results on the perimeter, size and shape of ponds were obtained using low altitude data on the digital processor. Computations of pond perimeters averaged 40 to 50 percent higher than control measurements obtained with aerial photographs and a wheel-type map measuring device. The map measuring device tends to smooth out irregularities in the shoreline. Acreages derived from aerial photographs are better estimates of basin size than of the actual water area. Automatic processing of multispectral data may offer greater precision in measuring water area, perimeter, or shape. Because of larger perimeter and lower area values, computed shape indices tend to recognize greater irregularities than those derived from office measurements.

CONCLUSIONS

The spectral characteristics of the components of a landscape containing waterfowl habitat can be detected with airborne multispectral scanners. By analyzing these spectral characteristics it is possible to identify and map the landscape components by analog and digital processing methods.

The recognition results obtained with the 2,000-foot data are reasonably accurate. Pond identification was accomplished successfully by combining the spectral signatures of open water and marsh vegetation. In addition, by operating on the recognition data, statistical summaries and distributions were obtained that appear to be more accurate than standard office measurements. Progress was made in the recognition of broad categories of land use and vegetation. Greater differentiation will be possible by collecting data later in the growing season, selecting large homogeneous areas for training sets, obtaining better on-site ground data, and using optimum data channels as determined by digital techniques.

Some materials can be recognized using high altitude data (10,000-feet) in the 0.62 to 1.0um region. Other wavelength regions might provide a more optimum recognition. Cloud shadows alter the spectral characteristics of the light reflected from materials and thereby lower recognition success. Electronic normalization techniques, however, may possibly be used to remove some spectral effects due to shadows.

At the present stage of development multispectral remote sensing techniques are not ready for operational application to surveys of migratory bird habitat and other such resources. Further developments are needed to (1) increase accuracy, (2) decrease retrieval and processing time, and (3) reduce costs.

Other resource agencies are experimenting with remote-sensing techniques that could replace or supplement expensive ground-based methods. Some potential applications include predicting the yield of food and fiber as well as timber and fish. Land-use patterns, snow distribution, soil erosion, forest fire detection, reservoir sedimentation, plankton content of areas of the sea, and sources of air and water pollution are examples of other vital resource data that may be monitored by aircraft or satellite borne sensing devices (Colwell, 1967, 1968; Frey, 1967; Pecora, 1966; Weaver, 1969; Thackrey, 1968).

In spite of apparent difficulties, resource managers cannot afford to ignore this new technique. Mining and petroleum interests are already using it to advantage to locate new areas for potential development. Resource managers undoubtedly will not solve all their problems with remote sensing but the technique can play an important role in providing better information for planning purposes.

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PANEL DISCUSSION

MR. JOSEPH LARSON: (University of Massachusetts): The State of Massachusetts has impowered the State Department of Natural Resources to restrict uses of inland wetlands prior to application—in other words, to locate classified wetlands and, before the fact, place restrictions on wetlands. The legislation has not been implemented because of an inability to locate the wetlands by regular photometric procedures and transfer this to maps which are suitable for filing in the Registry of Deeds for court procedure.

Is there any indication as to when this procedure you have been talking about will be ready? In fact, can some of these locations be made?

DR. FISCHER: The answer is both "yes" and "no."

We can locate relative wetlands with this photography. They show up fine in black and white. However, I don't think the present circumstances would be sufficient for you to make any broad assessments from the information we presently have.

CHAIRMAN DYKSTRA: I wonder if you could tell us, from your information, as to what the approximate coverage path of the new satellites will be?

DOCTOR FISCHER: Yes, the satellite will be near polar so it will cover essentially all of the earth. We won't be able to get all the data back for all of the earth but any part of the United States will be covered.

TECHNICAL SESSION

Monday Afternoon—March 23

Chairman: Ward E. Stevens

Regional Director, Canadian Wildlife Service, Edmonton, Alberta, Canada

Discussion Leader: Thadis W. Box

Dean, College of Natural Resources, Utah State University, Logan

FOREST AND RANGE RESOURCES

PREDATION BY BLACK-BACKED JACKALS ON NEW-BORN BLESBOK LAMBS

S. S. du Plessis
Nature Conservation Division, Pretoria, South Africa

The blesbok (*Damaliscus dorcas phillipsi*) (Fig. 1) is a gregarious antelope belonging to the Tribe of Alcelaphini of the Family Bovidae. Adult females average 150 pounds in weight while males may reach 190 pounds. Before the advent of the white man vast herds roamed the open grasslands in the interior of South Africa. Today it is still common on fenced farms over a large part of its former range, mainly in the Southern Transvaal and Orange Free State. The climate is characterized by summer rains (October to April) and a cold dry winter.

The restricted lambing season stretches from mid-November to early January, with a sharp peak in early December. This coincides with a period of optimum grazing conditions. The cream-colored lamb runs with its mother from a few minutes after birth but often lies down while the mother grazes nearby.

The present study emanated from an investigation of productivity in a grassland-ruminant ecosystem on the Van Riebeeck Nature Reserve near Pretoria, South Africa during the period 1966-68 (du Plessis, 1968). At that time this reserve supported about 800 blesbok and some other game on an area of 6500 acres.

Figure 1
An adult blesbok male on the Transvaal highveld in South Africa. The ewe also has horns similar to those of the ram but they are more slender. The blesbok's name is derived from the Afrikaans word *bles* or blaze and refers to the prominent white face-patch. The body color of this gregarious antelope is a rich brownish plumb.

A sudden drop in the lamb crop from 1963 to 1964, followed by a second poor crop in 1965, led to an investigation of pregnancy rates and lamb survival.

By camping on the reserve during the lambing season I was enabled to keep the animals under almost continuous observation for a period of 12 days during a time when many lambs were born. Lambs were counted regularly throughout the lambing season and the one burnt area was traversed regularly to look for dead lambs and afterbirths.

Classification and counting of the animals were done with the aid of binoculars, or a 40 $\times$ 60 spotting scope, a hand counter and a tape recorder. This work was facilitated by the fact that the animals congregated on spring burns during the lambing season and were relatively tame.

I gratefully acknowledge facilities and technical assistance provided by the Transvaal Division of Nature Conservation. I am also indebted to the City Engineer, Pretoria for permission to work on the Reserve, to Paul Adendorff and Norman Khoza for assistance during field work, and to Jan van Zyl for undertaking the feeding experiment with jackal.

RESULTS

Table 1 shows the results of two counts during two successive lambing seasons. Unclassified ewes represent animals that were lying down or were partly visible so that only sex could be determined from horn shape (Du Plessis, 1968).

TABLE 1. STRUCTURE OF THE BLESBOK POPULATION ON THE VAN RIEBEECK NATURE RESERVE PRETORIA DURING THE 1966 AND 1967 LAMBING SEASONS

Class of Animal	Number	
	Dec. 6, 1966	Nov. 23, 1967
Mature females		
Heavily pregnant	207	308
Not visibly pregnant	67	73
With lamb	112	79
Lamb lost	45	—
Unclassified	72	13
Total mature females	503	473
Percentage pregnancy[1]	84.5	84.1
Number of pregnancies[2]	424	398
Other		
Two-year old females	23	18
Males (two years and older)	213	188
Yearlings (both sexes)	41	157
Lambs	112	79
Totals	892	915

[1] Calculated from classified females.
[2] Assuming the same pregnancy rate for unclassified as for classified females.

Out of a total of 424 pregnancies during the 1966 lambing season only 157 (37 percent) lambs survived. The following evidence pointed to heavy predation on new-born lambs:

1. All blesbok were in fine condition and ewes gave birth to healthy lambs;
2. Jackals (*Canis mesomelas*) were regularly sighted and numerous calls were heard at night. During the peak of the lambing season their young were about four months old and one pair reared four pups in the immediate vicinity of one herd. Remains of blesbok lambs were found near their den.

3. Hair of blesbok lambs was often noted in jackal faeces.
4. Out of a theoretical loss of 128 lambs in the herd chosen for intensive study only eight could be accounted for as carcasses while the remains of another seven were found.
5. All afterbirths dropped during the day disappeared overnight.
6. On three occasions during the day jackals were seen overpowering lambs that were lying down. The ease with which this was done was no less surprising than the inability of the mother to defend her young.
7. The fact that 28 lactating ewes with greatly swollen udders but without lambs were counted in one herd on December 6 alone (Table 1) showed that more lambs were being lost than could be accounted for as carcasses or other remains.

The fact that even skulls and hoofs of lambs were eaten indicated that they were killed while their bones were still soft. They were presumably taken during the first two days of their lives when they tend to lie down for much of the time, thus falling an easy prey to jackals.

ESTIMATING THE JACKAL POPULATION

Although fairly convincing evidence for jackal predation as a factor in lamb mortality was thus found, it was decided to investigate the matter further by reducing the jackal population and again measuring lamb mortality. For this purpose an estimate of the jackal population was essential in order to avoid too drastic a reduction of their numbers.

The numbers and weights of lambs and afterbirths presumed to have been removed over a given period by jackals were known. An estimate of the population could be derived, provided that the daily food consumption of a jackal was known. This was determined by feeding five adult black-backed jackals kept under semi-natural conditions in a 16-acre enclosure on the S.A. Lombard Nature Reserve, near Bloemhof. The animals were given as much meat as they could eat for a period of 23 days. Weighed carcasses of spring hares, springbok and sheep were placed in the enclosure every evening, the remains collected the next morning and again weighed. Weight loss through evaporation was determined by weighing a separate piece of the same type of meat in the evening and again in the morning, and making allowance for water loss.

This experiment was kindly undertaken by Jan van Zyl. The mean daily consumption per jackal was 31.8 ± 4.5 ounces, which was taken as 2 pounds for purposes of calculation (Table 2).

TABLE 2. CALCULATION OF JACKAL POPULATIONS FROM MORTALITY OF BLESBOK LAMBS 1966 AND 1967

	1966		1967
Number of blesbok pregnancies	424		398
Lamb mortalities (50 days)	267		58
Weight of afterbirths @ 2 pounds each	848 pounds		796 pounds
Weight of lambs killed @ 15 pounds each	4005 pounds		870 pounds
Weight eaten by jackal in 50 days	4853 pounds		1666 pounds
Jackal predation days @ 2 pounds per day	2426		833
Theoretical number of jackals during lambing season	48		16
Actual number of jackals killed September 1967	26		—
Theoretical number left	22		—
Difference between 1966 and 1967 seasons =	48 − 16	=	32 jackals
Number killed September 1967			26
Number not accounted for			6

Based on actual weights of lambs and afterbirths the average weight of a new-born lamb at Rietvlei was taken as 15 pounds and that of the afterbirth as 2 pounds. If it is assumed that all lambs lost during the first 50 days of the lambing season (267) as well as the afterbirths of all lambs born up to that date (424) had been eaten by jackal this would amount to 4853 pounds over a period of 50 days. This would represent the predation exerted by the equivalent of 48 adult jackal. It was arbitrarily decided to reduce the population by about 25.

In another attempt at estimating the population, jackals were captured alive in August 1967, marked with ear tags and released, in the hope that later recovery during the control program would make such an estimate possible. A coyote-getter was used to spring a loop snare, attached to the tip of a heavy-duty fishing rod which was mounted on a revolving base. The snare caught the jackal round the waist, thus preventing it from becoming strangled.

Of the six jackals marked and released by this method none was subsequently recaptured. After the first one had been caught they became extremely wary of the snares, and judging by spoor, they moved out of the reserve. Investigation revealed that there were numerous holes in the perimeter fence with signs of jackal traffic through them. This indicated that the population possibly inhabited an area much larger than the reserve.

THE EFFECT OF JACKAL CONTROL ON LAMB SURVIVAL

On September 12, 1967, 28 coyote-getters were set out on the reserve. Fifteen of these were pulled by jackals during the first night, and nine carcasses were recovered the next morning. This catch rate was unequaled in the history of the coyote getter in the Transvaal and was regarded as evidence of an unusually high population density.

Within four days 21 jackal carcasses were recovered. A larger number of getters were pulled, however, and, judging by spoor at these getters it is likely that at least another five animals were killed that could not be recovered. Eighteen carcasses were found in a fresh state, consisting of 10 males and eight females. The teats of seven females showed that they had been suckling pups. One litter of three, dug out of a burrow, was about one month old at this time.

After the reduction campaign, all holes in the boundary fence were closed in order to stop any possible influx of jackals from the surrounding farms. The sighting of jackal on the reserve shortly after this confirmed that there were still some left.

The 1967 lambing season commenced on November 13 under conditions almost exactly the same as those of the previous season, except for a smaller jackal population. Daily observations were again confined to the large herd on the northern side, although regular counts of lambs in the other herds were also made.

The lambing seasons of 1966 and 1967 are compared in Figure 2, which clearly shows the dramatic difference in lamb survival before and after reduction of jackal numbers. In the absence of any evidence to the contrary the difference is attributed to predation. This conclusion is further supported by the fact that, whereas in 1966 lamb

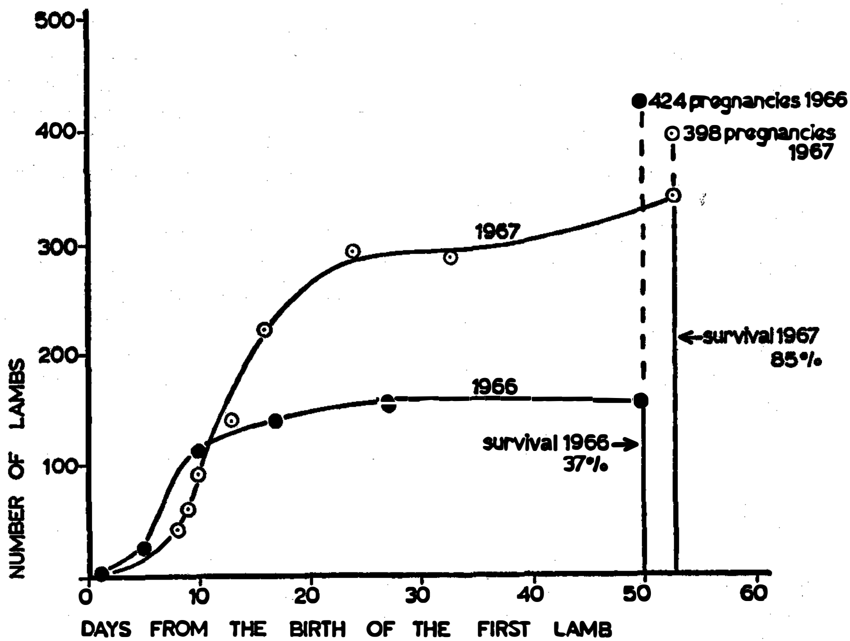

Figure 2.—Survival of blesbok lambs at Rietvlei in 1966 and 1967 to show the effect of jackal control on lamb mortality.

carcasses all but completely disappeared from the study area except for an odd scapula, leg or jaw-bone, in 1967 the partly eaten remains of several lambs were found on the burn. Similarly, afterbirths all disappeared overnight in 1966 whereas in 1967 they were often found rotting on the veld. Crows, which were never seen on the lambing ground in 1966, were attracted by the afterbirths and lamb carcasses during the 1967 lambing season; they visited the lambing ground every day, feeding on afterbirths, partly eaten lamb carcasses and the eyes of fresh carcasses.

Jackals were seen and heard, but in smaller numbers than during the previous season. There could be no doubt that the predation pressure was much lighter than in 1966. Figures of lamb mortalities during the first 50 days of the lambing season were used to calculate jackal populations for the two seasons. The calculations in Table 2 were based on the following assumptions, which seem acceptable in the light of existing knowledge:

1. Ewes classified as pregnant at the onset of the season had all given birth by the 50th day of the season.
2. The number of afterbirths (2 pounds each) available to jackals was equal to the number of pregnancies.
3. Lambs were killed shortly after birth.
4. The reserve was populated to carrying capacity by jackals so that young animals moved out of the reserve at the attainment of sexual maturity; therefore the population of the reserve did not increase between the 1966 lambing season and September 1967, when the population was reduced and the holes in the fence closed.
5. Jackals fed solely on blesbok lambs and afterbirths during the two lambing seasons.
6. No other predators were preying on blesbok lambs during the lambing season.

Although no accuracy can be expected in this type of calculation Table 2 shows satisfactory agreement between the number of jackals killed and the increase in lamb survival. The jackals not accounted for may represent those six marked and released. Experience elsewhere in the Transvaal showed that the jackals marked and released tend to leave the area (unpublished reports). If the food consumption of a litter of half-grown pups is taken as equal to that of one adult jackal then the seven suckling females killed would actually have exerted a predation pressure equal to that of 14 adults. This would add the equivalent of another seven to the total killed.

It is concluded that jackal predation offers a satisfactory explanation for lamb mortalities during these two seasons.

Grafton (1965) found that the food of jackals from farming areas in the Transvaal included 28.7 percent carrion, 18.5 percent domestic stock and 9.7 percent antelope by volume, the rest of the diet being made up of a variety of smaller animals. Estes (1967) described the black-backed jackal as an important predator on the fawns of Thompson's gazelle (*Gazella thomsonii*) and Grant's gazelle (*G. granti*) in the Ngorongoro crater. Mr. Lindbergh (personal communication) of the farm Vaalboschfontein in Wolmaransstad district counted 12 skulls of springbok fawns at a jackal den. There is thus sufficient evidence that this strong and versatile predator could be an important limiting factor on antelope populations, by virtue of its depredations on the newly born young.

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DISCUSSION

DISCUSSION LEADER THADIS W. BOX (Dean, College of Natural Resources, Utah State University, Logan): Thank you, Dr. du Plessis.

The purpose of this discussion period is to allow you to explore in more depth items that the authors have raised. Rather than take up any more time I will entertain questions from the floor at this time.

DR. OLIVER HEWITT (Cornell University, New York): This is a fascinating example of intensive and selective predation. I would like to ask Dr. du Plessis, what is the sequel to this story? Has he continued studying the jackals prowling the area? If not, what has happened to the lamb crop in the last two or three years?

DR. DU PLESSIS: Dr. Hewitt, I have noticed that after the jackals were reduced in number, the breeding was apparently very successful. I had, however, no means of following this up in detail; but I did notice that pups were all growing up and they were almost all fully grown when I saw them. Therefore, I presume the jackal population grew quite rapidly after the reduction in the number of jackals.

During the past lambing season, November, 1969, we had approximately 550 pregnancies, and we counted 500 lambs. Therefore, survival was, indeed, very high.

Although I was not in a position to do any intensive work on this, I did get the impression that we had killed most of the jackals that were prone to killing fresh-born lambs, because there is apparently not the same relationship between the number of jackals and the degree of predation on the lamb crop.

This is one of the reasons why I suspect that we have been dealing with a rather unusual situation.

FROM THE FLOOR: Has Dr. Du Plessis attempted to establish any kind of predatory animal control program with relation to jackals?

DR. DU PLESSIS: Yes. The jackal, of course, is an important problem all over South Africa. We must control them. We have been using hounds for many years, and we used the coyote-getter which is extremely effective.

FACTORS INFLUENCING RUFFED GROUSE POPULATIONS[1]

GORDON W. GULLION[2]
Forest Research Center, University of Minnesota, Cloquet

Since 1956 a study of the response of ruffed grouse [*Bonasa umbellus* (L.)] populations to forest management activities has been carried out at the Cloquet Forest Research Center (46°42′ N. Lat., 92°32′ W. Long.), about 25 miles west of Duluth, Minnesota. In order to detect the influence man-made changes in the forest habitat have upon these grouse it has been necessary to delve into most aspects of their life history and their relationships to their environment. Our study techniques and the features of the study area are well reported in the literature (see Gullion, 1967; Gullion and Marshall, 1968).

From this intensive 14-year study and the extensive data gathered by Ralph T. King (1937) in the early 1930s and by William H. Marshall (1954) between 1945 and 1956, we believe that we have been able to identify some of the short- and long-term factors which have a significant effect upon ruffed grouse occurrence, survival, and abundance.

SHORT-TERM OR "CYCLIC" FACTORS

Ruffed grouse have long been considered one of the "cyclic" species of small animals indigenous to northern, boreal forested regions, but biologists have had difficulty explaining this phenomenon, or even agreeing that it exists (cf. Cole, 1951; Keith, 1963). If we call this species "cyclic" we should do so in the context used by Grange (1965:122). That periodic and often dramatic changes in the abundance of these birds occur are readily apparent from the Cloquet census data recorded since 1932 (Marshall and Gullion, 1963). The factors affecting these often dramatic changes in population densities and the mechanisms by which they operate have proven somewhat elusive.

At Cloquet we are convinced that predation is the ultimate fate of more than 80 percent of our grouse, but predation is probably seldom a limiting factor *per se*. Rather predation represents the consequences of environmental stresses, habitat inadequacies, or social behavior—and often all three operating in concert. Legal fall hunting appears to be of as little consequence as a factor limiting ruffed grouse populations in northern Minnesota as has been shown elsewhere (e.g. Palmer and Bennett, 1963).

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Environmental Stresses

In northern Minnesota I believe we must consider ruffed grouse to be chionophiles, or "snowlovers" (Formozov, 1964:65), and that their overwinter welfare depends in large degree upon snow conditions. Unfortunately, weather bureau records do not indicate aspects of the "quality" of the snow-cover for these birds; or even the severity of the winter's temperature regime for them. Thus, 20 inches of snow with a hard crust can be as deleterious as 6 inches of soft snow with no crust, when the temperatures remain in subzero (°F) ranges for prolonged periods.

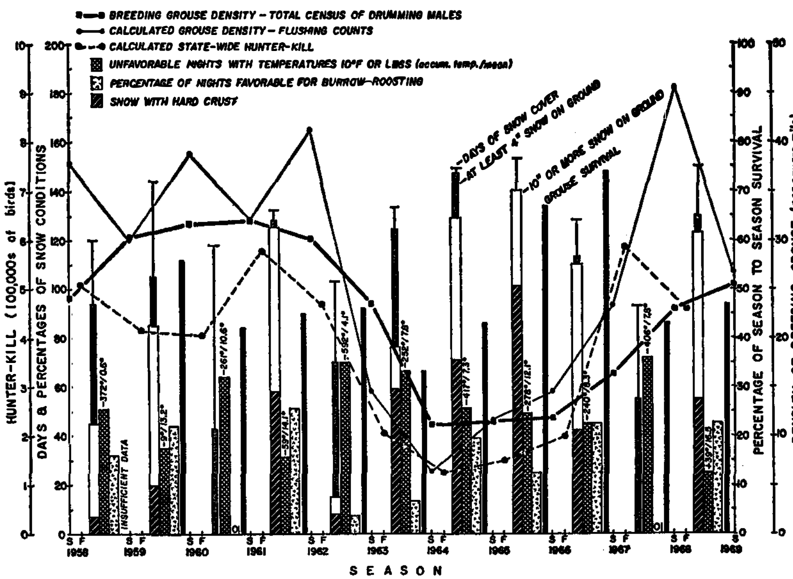

Figure 1.—Illustrates how the breeding ruffed grouse population on the Cloquet study area has varied since 1958 in relation to the major environmental factors which appear to affect these changes. These data are also compared to spring population estimates based on flushing counts (Gates et al., 1968) and calculated annual state-wide ruffed grouse harvest (Minn. Div. Game & Fish). Accumulated temperatures represent the sum of daily minimum temperatures below 10° F during the winter period when snow-burrowing was not possible (the "unfavorable nights"); while the "mean" represents the average of minimum daily temperatures during the period when grouse could not use snow to their advantage (data from records maintained by Cloquet Forest Research Center staff). "Percentage of nights favorable for burrow-roosting" represent that portion of the period when snow uniformly covered the ground that ruffed grouse could use snow to their advantage for burrow-roosting.

Figure 1 shows the relationships we have observed at Cloquet since 1958. The major conclusion we can derive from these data is that periodic fluctuations are not so much the result of any "die-off" or accelerated losses among living grouse as they are the failure to recruit young birds each season to replace those lost through "normal" attrition.

During the 10 years of adequate study only in 1963-64 was the overwinter loss substantially greater than a mean of about 55 percent. This we attribute to increased predation associated with poor snow conditions and a sharp decline in both snowshoe hare (*Lepus americanus*) and red squirrel (*Tamiasciurus hudsonicus*) numbers. These two mammals and ruffed grouse are essentially the diet of the raptors wintering at Cloquet—predominantly goshawks (*Accipiter gentilis*) and horned and barred owls (*Bubo virginianus* and *Strix varia*). The following year, with hares and squirrels still scarce and grouse able to spend most of their time in snow-burrows, the raptors turned upon one another (Gullion, 1965).

But when a population suffers a "normal" attrition rate of 55 percent per year, it soon dwindles markedly unless there is substantial annual recruitment. This recruitment failed in 1962 and 1963, resulting in a sharp decline in breeding grouse populations from 1962 to 1964 (Figure 1).

More satisfactory wintering conditions in 1964-65 allowed better survival, and breeding populations increased with some recruitment of young grouse. Overwinter survival in 1965-66 was high, and the birds were in good condition, so there was a substantial production of young grouse in 1966. This, coupled in 1966-67 with the highest overwinter survival we have recorded at Cloquet, resulted in spring 1967 breeding population nearly 60 percent above 1966, and we had a "boom" year. Poor snow conditions in 1967-68 resulted in a poor production season in 1968, and 1969 proved only moderately successful. Yet 1969 breeding grouse densities were 115 percent above 1966 levels, but still only about 80 percent of the density we recorded in 1961.

While we have significant data concerning year-to-year changes in weights of breeding male ruffed grouse, an expression of condition, we must largely hypothesize concerning the precise mechanisms operating to affect annual production rates. We believe the stress factors operating against ruffed grouse in Minnesota affect our birds in much the same manner as suggested by the experimental evidence of Zwickel and Bendell (1967) for blue grouse (*Dendragapus obscurus*) on Vancouver Island, B.C., and by Jenkins *et al.* (1967) for red grouse (*Lagopus l. scoticus*) in northeastern Scotland.

Like the authors just cited, our studies to date have indicated that annual reproductive success has been largely determined before nesting begins. Environmental conditions during the nesting season; during the 2 or 3 weeks immediately following the hatching of the chicks; and during the remainder of the summer appear to have little significant effect upon the current season's production.

We believe that when environmental temperatures drop much below 20°F they are below the thermoneutral range of this grouse and that the birds must increase their metabolic rates to maintain body temperatures.

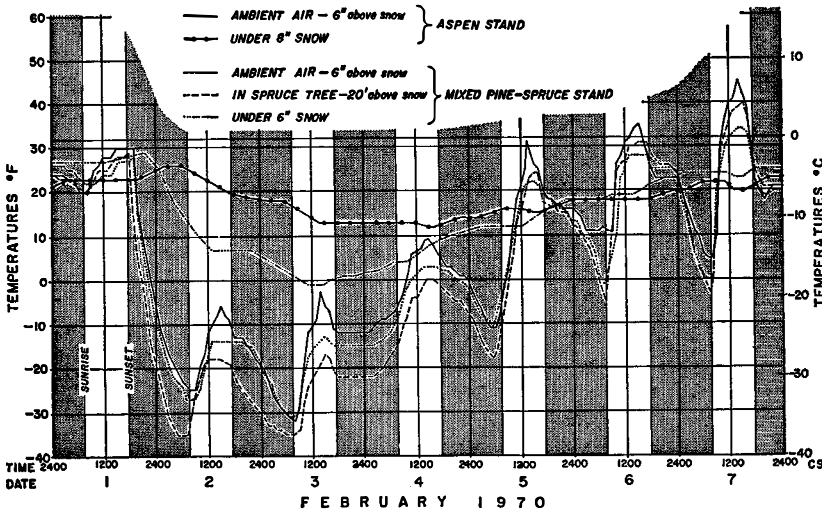

Figure 2.—A comparison of hourly temperatures recorded at different sites in two habitats available to ruffed grouse in the Cloquet Research Forest in northern Minnesota.

A ruffed grouse burrowed under 6 to 8 inches of snow at Cloquet is in an environment that remains about 20°F—even when the air temperature may be 50 to 60°F colder at the surface of the snow. As Figure 2 shows, this winter grouse-roosting in snow-burrows in open hardwood situations were in substantially warmer sites than those using snow-burrows under conifer stands; and very much warmer than the sites occupied by grouse roosting either at the surface of the snow or in a dense spruce (*Picea mariana*) 20 feet above the ground.

Grouse overwintering at Cloquet in 1966-67 could have spent 58 nights at about 20°F in the security of a snow-burrow, and 70 nights roosting on the snow or in trees exposed to a mean of minimum temperatures of 8.3°F. These birds undoubtedly used less of their energy resources to keep warm than did the grouse during the winter of 1962-63 when the minimum temperatures averaged 4.1°F during the 96 nights when they could not snow-burrow.

From these data it seems apparent that snow depth and quality is a most important factor affecting year-to-year changes in northern Minnesota's ruffed grouse populations—but it is not the entire story.

Intrinsic Factors

We have found at Cloquet that the color of a ruffed grouse's tail indicates the bird's probable longevity. Over the past 13 years male grouse with red tails have lived an average of only 69 percent as long as the birds with gray tails (11.4 mons. vs. 16.6 mons.—significant at 99.5% level; 275 df.). Furthermore, this differential survival appears to be related to environmental stress. It is during winters of unfavorable snow conditions that the red birds show the greatest losses. In good snow years, such as 1964-65, the red birds survived as well as the gray birds (Gullion and Marshall, 1968:153).

In addition to our Cloquet data we have reported some interesting state- and continent-wide variations in color-phase ratios which suggest that red-phased ruffed grouse are less tolerant of cold than the gray birds (Gullion and Marshall, 1968:155-157).

I must add that we still need a great deal more information about color-phase ratios from various parts of the continent, and how they vary from year to year in relation to environmental conditions.

Nutrition

At least on our study areas in Minnesota the food item which largely determines the distribution of breeding grouse each spring is the availability of the staminate flower buds of the quaking and bigtooth aspens (*Populus tremuloides, P. grandidentata*) (Gullion, 1969).

Ruffed grouse do feed upon other plant materials. In fall, winter and spring they are largely "flower-eaters," taking the flower-buds or aments (catkins) of several trees and shrubs. But in our region we cannot long sustain a breeding population of these grouse where they do not have access to the flower-buds of male aspen about 25 years of age or older (a "good" population is a breeding pair per 10 to 15 acres of forested land).

We can say almost without reservation that cutting all of the mature aspen from a forested tract of 40 acres or larger is a most certain means of eliminating overwintering and breeding ruffed grouse from forested areas in our part of Minnesota. We suspect the same applies more widely in other boreal forested regions, but have no supporting information.

Our study of the mechanisms involved began in earnest in 1965. As hypothesized by Laukhart (1957) we know now that nutrient values of the food materials available to and used by ruffed grouse show significant annual and regional variations in quality, as well as in differences between the flower-buds of "used" and "unused" male aspens (Huff, unpubl. data). We have also demonstrated significant annual variations in the quantity of food materials available to ruffed grouse in the Cloquet area (Svoboda and Gullion, 1970).

Social Behavior

At least male ruffed grouse are intensely territorial in their social behavior. Their "drumming" activity and other displays certainly are used more to repel or warn territorial interlopers than to attract mates. Drumming serves the latter function for perhaps a week or two out of the 7 or 8 months per year that male grouse are closely associated with drumming logs (see Brander, 1967; Barrett, 1970).

Drumming is also an "expensive" behavior, for the grouse that successfully defend the most choice sites, the "perennial logs," are the least likely to live from one breeding season to the next (Gullion and Marshall, 1968:128-134).

Territorial behavior appears to be as much an ultimate factor limiting the density of ruffed grouse populations in Minnesota as Jenkins *et al.* (1967) have shown it to be for Scotland's red grouse. In our region lighter, and presumably inferior young, male grouse which survive the winter have usually been in the less choice "transient drumming centers." Probably during the fall period of dispersal many other young grouse have had to settle in habitats that were vacant because they were too poor to support prior occupants overwinter. These are the grouse that we contact mostly as feather piles in the spring, representing overwinter predation losses.

But this brings us back to the proximate factors which are generally limiting the abundance of ruffed grouse; *i.e.*, environmental conditions, nutrition, and quality of the habitat. There are probably few extensive forested habitats of such fine quality that social behavior limits the size of the population over a large area.

LONG-TERM INFLUENCES

To understand the long-term factors which I believe affect the abundance of ruffed grouse in the boreal forested regions of this continent we must conceptualize the ecological niches existing in the primeval forests which favored the evolutionary development of this species. We must further consider the probability that these grouse are better adapted physiologically to the milder climates, where agriculture has largely supplanted the hardwood forest. Leopold expressed this opinion in 1931 (p. 149): "that the center of the north central region was the optimum range of the ruffed grouse, and that

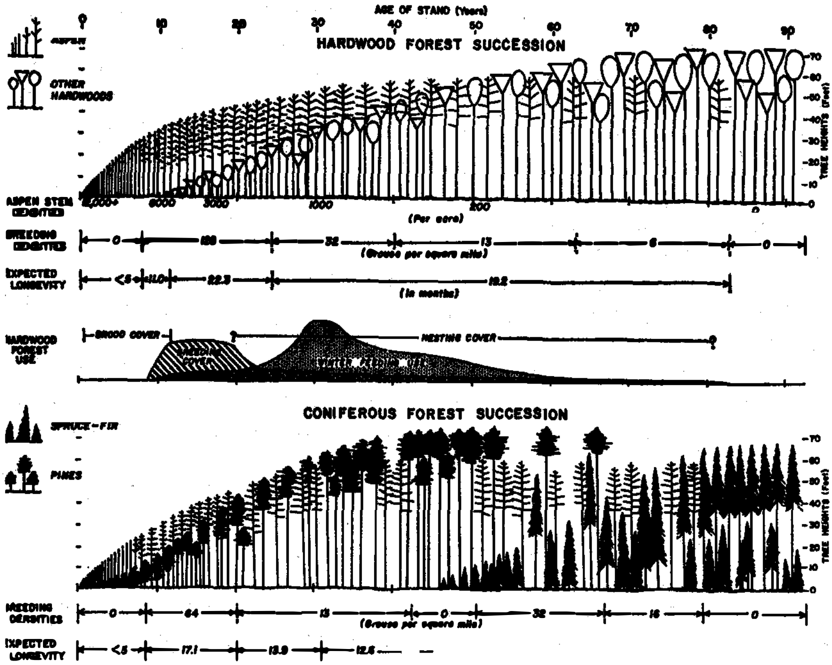

Figure 3.—The relation of ruffed grouse usage, breeding densities, and longevity to stages of succession in Minnesota's hardwood and coniferous forests. The "age of stand" applies most appropriately to the hardwood forest succession, but applies as well to the first 30 to 40 years of the coniferous forest succession insofar as the aspen-pine relationship is concerned. Habitats where "expected longevity" is <5 months represent "population sinks" to which young grouse disperse in the fall, but seldom survive to the breeding season. "Hardwood forest use" is shown in terms of relative importance of the various aged stands for breeding cover and winter feeding use. Relative values have not been determined for brood and nesting cover use.

the bulk of its present distribution occurs on marginal (which is to say adverse) environments."

As Grange (1949:78-79) and others have amply described, this grouse is adapted to early successional stages in the boreal forests. The temporal niche these grouse fill in the successional recovery of a devastated boreal forest, where aspen is the primary species responding, is shown in Figure 3.

Natural Habitat "Management"

The aspen stands ruffed grouse are so dependent upon are maintained as components of the boreal forest by frequent catastrophe in those forests; in the primeval forest this was predominately wind-storm or fire. The aspens are short-lived species, regenerating most readily as suckers from roots but having little tolerance for shading. Therefore aspen thrive only during the early successional development of the boreal forests and will soon lose out in competition and be supplanted by the longer-lived, shade-tolerant tree species in forests long protected from fire, wind-storm, or even logging (Graham *et al.*, 1963:25).

But considering the limited mobility of these birds and the diversity of habitat qualities needed within their limited range (Gullion, 1969), it seems probable that neither fire as a widespread holocaust nor wind-storms smashing great swaths through the forest were or are necessary to maintain high-quality ruffed grouse habitat. Rather it was the small fire, burning but a few acres following a lightning strike which was most likely beneficial to these birds (Gullion, 1968). Komarek (1968:176) has pointed out that lightning strikes even in the absence of fire could be responsible for altering the forest habitat over several acres.

Similarly, wind-storms knocking down small groups of trees scattered through the forest were probably equally valuable. In the summer of 1968 a tornado skipped across a mature hardwood forest on our Mille Lacs study area in central Minnesota. In a few moments this storm duplicated the type of clearings a Minnesota Division of Game and Fish labor crew had spent several weeks cutting a few months earlier, both in number and in size.

The Role of Fire

We believe it is significant that the periods of greatest ruffed grouse abundance in northern Minnesota have occurred at intervals of roughly 2 to 4 and 10 to 12 years after peak fire seasons in the state.

Re-examining Figure 3 it is not surprising to find this relationship. It is the second or third year after an aspen stand has been devastated by fire or logging that it begins to provide habitat for broods; and at about 10 to 12 years the stand has grown and thinned sufficiently to provide the quality of habitat required year-around by adult grouse. But once the aspen stand proceeds beyond the age of 20 to 25-years it "goes-by" as a best quality year-long habitat for this species of grouse (Gullion, 1969).

We believe there are several benefits which ruffed grouse derive from fire in the forest which are difficult to provide by any other means. Foremost is the story of forest succession just discussed. Fire sets the forest back to earlier successional stages and fire-seared aspen stands regenerate more luxuriantly than those which have been only clear-cut (Strothman and Zasada, 1957:11). With first season sucker growth of 4 to 6 feet common, and stem densities often exceeding 10 to

12 thousand per acre, aspen quickly develops a valuable quality of cover.

In addition fire burns the accumulated litter on the ground, which we feel benefits ruffed grouse in two ways. First, burning of the litter accelerates recycling of the minerals held in the organic debris, and by changing soil pH may release for plant use essential elements bound to soil particles (see Ahlgren and Ahlgren, 1960, for a review of this literature). This accelerated mineral recycling most often results in a considerable increase in the nutrient quality of plant materials used by these grouse and other animals.

Secondly, the "sanitation" accomplished by the burning of accumulated branches, tree tops and other bulky litter on the forest floor reduces the hunting cover for the mammalian predators which prey on both young and adult grouse.

Finally, fire may play an important role in relation to the preference these grouse show for the flower buds of old and often diseased or injured aspen (Svoboda and Gullion, 1970). Fire scorching may injure thrifty trees or speed up physiological aging, providing in younger forests and in greater quantity the quality of flower buds required by these grouse. We are currently investigating these possibilities.

Our Concept of Ruffed Grouse Cover

We presently make two distinctions when referring to cover for ruffed grouse. The cover in which these birds are most secure and live longest is predominantly short *vertical cover—i.e.,* the stems of tall brush and young trees. We see evidence of their preference for this type of cover especially in their choice of drumming logs and nesting sites. Vertical cover over litter-free ground provides the grouse with the best opportunity to keep the nearby landscape under effective surveillance—and we believe the safest relationship a ruffed grouse can have with its predators is to see them first. Good vertical cover also provides an effective barrier against surprise attack from above by raptorial birds.

The other form of cover we call ***horizontal*** cover. This includes brush piles, fallen tree tops and limbs, slashing, and the overhead boughs of the evergreen conifers. This type of cover does not allow a ruffed grouse to maintain effective surveillance over its surroundings and provides better hunting cover for its predators than escape cover for grouse. Figure 3 shows how survival of established drumming male grouse can be related to the quality of the forest composition.

In our lowest security habitats, the closed-canopy, "high-tree" pine forests (Smith, 1958) we seldom have young grouse surviving long enough to appear in these survival data. These pine forests serve as population "sinks" by absorbing young grouse unable to compete successfully for more secure habitats in the fall but fail to provide the quality of cover necessary to allow them to live to breeding age.

The Recent History of Grouse Habitat and Population Changes

In Minnesota slash-burning after logging and fire for land clearing was a common and encouraged practice during the early 1900s (Dana *et al.*, 1960:25). The peak fire years of 1917-18, when about 2 million acres burned, were followed 4 years later by high grouse populations in 1922-23, and again in 1933-34, 15 years later. The 1933-34 peak also followed 2 to 3 years after 992,000 acres burned in northern Minnesota, and this burning (plus some 710,000 acres in 1933-34) was followed by another peak grouse population 10 years later, in 1941. But this latter peak was much lower than in the early 1930s for relatively few fires and acres had burned during the preceding 2 to 4 years.

In the late 1930s forest fire suppression and control efforts had finally become effective, and widespread fire ceased to be an important ecological agent affecting Minnesota's boreal forests. Except for a brief resurgence in 1950-51 (following two moderately bad fire years in 1948-49), Minnesota's ruffed grouse population has continued a general long-term decline, as the millions of acres of aspen forests resulting from the fires prior to the mid-1930s passed from the productive young age classes into "gone-by" stands 25- to 30-years old and older.

Now and the Future

This trend continues today. Groff (1966:1) states that more than one-half of the 5.4 million acres of aspen forest type in Minnesota "is in stands 30 to 50 years old—rapidly approaching maturity." Noreen and Hughes (1968:4) point out that the current rate of harvesting aspen in Minnesota is "less than one-third of the desired cut," and Stone (1966:19) predicts that by the year 2000 the anticipated annual aspen timber cut of 54.4 million cubic feet "will be less than losses due to mortality." Under current and projected timber management practices in Minnesota we can expect increased maturity of the aspen forests and a consequent continued long-term decline in the abundance of ruffed grouse, and probably other game species as well.

However, there is a marked increase in the interest being shown aspen by wood processors, and we hope that the projections of expected utilization of aspen in future years may be considerably short of the actual cut.

An alternative would be the widespread use of fire in mature aspen forests for the purpose of regenerating aspen stands which otherwise will be lost as a timber resource to maturity or competition and for the purpose of rejuvenating the habitat for ruffed grouse and other forest game species.

However, it does not appear that severe burning of large acreages would be desireable for ruffed grouse. Due to the small size of the home range, or activity center of this species any major alteration of the forest cover on an area much larger than about 10 contiguous acres will reduce the breeding density of these grouse for a number of years.

ACKNOWLEDGMENTS

Many persons have played important roles in the progress of this project. The continued interest and help of Drs. A. C. Hodson and Wm. H. Marshall has kept the project funded. Dr. B. A. Brown and the School of Forestry, University of Minnesota have provided essential physical facilities at the Cloquet Forest Research Center; and various members of the School of Forestry staff have provided valuable assistance. The cooperation and assistance of the staff of the Minnesota Division of Game and Fish has made possible an important auxilliary project on their Mille Lacs Wildlife Area.

R. T. King and W. H. Marshall have made pre-1956 data available. Drs. R. W. Barrett, R. B. Brander, R. L. Eng, and J. J. Kupa, and Messrs. G. A. Godfrey, D. E. Huff, P. Schladweiler, P. V. Vanderschaegen, and W. P. Wenstrom, have all made valuable contributions during their graduate careers; and the assistance of F. J. Svoboda has been essential.

Some 111 forestry students have provided the part-time manpower necessary to inventory the total population of breeding male ruffed grouse on a 14-square mile study area, which includes the 5-square mile Cloquet Forest. Many other student foresters ran the "King census" as part of their undergraduate exposure to wildlife techniques, and thus have maintained a unique continuity of ruffed grouse population data for the Cloquet Research Forest.

In addition to his continued participation and many other contributions to this project, Dr. Wm. H. Marshall's constructive review of this paper is most gratefully acknowledged.

Both the Minnesota Department of Conservation, Division of Game and Fish (Federal Aid to Wildlife Restoration Project W-35-R) and the Minnesota Agricultural Experiment Station (Project 83H) have supported this research. National Science Foundation grants GS-8644, G-17858, and GB-1345 made possible the radio-telemetry work.

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DISCUSSION

DISCUSSION LEADER BOX: Mr. Gullion has covered a number of subjects and given us a great deal about which to think and question. Therefore, let us move directly into the questioning.

While someone is coming to the microphone I would like to ask Mr. Gullion, what sort of burning program he would recommend for increasing a grouse population.

MR. GULLION: We are not making recommendations yet. We are still working on this phase of the research, but it probably should be on fairly small acreages. We believe that any management of the hardwood forest habitat which provides a uniform stand in age class and species structure larger than 10 acres is deleterious to the maximum population of grouse.

We should like to see hardwoods managed on a 40-year cycle, and I think it would be beneficial to the grouse population. And, it has some economic possibilities, too.

FROM THE FLOOR: First, are there differences in the effects of winter weather on the adult bird? Is mortality spread throughout the winter? Or, is it greater in the initial changeover in early fall?

MR. GULLION: Overall winter losses among juvenile birds are about double what they are in the adult birds. That is, we compute our adult population turnover on an annual basis, and it averages about 55 per cent per year. We find the same rate of turnover in the juvenile population between October and the following April. Once the bird has survived the first winter, the survival rate improves considerably.

The timing is something we are a little less certain of from our studies. It appears that if we have a fair degree of mortality late in the Fall and again sometime in the spring, there does not seem to be an even distribution of mortality throughout the winter period.

FROM THE FLOOR: You indicated that the drumming behavior was a costly process. Did you mean costly in terms of the grouse? Did you mean costly in terms of the energy protein required to maintain them at this time of the year?

MR. GULLION: I am sure I was not thinking of the second point of view, but since you bring it up it is interesting. I am sure that arises.

In the drumming season we know the birds lose about 1.5 percent of their weight a day. This could be very costly if they are in a critical nutritional situation anyway. It is most costly in terms of nutrition loss.

FUNCTIONAL ASPECTS OF WIND AS AN ECOLOGICAL AND THERMAL FORCE

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Ecological studies of the effect of wind have often emphasized the function of wind as a mechanical force. Wind aids in the dispersal of insects and seeds, it destroys valuable timber, and it disperses scent. The function of wind as a thermal force is also of ecological significance since it affects the thermal energy balance of an animal, resulting in both physiological and behavioral responses. The effect of wind on the thermal characteristics of the surface of an animal is also an important consideration when evaluating the capabilities of heat-sensitive film for remotely sensing different animal species in natural cover. This paper includes descriptions of the conceptual design underlying the effect of wind on the temperature characteristics on the surface of an animal, and data are presented that show the dynamic fluctuations of these temperatures on the surface of white-tailed deer. The research is financed jointly by the College of Agriculture at Cornell University and the New York State Conservation Department through Pittman-Robertson Project W-124-R. The cooperative research efforts of Sage Action, Inc., a firm which majors in aerodynamic engineering research, are acknowledged.

Knowledge of the characteristics of wind flow about an animal is essential before one can analyze the function of wind as either a mechanical or a thermal force on the animal. The effect of wind on surface temperature characteristics is being analyzed in the Thermal Environment Simulation Tunnel (TEST) at the BioThermal Laboratory, Cornell University, where wind velocities from 0-16 mph can be controlled.

The vertical profile of wind velocity over any surface shows an increase with height as the air closest to the surface is slowed by friction between the surface and the air molecules. This wind profile can be predicted using equation (1) from Sellers (1965):

$$u = (u_*/k) \ln (z/z_0) \tag{1}$$

where u = wind velocity at height z
u_* = friction velocity
k = von Karman constant = 0.4
z = height in centimeters
z_0 = roughness parameter of surface; the height at which velocity is zero

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[2]Assistant Professor in Wildlife Science.

The reduction in wind velocity due to friction will be greater over a rough vegetation-covered surface than over a smooth snow surface. If the wind velocities were the same, say 622 centimeters per second (13.9 miles per hour) at a height of two meters over both types of surfaces, the velocity at a height of 75 centimeters, or around the top of the back of an average deer, would be about 433 centimeters per second (9.7 miles per hour) over grass 60 to 70 centimeters high, and 572 centimeters per second (12.8 miles per hour) over a snow field (Figure 1). The shape of the velocity profile within the vegetation depends on the life-form and density of the vegetation. The profile within the vegetation in Figure 1 is approximated for grass from data for air flow through a corn field (Ordway, 1969). Similiar profiles are shown by Plate and Quraishi (1965) for corn and wheat. It is clear that the deer is not exposed to a single velocity but to a range of velocities that are a function of the physical characteristics of the environment.

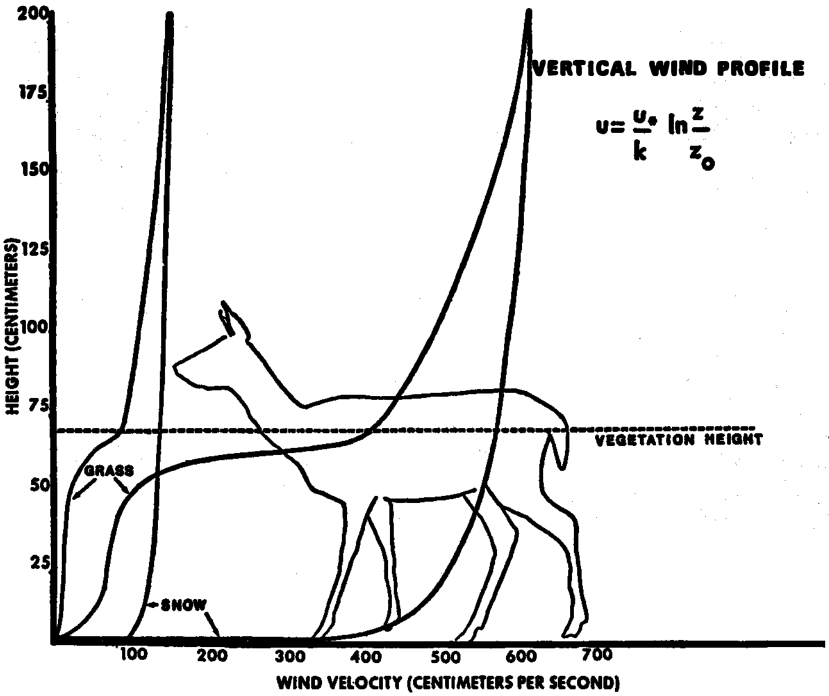

Figure 1.—Predicted vertical profiles of mean wind velocity over 60-70 centimeter grass and over a snow surface. The profiles within the vegetation are based on data on corn (Ordway, 1969).

Vegetation and physical objects interrupt wind flow, causing turbulence or "mixing" of the air. Turbulent flow can be described in terms of scale and intensity. Turbulence scale is a measure of the size of the turbulent wind mass, and turbulence intensity is the magnitude of fluctuations relative to the average or mean wind speed. Trees and shrubs in deer habitat impede wind flow, reducing the mean wind velocity and increasing turbulence. The amount of turbulence created by trees and shrubs in deer habitat depends on the size and the spacing of the trees and shrubs.

An animal presents an obstruction to wind just as a tree does, creating distinct wind patterns that are dependent on its body shape and posture. Analyses of the patterns of wind flow around a model white-tailed deer in a bedded posture indicates that the air flows smoothly around the windward side of the animal (Figure 2).

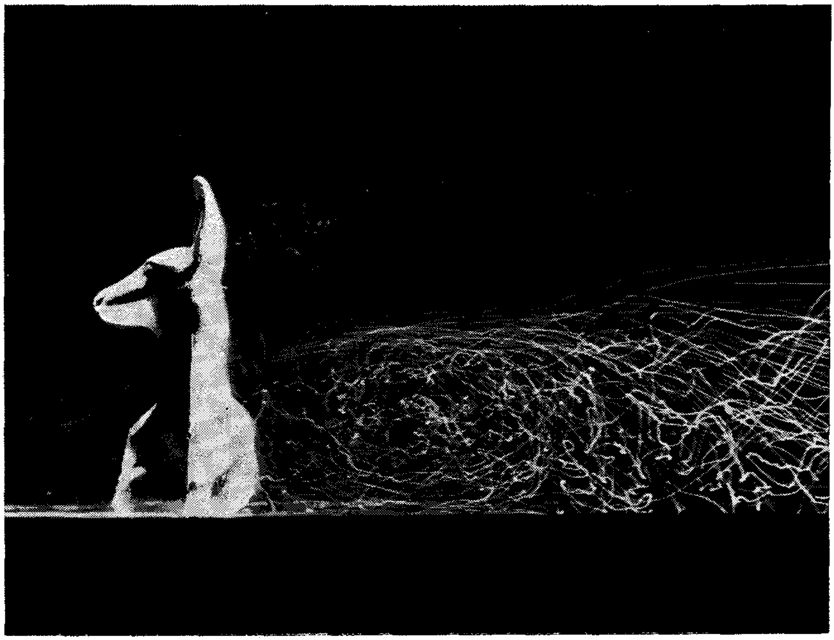

Figure 2.—Patterns of air flow about a model of a deer in a bedded posture in the Thermal Environment Simulation Tunnel. Note the turbulent area that develops on the leeward side of the animal.

Turbulence develops on the lee side of the animal, and the presence of this turbulent area affects the animal's surface temperature because of the rapid fluctuations in wind velocity.

Analysis of the function of wind in thermal energy exchange requires an understanding of the effect of wind on the layer of air close to the hair surface (commonly called a boundary layer) through which a thermal gradient develops between the warm surface of a deer and its environment. Animals with heavy hair coats like the white-tailed deer have a boundary layer with unique thermal gradients. In still air, the boundary layer may extend through the hair layer and several centimeters beyond the hair.

Heat transfer from the skin to the hair surface in still air occurs primarily by free convection, or convection that develops as a result of density differences in air at different temperatures. Conduction occurs because there are temperature gradients along the hair shafts themselves. The air trapped within the hair provides the major insulation since air has a lower conductivity than hair (Hammel, 1955).

A simulator heated to body temperature (38°C) and covered with deer hair is being used in the Thermal Environment Simulation Tunnel to study the dynamic relations between wind and heat flow through deer hair. The temperature profile is measured with an array of 12 copper-constantan thermocouples oriented at right angles to the hair surface at intervals of 0, 0.5, 0.75, 1.0, 1.25, 1.5, 1.75, 2.0, 3.0, 4.0, 11.0, and 18.0 centimeters from the skin surface. The effective surface temperature is measured remotely with a Barnes IT-3 Infrared Thermometer. The results of deer simulator experiments are being used to aid in the interpretation of data from white-tailed deer in outdoor pens where wind flow characteristics cannot be controlled.

As the wind velocity increases, the depth of the thermal boundary layer is reduced. In a wind of 10 or more miles per hour and in an air temperature of 0°C, the temperature gradient is confined to the hair layer, about two centimeters deep (point a, Figure 3). The temperature one centimeter from the skin surface is 18°C in still air (point b, Figure 3) and at a velocity of 14 miles per hour the temperature at one centimeter is reduced to 4.5° C (point c, Figure 3). Thus the *effect* of wind extends into the hair layer, compressing the temperature gradient deeper into the hair. The actual air movement through the hair has not been studied yet.

Radiant heat loss from the surface of an animal is calculated from the surface temperature and the emissivity of the hair surface (Equation 2).

$$Q_r = \epsilon \sigma T^4 \tag{2}$$

where Q_r = radiation in Kcal m^{-2} hr^{-1}
ϵ = emissivity = .98 to 1.00 (Hammel, 1956)
σ = Stefan-Boltzman constant = 49.3×10^{-9}
T = surface temperature on the absolute scale

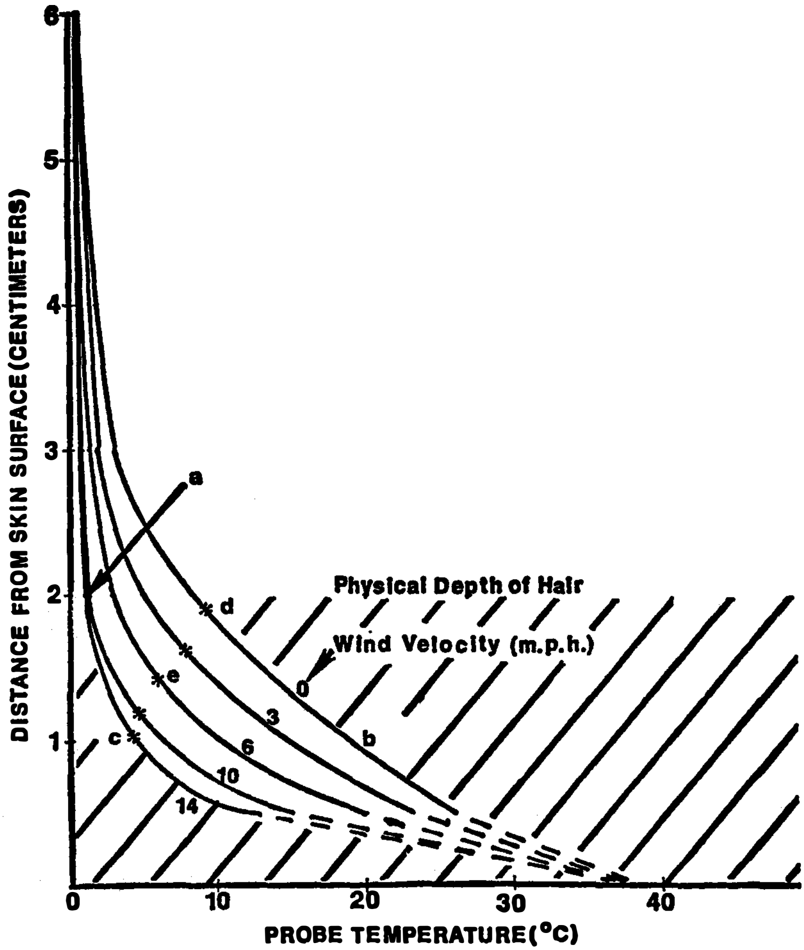

Figure 3.—Temperature gradients in the thermal boundary layer of a deer simulator in an air temperature of 0° C. The hair is oriented with the wind.

The radiant surface temperature of a deer is a function of the insulation provided by the hair, the temperature of the air trapped in the hair, and the emissivity of the hair surface.

The actual surface that is radiating energy is not a single plane in the hair but a spatial integration of the thermal characteristics of the hair layer. Thus the radiant surface is not defined by the physical depth of the hair but by the thermal regime in the hair layer, and it changes whenever there is a change in the wind flow, in the amount of radiation striking the animal, the surface temperature, orientation of the hair, and any other variable thermal parameter.

At an air temperature of 0° C, no wind (free convection), and uniform radiation in the TEST, the radiant temperature of the deer simulator was 9.2° C, and this radiant temperature was equal to the temperature on the thermal gradient at point d (Figure 3). Note that the distance from that point to the skin is almost two centimeters. Under the same TEST conditions except for a wind velocity of 14 miles per hour, the point where the radiant temperature equals the temperature on the thermal gradient (point c) is about one centimeter from the skin surface. Other points where the surface temperature equals the temperature on the thermal gradients for velocities of 3, 6, and 10 miles per hour are also shown (*). Thus the location of the radiant surface varies from one to two centimeters under these conditions in the TEST, which is an indication of the effect of wind on the insulating characteristics of the outer hair surface.

A distinctly non-linear effect of wind on the temperature profile and surface temperature in deer hair has been observed in our experiments; the lower wind velocities have a proportionately greater effect than high velocities. This is in agreement with basic convection theory in thermal engineering; Gates (1962) presents convection coefficients for flat plates that illustrate the non-linear effects of velocity changes on convective heat loss. The non-linearity is evident in Figure 3. At an air temperature of 0° C an increase in wind velocity from 0-6 miles per hour results in a 3.8° C decrease in surface temperature (from point d to point e), but an increase of 8 miles per hour from 6-14 causes an additional decrease in surface temperature of only 1.5° C (from point e to point c).

Wind reduces the radiant temperature of an animal's surface so that it is closer to air temperature. At an air temperature of —20° C and no wind, the surface temperature of the deer simulator was —6.2° C. At the same air temperature but with a wind of 14 miles per hour, the surface temperature was — 13.5°C. Thus, the difference between air temperature and surface temperature in the first case is 13.8° C (point f, Figure 4a), and in the second case 6.5° C (point g, Figure 4a). These differences in the surface temperature: air temperature relationships that can be attributed to wind may be greater than the differences between different species that are living in the same habitat. The feasibility of remotely censusing animals on open range with heat-sensitive film must be questioned seriously in view of the dynamic changes observed in our experiment. Our work on live animals shows that the variability for single individuals is even greater than the variability for the simulator. Further, differences

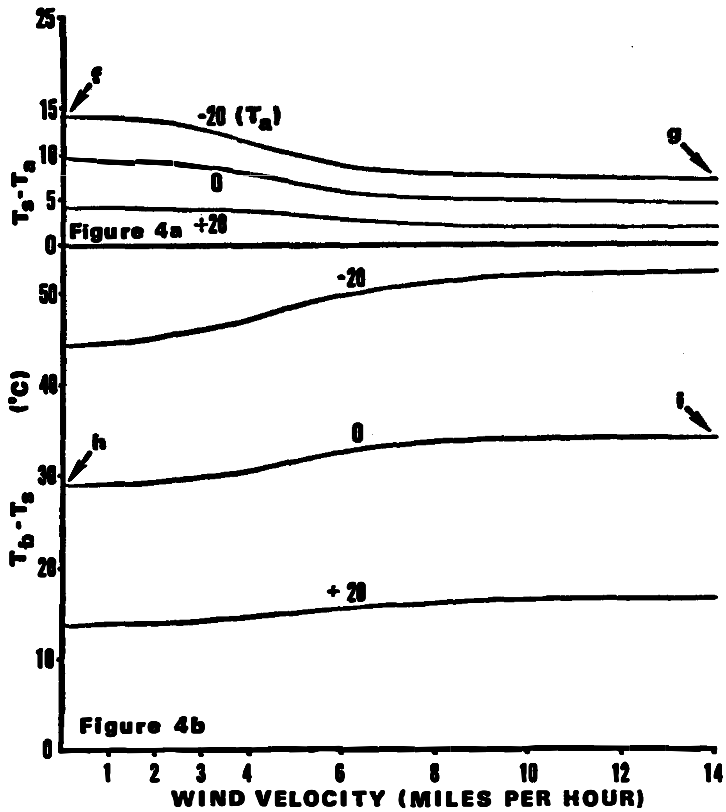

Figure 4.—(a) The effect of wind on the temperature differences between the radiant surface temperature (T_s) of the simulator and air temperature (T_a). (b) The effect of wind on the temperature difference between the body core temperature (T_b) and the radiant surface temperature of the simulator.

between individual deer have been observed, although not tested statistically yet.

Since the homeotherm maintains a fairly constant body core temperature, the decrease in surface temperature due to wind will result in a greater temperature gradient between the core temperature and surface temperature, and this may have a significant effect on the energy requirements of the animal. The difference between body temperature and the surface temperature at 0° C air temperature is 29.2° C under free convection (point h, Figure 4b) and 34° C in a 14 miles per hour wind (point i, Figure 4b). There will be a greater heat transfer by conduction from the body core to the animal's radiant surface under windy conditions because of this increased temperature gradient.

The same basic relationships for the effect of wind on surface temperature and temperature profiles on the thermal surface of an animal are observed for hair oriented with the wind and against the wind. When the wind blows against the lie of the hair, however, the temperature profile is elevated and spread out more through the fur. Thus the temperature is slightly higher at any given depth when the wind is against the hair than when the wind is with the hair. The surface temperature is also 1 or 2° C higher when the wind is blowing against the hair. This will result in a greater heat loss by radiation; its effect on convection is being studied at the BioThermal Laboratory.

Convective heat loss is dependent on the surface temperature of the animal and a convection coefficient that is dependent on the thermal characteristics of both the fluid (air) and the convector (the animal), on the shape of the convector, and the fluid velocity. The convective component of heat transfer from an animal is increased as the wind velocity increases. Radiant heat transfer is reduced because of the decrease in surface temperature, but the net effect of wind is to increase the total heat loss from an animal (Clayton, 1962).

Wind velocity and air temperature are just two of the parameters that function in determining the energy balance of a homeotherm. Physiological and behavioral factors such as blood flow, muscle metabolism, body size, posture, and feeding level function together with the physical environment factors to determine an animal's thermal energy balance (Moen, 1968). An animal cannot control the physical processes of heat transfer but it can alter its thermal balance by physiological and behavioral responses. Heat production can be increased by shivering and gross body activity, and heat loss can be decreased by reducing blood flow to extremities. Postural changes are another effective behavioral response to thermal conditions; an animal can reduce heat loss by minimizing surface area when it beds in a closed posture. The use of shelter is effective for reducing thermal losses, especially from wind effects.

SUMMARY

Heat transfer on the thermal surface of an animal is a dynamic process affected by wind which penetrates the hair, disturbs the insulating hair layer and alters the surface temperature and temperature profile. Changes in the orientation of the hair and other biological responses contribute to variation in the thermal parameters. Wind flow patterns are extremely variable, being influenced by vegetation,

topography and the animal surface itself. Care must be taken to properly identify the wind flow characteristics and their effect on the thermal surface of the animal before attempting to use remote sensing to detect different animal species by their surface thermal characteristics.

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DISCUSSION

DISCUSSION LEADER BOX: Mrs. Stevens has raised a number of questions that probably should have been raised in the other sessions, particularly the one on remote sensing. Are there any questions that you have for her?

FROM THE FLOOR: When you say "heat sensitive film," at what general altitudes are you proposing? Are you thinking of the sort of devices that have been obvious for a long time, where we would never be able to distinguish the species? I wonder if you could clarify that?

MRS. STEVENS: I am referring to the heat sensitive film being used now for remotely sensing animals at heights of approximately a thousand feet; and it is clear from our work that this cannot be done and distinguish the different species.

I believe some more work should be done on the characteristics of the species and the effects of environmental factors so that a great deal of time is not wasted in scanning situations where the data will not be of value.

FROM THE FLOOR: Thank you for the clarification. Our device is a scanning system, and we are measuring the temperature of an area of three square feet on the side. This is for instantaneous spot, and it is just, from a purely theoretical point of view, impossible to distinguish species.

Also, an area that had bison, antelope, and some deer would vary tremendously between the species depending on specific designation.

DISCUSSION LEADER BOX: Have you worked with species other than deer?

MRS. STEVENS: No. White-tailed deer are the only species we worked with at this time.

As the gentleman indicated, however, Marble has worked with other species and found similar surface temperature characteristics.

FROM THE FLOOR: Has any work been done on birds?

MRS. STEVENS: No work on birds has been done at our laboratory.

FROM THE FLOOR: Do you know of anyone else who has done it?

MR. STEVENS: No, I do not.

WINTER FLUCTUATIONS IN SIZE OF HOME RANGE OF THE RED SQUIRREL (Tamiasciurus hudsonicus)

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An intensive study of a local population of red squirrels, *Tamiasciurus hudsonicus preblei* (Howell), was conducted over the winter 1968-1969 at Heart Lake, N.W.T., Canada (60°50'N, 116°35'W). The purpose was to investigate home range, territory and movements as they related to weather in a harsh climate. Other studies of red squirrels have been conducted in more southern areas, such as central New York (Layne, 1954), and southern British Columbia (Smith, 1968; Millar, 1968), or have been concerned with other aspects of squirrel ecology (Brink and Dean, 1966; Smith, 1967). This study was supported by a contract with the Canadian Wildlife Service, a grant (A1410) from the National Research Council of Canada and by the University of Alberta.

METHODS

A study plot was set out in the summer of 1968 near the University of Alberta's Boreal Field Station at Heart Lake. This plot encompassed 31.25 acres of mixed jackpine (*Pinus banksiana*)-white spruce (*Picea glauca*) association in a rectangle 100 rods by 50 rods, with the long axis lying due north-south magnetic. Four landscape types were recognized: 5.10 acres open dry, 11.50 acres semi-open dry, 7.07 acres semi-open wet, and 7.58 acres dense wet (Figure 1).

The study plot was a grid with six rows A to F and lines 1 to 11, each spaced 10 rods apart (Figure 1). A National live-trap with bait, terylene bedding and a polyethylene cover was placed in a protected spot near each intersection. Alternate rows were trapped daily to minimize interference with natural squirrel movements. Traps were set only during daylight hours to prevent overnight exposure of squirrels caught in late evening and excessive interference by nocturnal small mammals. Traps were checked once, or twice with longer day length, between setting at dawn and closing at dusk.

Animals were marked by toe-clipping on first capture. Front digits were used as numbers 1 to 8 and hind digits 10 to 100. No unit 9 was possible with this method. Marked squirrels could be recognized by their tracks under certain snow conditions. Recaptured animals were identified and immediately released to minimize chances of trap shock.

Squirrel home ranges were mapped from monthly recapture data using a modified boundary strip method. Rather than adding the

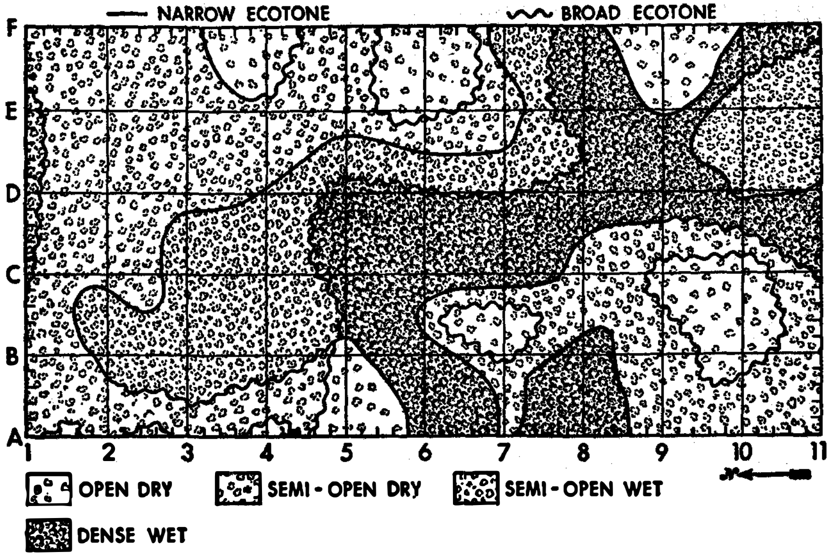

Figure 1.—Study plot—landscape types.

usual strip of one-half the distance between traps to the minimum area, an attempt was made to more closely approach reality by increasing the depth of the strip from a boundary trap with each additional recapture at that trap. The distance between grid intersections was divided into five 2-rod intervals. In plotting the trap-revealed range of a squirrel, a minimum area was first enclosed by joining the outlying points of capture with straight lines on a map. Then, a strip was added by multiplying the number of recaptures at each boundary trap by two rods to obtain the depth of the strip at that trap. Animals captured more than four times at such a position were assumed to have reached the next trap at least once in the month. Their range was therefore extended to the next trap position but not beyond. Single captures well outside of normal ranges were treated as sporadic movements and mapped as narrow lines extending from the home range boundary to the point of capture. This was done subjectively, depending largely on distance between the capture and areas where the squirrel was normally recorded, and proximity of the point of capture to the centers of activity of other squirrels.

Maximum and minimum temperatures were recorded daily from September 1968 to September 1969. Ten-day "means" of these values were calculated to show gross changes in temperature range during the study period (Figure 2).

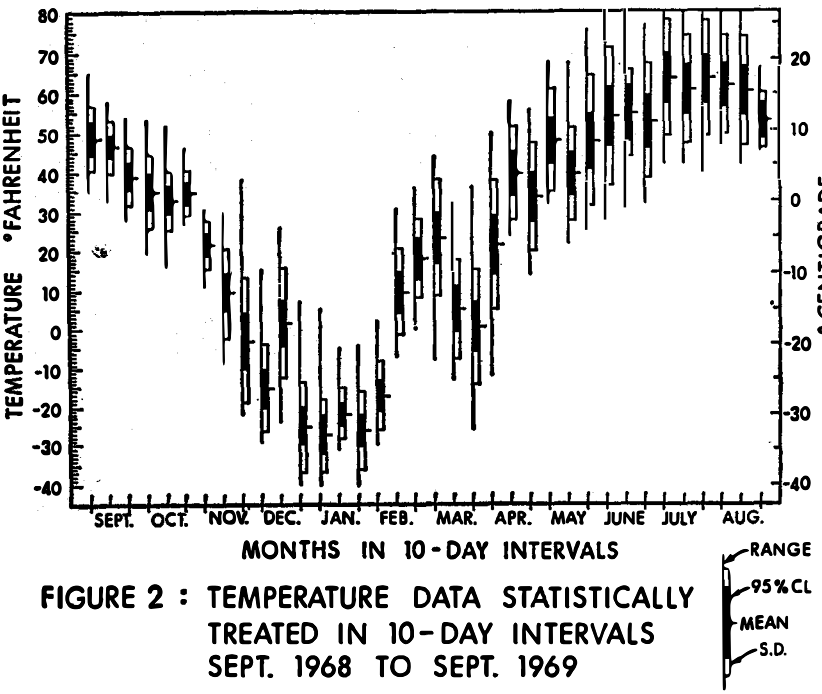

Figure 2.—Temperature data statistically treated in 10-day intervals Sept. 1968 to Sept. 1969.

RESULTS

Temperature, Snow and Trapping Success

Temperatures averaged below freezing from November to early April, below 0°F from late November to early February, and below —20°F from late December through January (Figure 2). The temperature decline in fall was quite regular, but the spring warming period was not. Temperatures approached melting in late February and early March, but for the remainder of March the mean was near 0°F. There was a very sharp rise in temperatures in early April, when daytime temperatures usually ranged to 40° and at night dropped below freezing. From mid-April through May temperatures usually stayed well above freezing.

The first permanent snowfall occurred on October 28, 1968 and by March had built up to approximately 20 inches in the open dry landscape type, 16 inches in the semi-open dry, 14 inches in the semi-open wet and 10 inches in the dense wet type. Snow in the more dense landscapes tended to be lighter and less deep because of qali (Pruitt, 1958) than the heavy crusted snows of open areas. This was reflected in the way the snows disappeared in spring, with bare ground first appearing in the dense landscape types in April but unbroken snow cover persisting through early May in open regions. During the rapid spring melt in 1969 much of the forest floor of semi-open and dense wet landscapes became flooded with near-freezing water through April and most of May.

TABLE 1. SUMMARY OF TRAPPING RESULTS

Month	No. of Squirrels Recorded	Est. Mean Range Area (acres)	Per Cent Landscape Type Occupied O D	S-O D	S-O W	D W	Total	No. of Occupied Middens	No. of Captures per Hour $\times 10^3$ (10-day means)
1968									
October	14	2.9	62	54	60	78	63	6	183[1], 701, 641
November	13	0.6	0	13	25	41	18	5	420, 231, 167
December	7	0.4	0	2	9	12	5	6	100, 250, 133
1969									
January	3	0.2	0	0	3	5	2	3	0[2], 21, 33
February	10	1.6	1	19	37	33	24	5	31, 191, 157
March	12	3.1	23	35	46	66	42	3	531, 338, 346
April	16	3.9	21	65	46	56	47	5	529, 270, 246
May	20	3.9	33	67	50	60	52	7	315, 418, 344

[1] Beginning of program, squirrels unaccustomed to traps.
[2] Only 4 days trapped.

Trap-success declined with the advent of freezing temperatures in early winter, then remained approximately constant until temperatures averaged about —20°F, below which there were almost no squirrels captured (Table 1). In late winter, captures per trap-hour increased as temperatures rose above —20°F, then above 0°F, but decreased again during the cold spell in March. However, trap success failed to respond as expected to the sudden warming in April. A preliminary increase with rising temperatures early in the month was followed by a great decrease in captures per hour as temperatures rose substantially above freezing. The level began to climb again slowly through May.

Trapping Success and Home Ranges

Through the period October 1968 to May 1969, 30 different squirrels were marked and released on the study plot. Few were present over the entire eight months and all displayed changes in areas of home range, sometimes moving entirely off the study area for periods of time. A month by month account of these changes follows. Major features are illustrated in Figures 3 to 6 and in Table 1.

The number of squirrels using the plot varied over the months of study (Table 1). A seasonal fluctuation from 14 in fall to 3 in mid-winter and to a high of 20 in spring suggests that carrying

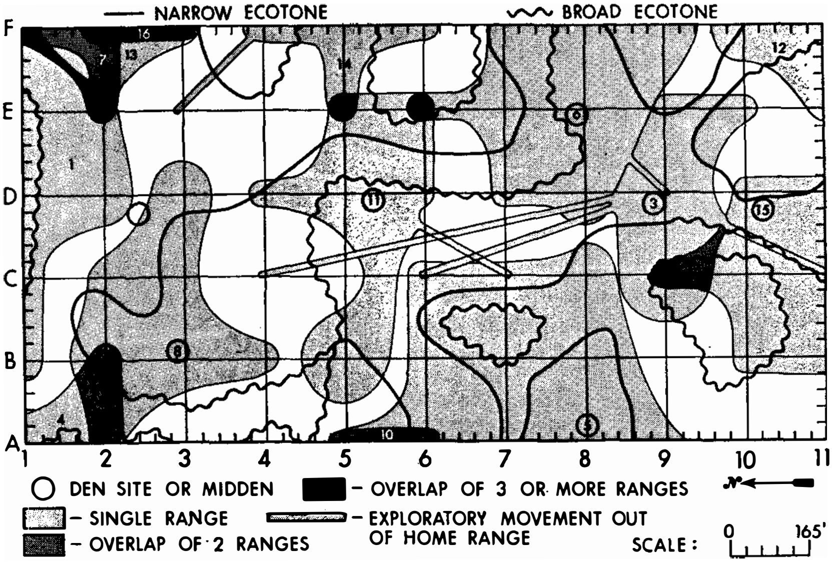

Figure 3.—Movements and home ranges—October.

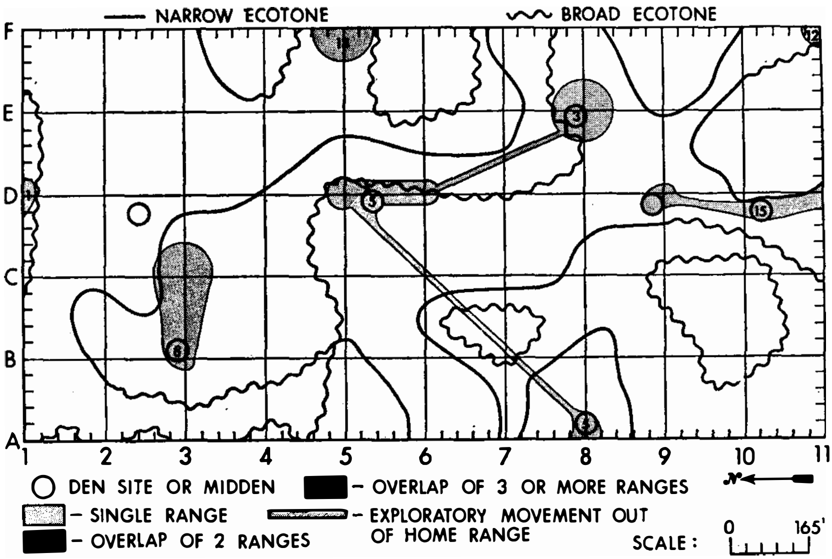

Figure 4.—Movements and home ranges—December.

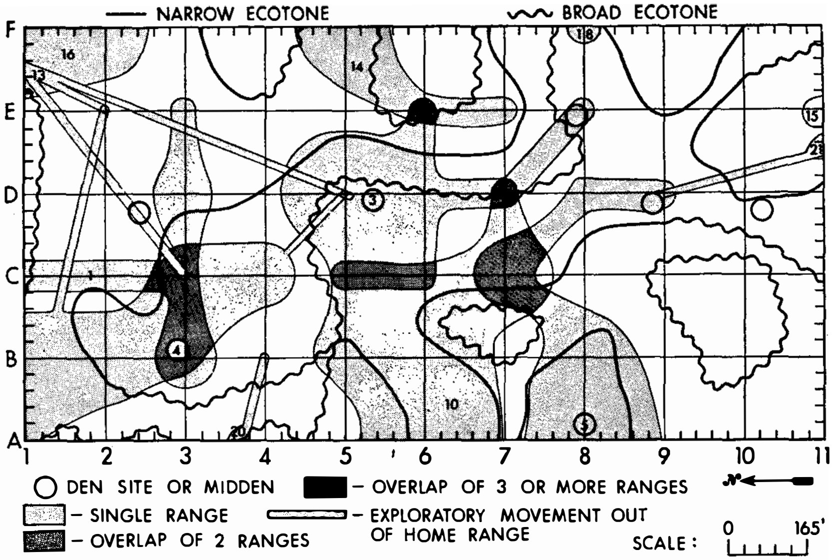

Figure 5.—Movements and home ranges—March.

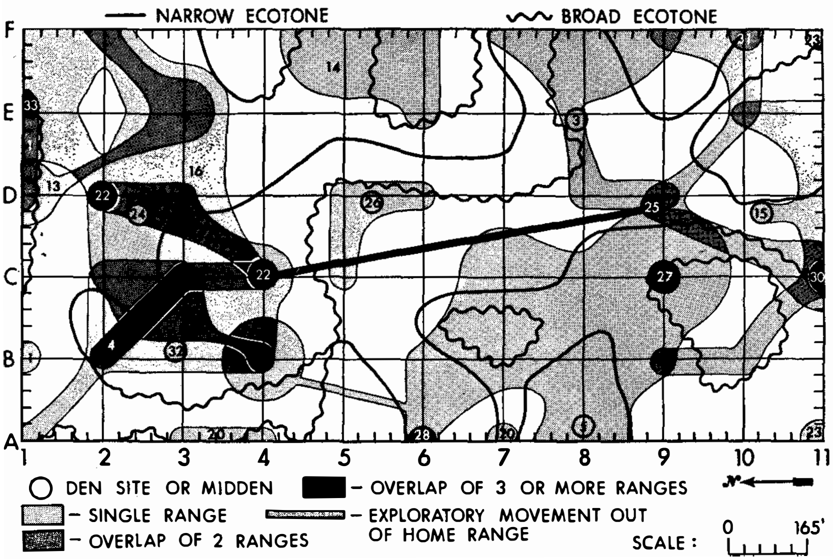

Figure 6.—Movements and home ranges—May.

capacity may be a far more complex principle than has previously been imagined, at least in areas of harsh climate.

Home-range size declined sharply from October to November with the onset of sub-freezing temperatures, reflecting the decline in trapping success previously mentioned. The end of the period of restricted movements in mid-winter was marked by an equally sharp increase from February to March. The continued increase in size in April and May, to values exceeding those in October, could be attributed to increased activity associated with mating, and possibly also to greater movement necessary in foraging over inundated ground, larger foraging areas available with a lower spring resident population, and an increasing number of daylight hours.

The percentage of each landscape type occupied over different months likely reflects habitat preferences. Open dry areas are essentially deserted over the period of extreme cold (Table 1), probably because they offer little food, shelter or soil for burrowing even at the warmest times of year, and the icy windblown snows likely present a greater barrier to tunneling than the lighter snows of other areas. We cannot explain why about twice as much of this habitat was occupied in fall as in spring. Of the three remaining landscape types, the more dense and wet areas seemed to be preferred from fall until the onset of thawing temperatures in spring. We suggest that the change to greater use of the semi-open dry habitat at this time was due to greater accumulation of water from snow melt in the other two landscape types.

The distribution of midden sites also reflects a generally greater attraction to the dense wet landscape type, with five of the seven middens in that region and one each in the semi-open wet and semi-open dry areas. This attraction is apparently to areas of deeper soil, more favorable for burrowing, as well as to areas where dense vegetation gives maximum protection from wind to permit accumulation of low density, highly insulative snow. Occupation of these middens seemed rather variable, but it can be noted that the one between traps D-2 and 3, in the semi-open dry region, was not occupied until the spring melt when the wetter areas presumably became unfavourable.

The proportion of the plot that was used each month also declined in mid-winter and increased again in spring (Table 1). At maximum contraction only about two percent of the plot was used. This is a 30-fold decrease from the amount used in October and is of the same order of magnitude as the winter range contraction of large ungulates. Squirrels used less of the plot in May than in the previous autumn, although there were then more squirrels on the plot and home ranges of residents were larger (Table 1). This apparent inconsistency is easily explained. Of the 20 squirrels recorded on the plot in May eight were clearly transients, so that the number of May residents was less than the number of October residents. Furthermore, part of the plot was covered by melt water and hence essentially uninhabitable.

Movements

In October there was little sporadic movement away from centers of activity and out of home ranges except in the case of No. 3 (Figure 3). Its home range was apparently limited to 1.5 acres, much smaller than expected, by the proximity of centers of activity of Nos. 6 and 15.

In November considerable reduction of movement resulted in the disappearance of Nos. 4 and 10 from the periphery of the plot. Also, following the death of No. 11 in a trap on November 7, No. 3 immediately moved from its October center of activity to occupy the newly vacant midden. Further changes in November included the movement of No. 15 during the first week to a new midden just south of the plot boundary; the disappearance of No. 7 from its midden 400 feet east of the plot around mid-month and its replacement by No. 16, a squirrel which had previously lived in a rock crevice between Nos. 7 and 13; and the disappearance of No. 6 late in the last week. Several sporadic movements occurred and were apparently directed toward areas originally occupied by Nos. 7 and 11. The single capture of a new squirrel, No. 17, was likely also the result of a sporadic movement from a center of activity east of the plot.

In December there was still shifting in the position of mapped ranges (Figure 4). Between December 12 and 14, No. 3 was apparently chased from, and replaced on, the midden near D-1 by No. 5. Number 3 moved to the newly vacant midden at trap D-8. Number 15 was captured only twice, on December 4 and 16, near the midden occupied in October. Its tracks were not recorded during the rest of the month. Sporadic movements were not observed.

In January there was almost no activity above the snow, with Nos. 3, 5 and 8 each captured only once. Evidence from track and snow tunnel surveys suggested that squirrel acivity was mainly in the subnivean environment, and almost entirely restricted to the immediate area of the midden and nearby cone stockpiles. Careful surveys along the lines of the grid, which now consisted of packed snowshoe trails, failed to disclose signs of any other squirrels. There was no movement onto the plot by those on nearby middens and apparently no sporadic movement or attempted shifts in centers of activity, even though four of the seven middens were vacant.

In February there was a marked increase in activity and many squirrels living near the plot (Nos. 1, 4, 10, 12, 14, 15 and 16) reappeared in the trap record. Three squirrels had changed centers of activity. Number 4 moved to a temporary den in a rock crevice near trap C-2 early in the month, No. 5 moved back to the midden at A-8 around February 19, and No. 15 moved back and forth several times between middens near D-9, D-10 and off the plot some 200 feet south of D-11. According to track records, No. 15 spent most time at the third site. There was some sporadic movement, most of it apparently related to the relocation of No. 5 and subsequent investigation of the vacant midden near D-5 by No. 3. Finally, in the last few days of February, No. 8 disappeared from the plot and No. 4 immediately moved onto its midden.

In March, further increase in activity was apparent from the greater number of sporadic movements recorded (Figure 5). Some shifts in range were noted: Number 3 moved back to the midden near D-5 on March 8, No. 15 was apparently active south of the plot all month except for one capture at D-8, and No. 16 moved north onto the range of No. 13. Three new squirrels, Nos. 18, 20 and 21 were recorded during March, probably as a result of sporadic movement from some distance away. Numbers 18 and 21, both males, were captured only once each during the study period, but No. 20, a female, had apparently moved onto a vacant midden 600 feet west of trap A-4 and was recaptured regularly in the following months.

In April further increase in activity was noted. More changes occurred in the range structure of the plot: Number 3 moved back to the midden at E-8 again on April 4 and remained there for the rest of the study period; Nos. 10 and 12 disappeared suddenly from the trap records about mid-month; No. 13 moved to a rock-crevice den farther west, away from No. 16 whose range expanded tremendously and overlapped some of the home range of No. 4. Number 1 appeared to have moved its range slightly north, but still occupied much of the same area as No. 4. Four new males (Nos. 22 to 25) appeared on the plot in April, all except No. 22 in the final two weeks. Number 23 was captured twice, and the others only once in that month. Number 24 was taken in trap D-5, but apparently moved to the midden between D-2 and 3 around the end of the month. Number 25 was captured around the vacant midden at D-9 on the area defended by No. 15, the latter having moved back to the midden at D-10. An unmarked male took up residence at trap D-5 on or just before April 27. This animal (No. 26) was extremely trap-shy and was not captured until May. Number 17 was taken once, its first record since November. Number 20, a female first recorded in March, was recaptured three times.

These records appeared to be due to a great increase in sporadic movement, particularly in the last half of the month and coinciding with the onset of the breeding season for squirrels in the study area.

May was the month of pregnancy, with activity on the plot similar to that in April but without such a high incidence of sporadic movement (Figure 6). Capture of seven new squirrels (Nos. 26-33) brought the total to 20 in the May record, with eight of these not reappearing after that month and therefore considered transients. Numbers 22 and 23, males taken first in April, were captured twice in early May and were not taken again. Number 25 was unsuccessful in maintaining occupancy of the midden near trap D-9, apparently having been chased by No. 15 north into the areas of Nos. 24 and 32. It then disappeared from the plot. Number 26 was captured only three times, but was sighted almost every day over the midden near D-5, and males No. 27, 28 and 31 were captured only once, in the first week of May. Number 31 later apparently took up residence 60 feet south-east of trap F-11 to fill the vacancy left by the disappearance of No. 12. Numbers 30, 32 and 33 were females. Number 32 moved permanently onto the plot near B-3, replacing No. 4 which disappeared around May 10. The other two females likely had moved nearer the plot over the winter, as they were present frequently in summer trap records after their first capture in May. Extreme overlap of ranges observed on the north end of the plot was eased with the disappearance, apparently through emigration, of No. 4 on May 10, No. 1 around mid-month, and No. 13 at month's end. However, the ranges of male No. 24 and females No. 16 and 32 continued to overlap, largely because of the extreme expansion of the range of No. 16. It is perhaps significant that these two females were the only ones on the plot that failed to produce young.

DISCUSSION

The correlation between changes in temperature and changes in trap success from October to March suggests that temperature exerts a major controlling influence on squirrel activity during winter. Changes in activity in turn govern changes in home-range size as revealed by trapping. Major changes in size of home ranges of squirrels have not previously been described. Layne (1954) concluded that adverse weather conditions and lowered temperatures had no long-term effect on red squirrel activity in New York, although activity was usually reduced for a few days at the onset of bad weather. In the north, squirrels reacted similarly in early winter when temperatures were seldom far below freezing, but it appears that severe mid-winter temperatures elicited a different type of response, namely retreat to the warmer subnivean environment. Pruitt and Lucier (1958) recorded a similar relationship between red squirrel activity and temperature in Alaska. The importance of snow as an environmental factor has been discussed by Formozov (1946), Pruitt (1957, 1958, 1960, 1966), and Fuller (1967, 1969).

The fall decrease and March increase in activity and home range size appear directly related to temperature. The sudden nature of these changes may be related to the spring and fall thermal overturns of Pruitt (1957). However, the correlation between temperature and activity breaks down in late April and early May when the snow cover is melting. We have attributed the decreased trap success at that time to a combination of the very wet or inundated ground and the occurrence of "spring snow" which is crusted at night but soft and wet by day. Squirrels, like other small mammals may thus be subjected to a spring critical period (Fuller, 1969).

Frequent shifting of squirrel home ranges was noted by Layne (1954) and considered to be a response to better food supplies. However, we consider that a number of factors may be involved in the changes in center of activity and areas of home range observed in this study. Moves commonly occurred after death of a resident squirrel created a vacancy. Vacancies were immediately filled when (1) the number of squirrels and amount of overlap of home ranges was large (the first move of No. 3, and April-May moves in the densely populated north end of the plot); and (2) the quality of the available areas was high in terms of food and shelter (the moves of Nos. 5, 15 and probably some of the new squirrels to take up residence on the plot in April and May). In other cases, shifts occurred well after a vacancy was formed (the moves of No. 3 from No. 5) or without a preexisting vacancy (the moves of No. 13 from No. 16 and No. 25 from No. 15). Numbers 5, 15 and 16 were apparently the most aggressive squirrels on the plot and in its vicinity. Number 16 increased its share of the plot several fold from February to May. Number 5 tried to defend two middens in early winter and No. 15 defended two middens on the plot plus one to the south of it for some time. Presumably these animals were benefiting from an increased food supply and availability of shelter at more than one location.

When a change in center of activity occurs, or a second midden is incorporated into a squirrel's range just prior to maximum midwinter restriction of activity, the new owner presumably uses food stores made by the previous occupant. If so the new occupant must be able to find such food even though it was stored by another squirrel and is buried under snow. The problem facing the new occupant is analagous to that facing small birds such as tits (*Parus* spp.).

Haftorn (1956) showed that tits store in characteristic places and in winter they search similar locations rather than depending on their "memory" of the precise location of their own caches. Haftorn referred to this method of food storing and retrieval as a "communal" system. It would follow that only those middens with food stores from a previous occupant receive attention from potential movers at this time of year. This could explain the lack of interest in the winter vacancy between D-2 and 3.

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DISCUSSION

MODERATOR BOX: Thank you. We have considerable time and I would like to ask Dr. Zirul to expand on his last comments by indicating whether there is some communal support due to the shifting activities?

DR. ZIRUL: Yes. I have done work, as I mentioned, on the hypothesis and the statements involved with the use of a "communal food store," during periods of harsh weather in Norway.

This involves the storage of food in specific habitats, on the underside of branches, in the notches of trees. Food stored in such a manner is therefore equally available to any small bird or creature of the same habitat, that is attracted to the same area.

In th case of the red squirrels, I suspect that the same mechanism operates, in that squirrels, rather than storing food in the known cache locations, and thereby being attracted to that specific location, when food is needed store food in general types of sites. They are innately attracted to general types of sites, and therefore, if a squirrel is lost or moves out of an area, or is chased out, those food stores are equally available to any other squirrel which may take over, or subsequently move into the area by similarly being attracted to those particular types of habitat.

If a squirrel is lost from the system, the food which is stored in an extremely harsh environment may be very important to squirrels living in that environment, and particularly so if the food is lost. A transient squirrel or one in a poorer area that moves in just prior to the maximum winter restriction of activity is able to utilize these food stores. Therefore another squirrel would not be able to utilize the environment.

FROM THE FLOOR: I would like to ask how the squirrels were housed?

DR. ZIRUL: Yes. I did stay with the term "home range" during the presentation of this particular paper, although all home ranges appeared as cells, and there may be a character by definition.

During much of the year, however, where home ranges are diminished, and away from the mountains or the home ranges of other squirrels, the fence is not really necessary and it is not used.

There are, however, again still displays that I have interpreted as being behavioral, and there are still calls being made, although they are very much fewer during periods of home range restriction.

During the breeding season, and during the summer months, the home range and territories are settlements, if you will allow that use of the term, and there are overlaps. These overlaps are overlaps as shown by a month of trapping, and therefore they may not be real territorial overlaps. They probably are not instantaneous overlaps in that two squirrels would find themselves in the same area, on the same date, at the same site.

Territorial behavior such as this involves the standard calling, chasing around trees and through treetops, and amorous chasing, as well as other types of behavior.

FROM THE FLOOR: Did you see any evidence of signposts, or anything of that nature?

DR. ZIRUL: I would not want to say that I saw signpost behavior. But my studies with the anal gland of the red squirrel yielded a marked increase in the development, activity, and output of the gland during the breeding and early post-breeding periods which may suggest a variation in signpost behavior.

I took an alcohol extract of the gland and used it in one particular spot and noted a very obvious activity response of red squirrels which came to the artificial feeding station when there was a deposit of this anal-gland material there. The squirrels went immediately into a very obvious territorial behavior—calling, chasing around, looking for another squirrel in the area—although this may have been not the particular anal gland extract I used, but rather the contributions of 40 or 50 years of squirrel use.

THE PUBLIC LAND LAW REVIEW COMMISSION—A PANEL

REMARKS OF THE MODERATOR

THADIS W. BOX

There is much being said today about the quality of the environment. Sometimes I wonder what we really mean when we talk about our environment.

Some people say that the current ecology movement is the greatest single event affecting the way man perceives himself since the Copernican Revolution; others say it is simply a passing fancy. In either case, I think that we have a real responsibility as practicing ecologists of long standing to do something about controlling our environment.

It is particularly important in assessing the Public Land Law Review Commission today that we take a long, hard look at about one-third of this total land surface of the United States that is part of our environment.

Approximately 96 per cent of the public lands in this country are in the western states, including Alaska. This makes up approximately a third of the whole country.

America has always been blessed with having a lot of land. In the early days we were more concerned with getting rid of it, or getting it into private ownership, than we were about managing it. What was left was that part of the country that was either too wet, too cold, too dry, or too high for intensive agriculture.

This remainder of the country has been managed by a number of different agencies, and under a number of different laws, which these gentlemen will discuss this afternoon.

The Public Land Law Review Commission was established to study the productivity of the land; the ways to dispose of it; and to review its value for public use.

Even though most of that land is west of the Mississippi in 11 western states, what this Commission reports, and what happens to the public land, will touch every section of this country, whether that section be in the East and concerned with the huge urban areas, or whether it be in the West, where the citizen is more directly associated with the public land. Each American has a stake in these lands, and these lands have a stake in his environment.

So, rather than use any more of the time these gentlemen have available this afternoon, I will ask them to proceed without introduction to their presentation and comment on the public lands and then we will open the panel for general discussion and questions.

THE PUBLIC LAND LAW REVIEW COMMISSION—AN EASTERNER'S VIEW

PHILIP HOFF
Burlington, Vermont

I confess that I approached my work on the Public Land Law Review Commission with a preconceived point of view which can be summarized as follows:

Public lands of the United States belong to all of the people of this country and that not even so little as one acre shall be disposed of except over my dead body.

Well, I've moderated some.

I still feel that the federal public lands belong to all of the people of this country, but a rigid, inflexible attitude of complete non-disposal doesn't make sense nor does it take into account the very real needs and problems of the western public-land states and communities. So I've come around to recognize that there must be some disposal—limited to be sure, and very carefully planned and thought through—but nevertheless, some limited disposal.

As an easterner, I think the first thing I learned was really how little I knew about public lands and the problems associated with them in the western states.

I'm no expert now, but I've learned a lot and as I look back, I am staggered by the enormity and complexity of the problems connected with public lands. Take water, for example. I understand now why it is so vital and why the laws dealing with it are so complex, and why people feel so strongly about it.

It is literally liquid gold!

From my five years on the Commission I have developed some convictions about our public lands which I would like to share with you today.

Because of the time limitations, these will necessarily be broad, and incomplete, but I hope that they will be specific enough to whet your interest and concern.

May I state the obvious first:

The present laws and policies dealing with our public lands are an uncoordinated and almost unbelievable hodge-podge accumulation from the past without a single discernible policy thread holding them together.

In this sense I believe that the persistency and tenacity of Congressman Wayne Aspinall in bringing the PLLRC together is to be highly commended. The Commission has a golden opportunity to make recommendations leading to an overall policy consistent with existing and future needs and demands of this country.

Lest I forget, may I at this point, interpose a word of defense on behalf of the bureaucracy which has administered our public lands and which has come in for more than its share of criticism, including criticism from members of the Commission and members of Congress.

It has been alleged that the various administrative agencies have gone beyond and at times even have prevented the intent of Congress.

My own observations would indicate that while greatly exaggerated, there is some truth to these allegations. And I would rejoin—thank God!

The truth of the matter is that they have been confronted with a series of outmoded, contradictory and confusing laws and policies.

In my judgment, they have had a much better grasp of the problems and potential of our public lands than have most of the members of Congress. In the face of all of this they have dared to act, not always wisely, to be sure, but on balance they have been one of the single biggest factors in the preservation and conservation of our public lands and I feel we are indebted to them.

I do not recommend the continuance of this situation because it does lead to confusion and uncertainty.

But the fact that it exists serves to point out our greatest need in dealing with our public lands, *i.e.,* a clear, balanced, and coordinated series of broad laws and policies that are subjected to constant and continuing review in such a manner that they can be adjusted and reviewed as circumstances change and as our knowledge increases.

In the establishment of these laws and policies, I believe that the overriding concern should be the overall welfare of the nation as a whole with particular emphasis on ecology, preservation, environment and control. In saying this, I do not mean that the legitimate needs and aspirations of the people of the western states or of their political institutions should be ignored.

The clue here, I think, is balance and accomodation with the national welfare having priority.

It does mean a frontal attack on outmoded concepts of the past such as wholesale disposal, homesteading, and the concept that we are so rich in natural resources that we can afford to despoil and rape our land, air and water of our material well being. Above all, it involves a recognition that man and nature can and must live in harmony.

Implied in what I have said previously is the concept that our public lands must be dealt with as a whole. This in turn leads to the rather obvious conviction that all activities dealing with public lands should be consolidated into one agency. Time does not permit a detailed presentation of this subject and I am very much aware that the details of consolidation are fraught with peril. However, from the viewpoint of intelligent planning alone, it is absolutely imperative. It is equally important in terms of people who are required to deal with our public land agencies. All too often they don't know where to turn.

All too often they are confronted with more than one agency with contradictory rules, regulations and policies. The present situation is absurd and, in the end, self-defeating.

PLANNING

I have pushed very hard on this subject within the Commission and, hopefully, with some success. I detect an air of skepticism on the part of at least some members of the Commission who too often have seen rigid pie-in-the-sky plans which are so far out that they serve no useful purpose whatsoever and are ultimately discarded. I believe this situation is changing. Planning is just beginning to come of age in this country. Planners are now increasingly recognizing that the whole process is inextricably tied into the political realities of our time, and that it must reflect realizable goals and alternatives. People, including politicians, are beginning to recognize that planning is an invaluable tool in the decision-making process.

It is very evident that interagency planning at the federal level alone has been virtually non-existent, or, at best, half-hearted. At the local or regional level it clearly does not exist.

Hearings held throughout the country have demonstrated time and time again the frustration of people and state and local governmental agencies in dealing with our various federal public land agencies. It is a part of the overall frustration of the people of this country in not being able to participate and have a voice in the decision-making processes that affect their everyday lives. I feel that proper planning with proper representation can help to alleviate this frustration and, equally important, can lead to policies and decisions that better reflect the various needs and aspirations of all of the diverse elements that make up our society.

I am not going to attempt to describe with particularity how this planning process should be established. I suspect that it could be handled in several equally satisfactory ways.

Certain elements cannot be disregarded, however. The first is adequate funding and full-time professional staffs.

The second is maximum participation on the part of all persons, governmental agencies and private groups who will be affected.

The third is continuous and elastic planning which has the capacity to change as circumstances and people change.

I might add that we are faced with the frightening prospect of accommodating an additional 100 million people in this country within the next 30 years (144.3 million if the present rate of growth continues.)

This should be a sobering thought for even a non-reflective man. I suspect that even with proper and intelligent planning, it will strain this country to its very soul. Without proper planning it could bring disaster.

From an ecological and environmental point of view, about which we still know all too little, planning is absolutely imperative. Assuming that planning becomes the crucible of the decision-making process, it is the one medium where environmental factors and potential environmental results can constantly be plugged in and weighed.

INVESTMENT IN OUR PUBLIC LANDS

I have become increasingly alarmed about the lack of investment in our public lands. They constitute a previous resource, but like all resources, they require continuing investment and shepherding.

We are deluding ourselves if we think that those resources will always be available without prudent investment. We have, perhaps unwittingly, taken out far more than we have invested. The time has come to balance return with investment.

NONFUEL MINERALS

It is here that I anticipate a sharp disagreement among members of the Commission. I personally can find no rationale in continuing with the present patent system even though it may be substantially improved. I, for one, feel very strongly that we should move to a leasing system.

The key, in my judgment, is that of control both in environmental terms and the orderly balanced shepherding of our resources.

I do not deny the defense factors in the utilization of our resources nor the necessity of a reasonable economic atmosphere for the production of minerals.

I do not agree that a leasing system would inhibit either the defense of this country or the economic atmosphere for the production of minerals. The question of inholdings alone mitigates against the intelligent planning and utilization of our public lands.

DISPOSAL

I am against disposal of our public lands other than in a very limited way and then only after very careful planning.

The attempts that we made to determine future demands on our back, I think we can all be grateful that, somehow in the past, we can definitely determine what future demands may be. But, as we look back, I think we can all be grateful that somehow in the past, we avoided wholesale disposal of these public lands. If this has been true in the past, I suspect that retention and control will be increasingly important in the future.

Planning, control, investment, multi-purpose use, ecology, environment, balance, and the needs and aspirations of our people—these should be our guidelines.

IMPLEMENTATIONS OF THE COMMISSION REPORT

The report of the Commission will be presented to Congress and the President on or about July 1. What follows thereafter becomes terribly important.

The Commission and the staff under the leadership of Congressman Aspinall have worked long and hard. I am convinced that the members of the Commission are men of good will, and a very real effort has been made to accommodate varying points of view and come up with a workable report.

Obviously, there will be disagreements. I would be the most surprised person in the world if you people agreed with everything in the report.

There will be a temptation, I think, for various members of Congress and other individuals and groups to pick off portions of this report and introduce it into legislation. If this occurs, it then becomes important for groups like yourself to see to it that all parts of the report are introduced into legislation and to closely follow and testify on this legislation as it proceeds through Congress.

The public lands belong not just to one person or group.

They belong to us all.

Let us approach it that way.

EMERGING TRENDS AND POTENTIAL PROBLEMS FROM THE STUDY PROGRAM OF THE PUBLIC LAND LAW REVIEW COMMISSION

HAMILTON K. PYLES[1]
Consultant to the Natural Resources Council of America, Washington, D. C.

Even if the work of the Commission were to end without a final report and recommendation, it will have made a valuable contribution to the future of public land management. It has brought knowledgeable people of opposing viewpoints together for frank discussion and better understanding. It has compiled a vast amount of information on public land laws and programs. It has stimulated critical self-analysis of agency programs and procedures in public land management. It has revitalized, on a grand scale, the public interest in the resources of the public lands and their future. The Commission and its staff deserve a great deal of credit for the untiring effort that has gone into this work.

Since I do not believe that any wholesale disposal of the public lands is in the interest of the general public or politically feasible, I am more concerned with what courses of action may be recommended for the protection, management, and use of the resources of the vast majority of public lands retained in federal ownership and not reserved or set aside for special purposes.

I am confining my remarks to what I consider to be a trend away from land management under the Multiple-Use Acts and toward functional management under a concept of maximum economic efficiency.

It appears to me that both the approach to the study program and the trend of many reports are aimed directly at an emasculation of the multiple-use concept of public land management. They tend to suggest a concept of "functional management" and explicit allocations of public land to specific or priority use rather than the present system of "multiple-use," which is "territorial land management" involving the community of resources that are present. If the marketable commodities on public lands are to be managed to secure the greatest dollar return rather than the best combination of all uses to optimize socio-economic values, the obvious losers will be those whose interests lie in the intangible and non-monetary commodities of public lands, such as hunters, fishermen and other recreationists.

The overall study program was designed with the idea of providing the Commission with a complete background of factual material, including a review of all the pertinent statutes in effect and the manner in which they are implemented. The main study subjects were

[1] In the absence of Mr. Pyles, this paper was read by Henry E. Clepper.

selected to cover the individual commodities that could be produced on public lands, such as timber, forage, outdoor recreation, etc. Several across-the-board studies, such as the "Demands on Public Lands," "Evironmental Factors" and "Multiple-Use," followed the commodity studies.

The result of this individual commodity approach is that timber, forage, water, minerals, wildlife, recreation, and other resources were studied as though they were unrelated to one another. Most studies of the individual commodities did recognize constraints placed on the commodity in question because of other uses and values. The analysis of the complex inter-related biotic community on these public lands and the problems of its management was made in a good but somewhat theoretical treatise at the tail end of the study program in a report on Public Land Policy and the Environment. "Quickie" case studies were made of a number of well-known problem areas rather than general field investigations of management effectiveness.

In the timber study, for example, the emphasis is on raw material, marketing, industrial dependency, and related economic factors. Emphasis is not given to watershed, environmental, or silvicultural issues.

Similarly, the forage study placed heavy emphasis on the economics involved in use of public-land forage by domestic livestock. No analysis was made that might help in understanding the relative value of the same range for watershed, recreation, wildlife, and other uses competing with livestock grazing.

There have been repeated proposals that market considerations and economic efficiency should play a more important role in agency policy in terms of long-term revenue maximizations. These proposals are based on a distinction between market and non-market programs on federal lands. Cost and revenue controls would be applied to the management of the market-oriented programs with the idea of maximizing profits. Non-market programs aimed at improving wildlife habitat, watershed, and such intangible values as scenic landscapes, pure water, etc., would have to be financed separately from general funds.

Implicit in these proposals that would maximize dollar returns from one commodity is the need to separate the cost of producing the marketable commodity from the costs of planning and other activities that serve to enhance or protect other non-marketable commodities and values on the same piece of land. Anyone with experience in multiple-use management of land and its associated biological communities will realize the impracticability of such separation of costs except on the most arbitrary and rather meaningless basis.

I presume that under the concept of a statutory highest-and-best-use system, mentioned repeatedly by the Commission staff and others, the Congress would allocate large areas of public land to the priority use of one commodity. Presumably, all other compatible benefits would be credited as "splinter" values.

The Advisory Council member representing the timber industries observed during one of the meetings that large areas of public land had been allocated to "wilderness" by statute and that he could see no reason why similar allocations of large areas should not be made for intensive timber management and production. The same argument could be made for grazing lands, highly mineralized areas, oil shale lands, critical watersheds, etc.

A logical sequel to such a concept would be reorganization of the Federal agencies along functional lines such as Wildlife Bureau, Timber Bureau, Grazing Bureau, Recreation Bureau, and so on. Presumably, these bureaus could all be placed in one federal Department for better coordination and national planning, I am sure everyone would agree that better coordination at the top is highly desirable, but coordination of uses at the bottom—on the land itself—is absolutely essential. Coordination of uses on the land would be most difficult under a system of functional management by Bureaus having differing responsibilities.

The main trouble with this concept is that public land resources do not come in neat packages—for the most part the resources are intermingled. I have worked on public lands from Southern California to Maine. I know of no large multiple-use area for which I could say one resource is the most valuable over all others in the public interest for all time. At least, not as long as "value" means more than dollar returns.

Maximizing the production or use of one resource must inevitably downgrade the production and use of others in the same area. Because of their inflexibility, statutory allocations and guidelines are not readily adaptable to rapidly changing needs and local conditions. Priorities set today may not fit the priorities of tomorrow. In fact, the priority of resource use can change seasonally for the same area.

Suppose, for example, the suggestion of the timber industry representative were followed and large areas of the public lands of the Pacific Northwest were allocated by statute to timber production as the highest and most valuable use of the land. Few would argue that timber growing is not a high and valuable use of these lands, but if it is given statutory top priority, what would happen to watershed, scenic and other values within or adjacent to these areas? Even if some constraints were included in the statutory guidelines to protect the environment, there would be no incentive to plan for improving watersheds, improving wildlife habitat, improving recreation and other values along with the production of timber.

Again, under the concept of allocating public lands by statute as being primarily valuable for one resource over all other resources, Congress would need a crystal ball to designate those parts of the public lands as being chiefly valuable for some mineral resource. I would also like to point out that the degradation of landscapes by strip mining private lands of the East resulted from this concept of a single dominant use of the land with maximum economic efficiency in mineral extraction as the goal. I believe most of us want to be sure that this situation is not repeated on the public lands in the West.

Conservationists, represented by some 15 national organizations, have recommended to the Commission that the Mining Law of 1872 be repealed and replaced by a leasing system. Such a system would retain the land in government ownership and provide some revenue for the Treasury.

In my experience, mining can, for the most part, be fitted into the development and use of other valuable resources of an area, if well planned and maximum economic efficiency of extraction is not the only goal.

The Congress over the years has set aside or allocated areas of the public lands for various purposes with guidelines for administration to assure that its intent is carried out. These statutory guidelines have varied from broad delegation of authority to explicit definition of the purpose and the manner in which an area of public land and its resources are to be used.

In general, where lands have been reserved from the public domain for a variety of uses, the statutory definitions of purpose and guidelines have been broad and permissive, leaving it to the appropriate Secretary to provide rules and regulations for administration and use. On the other hand, when the Congress has authorized areas to be established or set aside from the public lands for specific purposes (*e.g.* wilderness, national parks, etc.), with the exclusion of certain non-conforming uses, the statutory purposes and guidelines have been explicit and the exercise of administration discretion is limited.

It seems to me that this is sound public policy in the allocation of public land for special purposes requiring the exclusion of non-comforming use and practices. For the remaining large bulk of public lands, which Congress intends should be used for a variety of purposes, it will be most difficult to improve on the present provisions of multiple-use acts. On the other hand, it is possible to greatly improve the multi-product returns through more sophisticated management techniques and more adequate funding.

Cost-to-benefit analysis and efficient expenditure of public funds in considering available options are applicable and well recognized in multiple-use management. The problems occur over the definition and measurements of benefits or values for which no known method now exists to express them in monetary terms. It may be possible to determine monetary values of all benefits in the future. Our present inability to assign dollar values to intangibles does not necessarily mean there are no economic benefits involved. Until we can assign a satisfactory dollar value to wildlife, wilderness, pure water, or natural beauty, we need to go slow in overemphasizing the production of the commodity with a current market value. The allocation of land on the basis of its being chiefly valuable for some marketable commodity can only result in sub-optimization of total product benefits available over time from all resources involved.

I don't believe any one would claim that public land management, particularly planning and decision making under the provisions of the multiple-use acts, have been perfect or even adequate. These inadequacies stem primarily from a lack of complete data on all resources involved, both tangible and intangible, and not from the concept or provisions of law. Of course, a complete inventory and data retrieval system is needed under any concept of land management.

As I said before, I haven't any idea what the Commission's final recommendations will be, but if it is persuaded by arguments of commodity-user groups and some study reports to recommend that Congress divide up the public lands according to a system of priority uses among the various commodities and services, it will be a backward step. Renewable resources are dynamic and ever changing. They are interrelated, and such a system would deny achieving the maximum benefits from our public lands.

THE STUDIES OF THE PUBLIC LAND LAW REVIEW COMMISSION: THEIR RELEVANCE TO THE WESTERN STATES

JOHN A. BIGGS
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The western states owe their existence to the system of federal public lands. Settlers were attracted by the opportunity to own land, to cultivate it and to develop homes for their families, and perhaps even more attracted by the stories and accounts of early explorers as to the magnificence of the West and the opportunities which were inherent in it. Successive waves of immigration, each penetrating farther towards the shores of the Pacific Ocean, brought about the settlement of the West and the eventual creation of the western states, as they now are known.

From these early usages of land and the products which were derived from it, whether crops, minerals, forest products or other resources, the West was largely developed. In the Twentieth Century it has become one of the most viable land areas of the United States, one whose population is increasing more rapidly than that of any other section of this nation. The West as a region now contributes materially to the human, economic and cultural well-being of the entire country.

The fact that most of the nation's federal public lands occur in the western states is, to many, one of the great amenities which make living in the West so highly desirable. These great public lands and their products continue to play an important part in the economy of the country but, increasingly they are being used and enjoyed for outdoor recreation by people attracted to them from throughout the entire United States. Thus, the deliberations of the Land Law Review Commission and the attention which the Congress gives to its recommendations not only are nationally significant, but they have a very special meaning to all people who live in the western states.

The findings of the Commission will have great significance to the fish and wildlife resources and very special significance to persons who enjoyably engage in fishing and hunting on the system of federal public lands. Therefore, may I briefly review generally the broad scope of the Commission's studies, their relevance to the West, and especially to wildlife:

There are, totally, some 760 million acres of federal public lands—nearly one-third the total land area of the nation. This distribution alone is a source of serious political, human and economic problems; 48.7 percent are in the State of Alaska, 47.5 percent are in the 11 western states, and only 3.8 percent are located in the remainder of the nation.

Principally, these lands are administered by the Bureau of Land Management and the U. S. Forest Service; however, the National Park Service administers 27 million acres and a variety of other federal agencies administer lesser amounts. All of these agencies have been charged by Congress or by administrative regulation with providing outdoor recreation on these lands to the extent that this is feasible, and the Land and Water Conservation Fund has been established to acquire additional federal recreational lands and to supplement the efforts of states and local governments in similar types of acquisitions.

In the Continental United States, excluding Alaska, 347 million acres of federal lands have been classified as outdoor recreational lands; 322 million acres are located in the West, and 25 million acres are scattered throughout the remaining states. Of these 347 million acres, less than 1 percent or 2.9 million acres, are water surface acres.

As an illustration of the magnitude of these holdings, state and local governments, collectively, own only 36 million acres of land, or less than one-tenth the total of federal public lands. In the north central and northeastern states, state and local holdings are greater than federal lands; in the South, and especially in the West, federal lands far outweigh state and local lands. The western lands, especially, are the source of great outdoor recreational values which include skiing, fishing, hunting, camping, swimming, hiking, to mention only a few. Much of these lands are wilderness lands; in fact, here in the West lies the nation's greatest storehouse of unspoiled forest lands, wild lands and wild rivers.

It is conservatively projected that outdoor recreational use of these lands will be 160 percent greater by the year of 2000 than it is now. The economic and social contribution of these lands to the nation's well-being is a substantial, dramatic and interrelated one, especially as it relates to the total public and private land holdings occurring in the Continental United States, as is graphically demonstrated by the following compilation:

ANNUAL ECONOMIC CONTRIBUTION

Use	Computed 1963	% of National Total	Projected 1980	% of National Total
Recreation	$2,900,000,000	13.2 %	$6,970,000,000	13.2 % (?)
Fuel Minerals	1,038,000,000	7.8 %	1,724,000,000	7.8 % (*)
Timber	428,000,000	24.9 %	644,000,000	24.9 %
Grazing	327,000,000	2.72%	337,000,000	.09%
Non-Fuel Minerals	148,000,000	2.35%	181,000,000	2.35%
Intensive Agriculture	—negligible—			

Note: (?) Time has demonstrated that every effort to project outdoor recreational usage has been shown to be too conservative, and actual usage has been substantially greater.
(*) The above figures do not take into account the contribution of the recent Alaskan oil discoveries.

Land without water is of little value, and only with substantial quantities of water can land constitute hospitable and productive environment for man, animals or plants. Considering that the largest acreages of federal public lands are in the western states, it is significant that the average annual water run-off occurring in these western states is 363,180,000 acre feet per year, or approximately 27 percent of the nation's entire water yield. Much of this water, actually 61 percent, originates from the public lands, principally the national forests.

This heritage of land provides not only the nation's greatest existing storehouse for outdoor recreation but, also, the nation's greatest potential for expanding these opportunities. In the field of wildlife harvest alone, approximately 35 percent of the big game harvested in the nation and about 8 percent of the small game and upland game are taken from these federal public lands. The human values inherent in these lands are unquestionably the most important resource of all, and especially is this true in the western states.

Since the inception of this nation, people have settled the land wherever it occurred and have developed and have made use of it attracted by the opportunity to own it. In every instance, the lands they used were drawn from the 1,442,000,000 acres which this public land empire originally consisted of. That it has now shrunk to 760 million acres, that the opportunity to privately claim or own it has become broader and more sophisticated, in no way detracts from the value which this great land system has to the general public; rather, still standing as a great remnant of what it once was, its continued ownership by the public is not only desirable, it is, in fact, essential.

No longer can it be said that because the public lands are in the West or even because they are in Alaska, they are not now available to massively larger numbers of people. The capacity of the average person to transport himself about and the time available to him to do this have increased almost beyond comprehension and will continue to do so at an even more accelerated rate; thus, common ownership and the right to use this system of public lands by all citizens of the United States is every day becoming a greater reality and privilege of citizenship.

As the economic and public demands of our country expand, they are accompanied by an insatiable appetite for land and for land usage. Somewhere, some place, if civilization and mankind are to enjoy the ordinary amenities of living, this reckless use of land will have to receive more careful consideration, and serious thought must be given to the retention of some system of natural lands in America.

The opportunity to fish and to hunt and to engage in a myriad of other types of outdoor recreation can only be had and maintained under a system of public ownership, to say nothing of what this system of public lands in the hands of a wise and knowledgable government can do to develop, assure and encourage the economic and human well-being of the country and its people.

These are some of the values and philosophies inherent in the thinking of people who value their right to a common ownership to these public lands and the right to use these lands, and who, as citizens of the United States, feel that to dispose of any material portion of this commonly owned land would be to remove from the use and ownership of American citizens one of their greatest of all heritages, and western people especially feel this way.

Thus, it can truly be said that the deliberations of the Land Law Review Commission and the conclusions and recommendations of the Commission will be one of the most significant exercises in democracy which will occur in this era, and nowhere will that be more significant than in the West.

The recommendations of the Land Law Review Commission and resulting actions of the Congress should result in a system of laws and policies relating to the ownership, use and management of federal public lands which is in keeping with the values which humanity and this nation places upon this system of lands and their uses which can be reasonably foreseen and projected for the future. It is very important that this system of laws and policies not become obsolescent but remain viable and consistent with constantly changing and broadening public interests and demands on the system of public lands.

People who have an interest in wildlife throughout the nation and again, particularly the western game departments, owe a vote of thanks especially to the chairman of the Commission, Wayne Aspinall; the director of the staff, Milton Pearl; and the staff itself for the outstandingly fine work they have done in a conscientious and able way to impartially examine all of these matters and to develop findings which are factual and informative.

It has been said that this may be the only opportunity of our lifetime to plan the proper use of that one-third of our nation's land which is today in federal ownership. To no single group are these words more significant than to conservationists and to people everywhere who cherish the presence of wildlife, and we therefore cannot, in any way, afford to further postpone or avoid our important responsibilities as they relate to the nation's system of public lands.

PANEL DISCUSSION

MODERATOR BOX: The program committee felt that the best way to get the material dealing with the Public Land Law Review Commission was through a panel. The success of any panel discussion is, first, to raise questions; second, a response from the audience; and third, the moderator's ability to stay out of the discussion.

I believe the panelists have done a good job of raising relevant issues, which takes care of the first point. School teachers have a bad way of putting their mouths in without engaging the mind, and I will try to stay out of the discussion. The rest is, therefore, up to you.

FROM THE FLOOR: I think Mr. Pyles might have pointed out to us that the initial directive to the Commission was to maximize the return from the public land and, of course, in an economic society like ours this necessarily means an emphasis on commodity production.

This would have been a tragedy if it happened just a few years earlier, but fortunately the report will come to us in a completely new era of thinking when we are at last aware of the fact that it has become necessary for us to balance our demands on the ability of the environment to continue maintaining us as a species.

It seems to me that the thing we need now to do, all of us, is to rethink the whole multitude of ecology which has been perverted in the last generation; and I would point out even in these three good papers given this afternoon no attention was given to the fact that the real function of the planned animal community is not to be used by man in a commodity sense, or for recreation, or esthetics, but rather to function in an ecological way to keep this planet viable.

If we can include this kind of thinking in our deliberations during the coming months on the report of the Commission, perhaps we can redirect ourselves in such a way that it takes better advantage of the hard work that goes into producing such a study. (*Applause*)

FROM THE FLOOR: We have had a major concern with the degrading industries. We delayed to wait for the report from the Public Land Law Review Committee. I do not believe we have had reference to that in any of the presentations made today.

We are very aware that a lobby could delay the increased effort that has been scheduled in this regard.

We are first concerned by the fact that this lobby is financed by the secondary rental of our public lands, in which the lessees sublease the land for many times the price they pay the federal government, and this money is used as a lobby to work against the better interests of the general public in their public land.

We are currently involved in such an issue, and I wonder if one of these gentlemen could comment as to what recommendations we may expect from the Public Land Law Review Commission relative to the fee increases, and relative to subleasing.

GOVERNOR HOFF: Perhaps properly I should attempt to answer that question since I am the sole member of the Commission present.

I do not think the recommendations will be that specific in that particular area. I would certainly hope that the work of the Commission would not delay further the increases in fees in this area, nor do I hope that it will affect the whole subleasing system.

Of course, I have become aware of the lobby. I have also become aware of quite a few other lobbies with respect to this whole work area, some of whom I had never heard of previously.

I can only speak for myself, and certainly I cannot speak for the Commission, and there is some sensitivity on the part of the Commission concerning stating of views until the report is made public.

I would think, however, that it would be leading more toward the practice that has been proceeding, I think, in a satisfactory manner until it was recently held up.

MODERATOR BOX: Yes, would you like to comment, Mr. Biggs?

MR. BIGGS: I should like to not rise to the defense of the livestock industry because certainly they are well able to defend themselves, but I think it is significant to take a minute to talk a little about the actual composition of the Public Land Law Review Commission.

The Commission was composed of 18 members, 6 of whom were public members and 12 of whom were members of Congress—6 Senators and 6 members of the House of Representatives.

The Commission was aided by an advisory council composed of 26 people. This was a very unusual arrangement because each of these 26 people was specifically selected to represent some special interest. They were not selected because their thinking was necessarily broad, or because they were intellectuals. They were selected to vigorously represent the interests that they were selected to represent.

This led to some very interesting discussions and situations.

I somehow had the feeling that when the deliberations started everybody was very demanding according to his special interests. Approximately midway I thought some of their feelings had mellowed a little; and toward the end I could only reach the conclusion they had become more positive than they ever were.

I think we need to recall the last effort on the takeover of the public land occurring, I believe, approximately 20 years ago, or even less than that. It was an effort that was led by the livestock industry, which petitioned Congress to provide ways and means for grazing permittees to own the lands they used.

This did not succeed.

I felt that, particularly as related to the wildlife interests, there was a new affinity and a new understanding between the livestock people and the wildlife people. The livestock people did not officially take the position favoring the disposal of the lands. Some regional and local groups, as I understand it, did, but the national position was in favor of retention.

They did point out, however, that their operation had become larger, more involved, and requiring more capital, as Governor Hoff mentioned. They felt that they were entitled to some better condition of tenure.

I question, too, whether the Public Land Law Review Commission, in considering the broad scope of such reviews, should attempt to get into the actual field of pricing the cost of grazing. I do, however, think, that the industry knows that it has a privilege and expects to give something in return for this privilege.

The industry spoke often of its willingness to make available access to public land, the blockage of which is so prevalent in some western states. A man owning a small amount of private land can now block public access to large areas of public land. Their total willingness to cooperate in any program to do away with this would appear significant. Again, their total willingness and desire to see the public lands used by outdoor recreationists and to expedite this would appear significant.

As a conclusion, they did indicate that they were not unwilling to make their own lands available on a broad basis if some of these things could be accomplished.

So, having participated in some of these controversies with the livestock industry, I have frankly lost some of my fervor. I do not know whether their assurances are any better than ours, but I tend to think their feeling is much more moderate than it used to be, and I think that perhaps they expect to get some better treatment in the way of grazing fees than they would get privately. I think they expect to give in return some guarantees that will assist in retaining broad public use of the public lands.

FROM THE FLOOR: I have one more question, if I may, Mr. Chairman.

Two of the speakers referred to the leasing of mining land, or lands to be utilized for mining.

We are very much concerned with this. Any of us who have lived near an area that has suffered from mining knows what it can do to the land.

Do you think there is enough public understanding of this that it will be accepted publicly, or are we going to have a selling job to do to the public?

GOVERNOR HOFF: This is the one specific that I am stressing heavily because I do not know and do not feel that there is sufficient public understanding in the East in this area to bring about a leasing system.

I will be frank and say that I strongly suspect the Commission itself—the majority—will not recommend a leasing system; but that there will be a militant minority, of which I will be one, that will recommend such a system. I am, however, convinced that this will never come about unless people like yourselves really get involved in a public education effort.

MODERATOR BOX: Mr. Clepper, would you like to respond?

MR. CLEPPER: He has answered it very satisfactorily, thank you.

FROM THE FLOOR: I would like to address my question to Governor Hoff, since he is a member of the Commission.

In a farm journal publication of February, 1970, there is a report of what the Commission's report indicates and it deals with some additional interesting aspects, one of which indicates that you are recommending against the grazing fees as they were already established.

What concerns me is contained in the last paragraph, and I should like to ask whether you will confirm or deny that this is what the Commission is doing, in that it would appear that the recommendation is to sell grazing lands at market prices.

GOVERNOR HOFF: There are presumably 18 people in this country who can answer that question. Obviously, one of them saw fit to release certain information to this particular publication which, under the rules of our Commission, he was not permitted to do.

I am not going to aggravate that situation.

The recommendations were arrived at in executive session, and the report will be out after the first of July so that it may be read and the recommendations may be reviewed.

I do not want to do violence to our own rules of order, so I will not comment on it other than to say I hope it will not be quite the way you have indicated it from the publication.

FROM THE FLOOR: So do I.

GOVERNOR HOFF: Perhaps this is a good place at which to say that it is extremely important that you people follow the recommendations of this Commission. They are going to have a decided impact upon everybody in this room in one way or the other. Again I will repeat what I said previously: Unless we can mobilize public opinion, particularly along environmental and ecological lines, it is quite possible that in certain areas we will have a great deal to lose.

FROM THE FLOOR: Do I take it, then, what you are saying is a warning?

GOVERNOR HOFF: Yes. (Applause)

MRS. ROBERT ERICKSON: (Racine, Wisconsin): I attended the Public Land Law Review Commission hearing in Milwaukee approximately two years ago. I was quite appalled at the general tone of the hearing. I would say that 95 percent of the people who spoke were men who proposed to make dollars from the public land. Most of them were lumbermen, mining people, people who wanted to graze on the land, and otherwise use it to line their pockets, to put it bluntly.

I really felt that the conservation organizations were very lax and behind in not appearing at this hearing in full numbers and in full force.

I should like to express the hope that all of us will be in full numbers and in full force when the report is published, and perhaps the speakers might like to comment on it.

GOVERNOR HOFF: I will by saying that I already have, and I agree with everything you say.

I should also like to point out that I was extremely disturbed over the failure of a great many conservation groups to read the particular reports or studies as they were published. They had been made available, after quite a bit of discussion within the Commission itself. They have been made available and they are available now.

Frankly, I think it is incumbent upon a group such as yourselves to read these reports. I personally frankly have also gone to a number of conservation groups and pleaded with them to become involved in taking a look at these studies in certain areas. I do not think there has been enough involvement in conservation groups, and I would plead with you to become involved.

FROM THE FLOOR: I would like to ask if, in the study of some of the case histories, does the Commission go into some detail on the proposed oil pipelines across Alaska?

I think here we have indications of this environmental disorder that might arise if the pipelines were put in and went into the tundra ecology; and as someone commented previously this did come before the Commission.

MODERATOR BOX: Governor Hoff says all he can tell you is he did.

While there is someone else coming to the microphone, I would like to pose a question.

Governor Hoff indicated that some portions of this report would undoubtedly be picked out and translated into legislation immediately. The other two speakers indicated that the multiple-use concept of management is, indeed, in danger, and that certain commodity organizations and groups will be pushing for their particular commodity. These people are saying that instead of having the old commodities of forestry, grazing, and so on, we may have new commodity groups of recreation and those in other areas.

What can we do to insure that these public lands are managed on an equal basis and not for some group, from agriculture, grazing, and mining to recreation, boating, et cetera?

GOVERNOR HOFF: You know you do not overcome a couple of centuries of history overnight.

There is not any question in the breakdown of the studies—as was properly pointed out in one of these papers—that many of these studies were approached from this point of view. There were those of us within the Commission who fought for a continuation of the fact of the multi-purpose use. I, for one, feel that a very serious error can be made by falling into a trap by mere propagandizing that some day we may be able to translate them into measureable terms.

The time has come when these values will be measured in terms of dollars and in terms of our society which I suspect is more important. But in any event there is an unquestionable danger, that portions of this report will be picked off, particularly by groups with vested interests, and introduced into legislation, and that the report as a whole will not go in.

If this happens, I think it can bring about some serious consequences. That is a trap into which one can fall and fall very deeply.

MODERATOR BOX: I should like to have the other panelists comment on this.

MR. BIGGS: I should like to say on this point that I was greatly impressed during these public hearings at the great number of people and groups who appeared and testified before the Commission on behalf of the environment, on behalf of conservation, and on behalf of many, many forms of outdoor recreation.

I agree that their testimony and their voices were not always too well coordinated, but I do not see how anyone could fail to observe a real national interest in the system of public lands.

I think that the public is going to be a pretty good watchdog of what happens; and I think we saw an illustration of that within recent weeks in the acts of Congress regarding the timber cut. This was an effort to make use of a more liberal portion of some of the products of the public land. It failed because a rather militant public said, "We don't want it."

I feel that despite the recommendations of the Commission—and surely the recommendations of the Commission in every instance will not be what we think are divine—it would be pretty difficult for any special-interest group to come out for material disposal of land or for significant special privilege usages which are because I think they will not pass public scrutiny.

FROM THE FLOOR: I have one question, but it has been partially answered.

It seems to me one of the values is the watershed value, particularly in the West, and there is not a sufficient attempt to support the watershed as there is in the case of timber, or related commodities. You cannot have excessive overgrazing, or excessive clearcut timber removal without doing irreparable damage to a watershed.

If the public has demonstrated this concern, or if the Commission has shown its concern in protecting our watershed values as they have in protecting, let us say, the grazing rights for a privileged few, it has not been apparent.

GOVERNOR HOFF: I would say yes.

MODERATOR BOX: Governor Hoff indicates the answer is affirmative, and that they have done a rather good job with it, but I think you have raised an important consideration here and made a rather eloquent speech for multiple use, even though there is some overgrazing.

Some grazing may be proper for good watershed management; and it may be in the public interest, if the watershed people can tell us what kind of vegetation they want for a particular forest. I think the grazing people can pretty well write a description for getting proper livestock use to produce the cover needed.

FROM THE FLOOR: I think that is correct, but I think we have too many illustrations that show much better examples of overgrazing than moderation in grazing.

MR. ERNEST E. DAY (NWF Regional Director, Idaho): I have a question of complete frustration.

The Timber Supply Act did reflect, I think, the thinking of the public recently. That, however, was shown in a negative manner to prevent something from happening which would perhaps have happened.

My question is with the Chairman of the House Interior and Insular Affairs Committee, with the people whom we have there. What steps can be taken to update—either through this report, or in any other manner—the ridiculous 1872 mining laws which permit severance of mining without even a substandard fee such as the grazing fees—without any payment, as there is in timber severance? How do you get around a situation like this?

I would like to ask Governor Hoff as a politician if he can inform me, or enlighten me in any manner?

GOVERNOR HOFF: You refer to me as a politician. I am an ex-governor. (Laughter) But then, I am seriously considering running for the United States Senate.

Now if I should win, the necessary legislation will be introduced. You can be assured of that. I will surely be looking to you for help.

MR. DAY: You will sure get it. Thank you. (Applause)

MODERATOR BOX: Are there other questions, comments, or discussion?

I think the success of this panel has been demonstrated by your active participation in the discussion. Questions and issues have been raised here that will be discussed long into the night.

We have time for some closing comment from our Chairman. So, Ward, will you make them?

CHAIRMAN STEVENS: I wish to thank the discussants on the panel very much for their participation. I found it both instructive and most interesting. Being from outside the continental United States, and being on the periphery of the scene, I wish that we had something like that in Canada.

Thank you, ladies and gentlemen.

We are adjourned.

TECHNICAL SESSION

Tuesday Morning—March 24

Chairman: Roy E. Tomlinson

Wildlife Biologist, Bureau of Sport Fisheries and Wildlife, Tucson, Arizona

Discussion Leader: Howard M. Wight

Associate Professor, Department of Fisheries and Wildlife, Oregon State University, Corvallis

FIELD AND FARM RESOURCES

REMARKS OF THE CHAIRMAN

Roy E. Tomlinson

Since I have a captive audience, I would like to announce that the Endangered Wildlife Research Program just made a release of masked bobwhites in the southern Arizona region. This is a "first" for our program in an attempt to re-establish that endangered species. We released some 160 birds which were raised at Tucson from 36 birds that were captured. We are very hopeful that after seventy years these bobwhites will again be part of our local fauna.

Also, I would like to say that when I took the chairmanship of this session I did not realize quite what I was in for. I expected to have people knocking on my door giving me papers that they wanted to present. However, this did not turn out to be the case. I think most people, therefore, don't realize you must get a paper or an abstract in some months in advance of the actual conference. Therefore, if any of you desire to give papers at the North American, remember, you cannot wait until February to approach the Chairman.

Another complaint that I received from various people was that the North American technical sessions were too general and that there was no place for technical people. One of the things that Howard and I tried to do when we assembled this program was to put the "technical" back into the technical session; therefore, I hope you appreciate our program today. I think it is going to be a good one.

ACCELERATED RESEARCH ON MIGRATORY WEBLESS GAME BIRDS

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Migratory Bird Populations Station, Laurel, Maryland, and
THOMAS R. EVANS
Department of Conservation, Springfield, Illinois

INTRODUCTION

The program of accelerated research on migratory webless game birds is a cooperative venture between the Bureau of Sport Fisheries and Wildlife and the several States. It is designed to provide information vitally needed to more properly manage this important resource. The birds included in this program are the Columbidae (doves and pigeons), Scolopacidae (shore birds including woodcock and snipe), Rallidae (rails and gallinules), and the Gruidae (cranes). Historically there has been a lack of concerted research effort directed toward these birds, with the result that management capability, for the most part, lags well behind that relating to waterfowl and resident game birds. This paper is designed as a progress report; partly to review accomplishments to date, but more importantly to describe the basic objectives of the program, the opportunities for participation, and the need for support in securing funds.

HISTORY

In July of 1967 the collective efforts of a rather large group of individuals representing various organizations came to partial fruition when Congress appropriated $250,000 earmarked for research and management of webless migratory game birds. Nearly a decade of endeavor had been required to attain this result. Initial impetus for a research program developed within the Southeastern Association of Game and Fish Commissioners which was primarily directed toward the mourning dove. In August of 1959 the International Association of Game, Fish and Conservation Commissioners entered the picture with the establishment of a Dove Committee (Kiel, 1961). A Mourning Dove Technical Committee, with Leonard Foote as chairman, was appointed and charged with the development of a national research and management program for mourning doves. The program was accepted by the International Association and by the Bureau of Sport Fisheries and Wildlife in 1960, and was the subject of a paper presented by Kiel at the 26th North American Wildlife and Natural Resources Conference in 1961. In 1960, the International Dove and Wetlands Study Committees became the Association's Migratory Birds Committee, with Tom Evans as Chairman. Although efforts to obtain appropriations for this early mourning dove research and management program were not successful, some of the objectives outlined in 1960 were accomplished despite limited financing.

In 1966, in conjunction with the 31st North American Wildlife and Natural Resources Conference, a special technical committee presented research needs statements on mourning doves, woodcock, snipe, white-winged doves, band-tailed pigeons and rails to a group of conservation executives of national organizations. Representatives of the National Audubon Society, the Wildlife Management Institute, the National Wildlife Federation, the Izaak Walton League of America and the Welder Wildlife Foundation agreed to support requests to Congress for funds to conduct cooperative research by the States and the Bureau of Sport Fisheries and Wildlife. Based on the technical committee's statements, a three-step program was prepared and submitted to the International Association at their regular legislative-executive committee meeting in December, 1966. The International Association requested that the Southeastern Association initiate the request for funds. This fund request was supported in House and Senate Appropriation Committee hearings by most national conservation organizations. Under the leadership of Dr. O. Earle Frye, many state game and fish administrators sent personal messages to members of their congressional delegations requesting the funds, and Director Gottschalk of the Bureau of Sport Fisheries and Wildlife detailed the need for funds when questioned by members of the Senate committee.

For the first year, $450,000 was requested, including $250,000 for state projects and $200,000 to supplement Bureau funds for work on migratory webless game birds. It was requested that appropriations be increased in the second and third years to attain a stable annual funding level of $1,296,000. Of this, $500,000 was to be for work to be performed by the States under Bureau contract, $596,000 for Bureau operating funds (hard core), and $200,000 for special studies to be conducted by the Bureau or under contract by the States.

As previously noted, the amount actually appropriated was $250,000, with the Bureau hard-core funds being eliminated by Congress. Two $25,000 Bureau studies were included, one on mourning doves in the Carolinas and one on woodcock in Maine. Since the Bureau needed funds to administer the contract research, 12.5 percent of the remaining $200,000 was reserved for this purpose and $175,000 was allocated for State projects.

On September 6, 1967, President Steen of the International Association established a National Program Planning Committee for Shore and Upland Migratory Game Birds—a subcommittee of the Migratory Birds Committee. The composition of the Committee is varied. Members from state conservation agencies are selected both geographically and by species interests. Also included are individuals from major national conservation organizations, and three Bureau representatives who serve ex-officio. This committee is charged with coordinating plans for the program and selecting projects to be funded. The committee works closely with management unit technical committees, whose recommendations are sought for regional priority rating.

PRESENT STATUS

Of the 27 proposals scheduled for state contracts in fiscal year 1968, all but one resulted in a signed contract. Due to unavoidable delays caused by a moratorium on all Federal Government contracts, many of the states were unable to begin work until fairly late in the fiscal year. One state chose to obligate $5,000 less than authorized for the first year of the study. Thus, at the close of the first year of the program, contracts had been signed with 19 states with a total of 26 projects amounting to $167,000. Also in operation were the two Bureau studies.

This high level of participation in the first year was a significant accomplishment. Administrative procedures had to be developed, and detailed project plans prepared, submitted, approved, and translated into contract documents. Many states had budgetary problems that had to be resolved before the funds could be included in their operating expenses, and both the states and the Bureau had personnel ceilings to contend with.

During the fiscal year 1968, the National Program Planning Committee developed a list of proposed projects for the succeeding year and asked for an additional $267,500 to supplement the initial $250,000 which had become a part of the regular Bureau budget. These additional funds included $50,000 for banding analysis by the Bureau's Migratory Bird Populations Station and $217,500 for 28 new state projects involving 11 states not in the first year's program. Unfortunately, the budgetary situation in that year was exceedingly tight, and Congress saw fit to approve only the continuation of the program at the initial funding level. Existing state contracts were renewed and the funds assigned to one state which was unable to utilize them were reassigned to two other states under new contracts. Thus, the full $175,000 was obligated in fiscal year 1969.

In planning for F.Y. 1970 the National Program Planning Committee requested an additional $418,700 in appropriations. Bureau funds for banding analysis were increased to $150,000 and $268,700 was asked for new State projects. There were some additions to, and deletions from, the previous program. The deletions involved projects which states had seen fit to initiate without accelerated funds. Despite sincere efforts in support of the program, the "add-on" funds were once more not included in the Bureau appropriation. Present plans call for the fiscal 1972 program ($375,000) to be included in the Bureau budget as submitted to Congress. If a 1972 appropriation can be secured via the Bureau budget, it is hoped that the Accelerated Research Program can reach its anticipated funding level using that same procedure by fiscal 1973. The direct appeal to Congress has not had sufficient support to get anywhere except the first year.

A major problem in the Accelerated Program is the failure to obtain sufficient funds for Bureau supporting activities. The contract work done by the states results in a significant, direct increase in the workload of the Migratory Bird Populations Station due to a great increase in banding and greatly expanded population surveys. These activities require additional work in the Bird Banding office and increase the need for coordination of data gathering and analysis of banding and survey records. In short, increased activity among the states in research and management of webless game birds inevitably increases the responsibilities of the Bureau, whose basic funds for this purpose have not been increased. It is also evident that a balanced program should augment federal and state programs in roughly equal proportion. The National Program Planning Committee is well aware of these problems and has acted to include a reasonable proportion of funds for the Bureau in its program development. When the program reaches its ultimate goal of approximately $1.3 million, with the recommended distribution, the problem will be alleviated. It will be accentuated, however, should additional funds be appropriated for state contracts without a concurrent increase in Bureau operating funds.

At the close of fiscal 1969, six projects for randomization of woodcock singing-ground surveys were completed, and $26,200 thus made available for new fiscal 1970 projects. Five new projects were selected by the National Program Planning Committee. At the close of fiscal 1970, six additional studies will be completed, and $94,200 will be available for reallocation. This reallocation was planned at the September, 1969 Committee meeting. Thus, even without increased appropriations, the National Program Planning Committee will have a continuing function, and funds will become available for new studies.

PROJECT SELECTION PROCEDURE

It is appropriate at this point to describe the procedures used to apply for Accelerated Research funds. It is important to know that all contracts under this program are between the Bureau and a state conservation agency. The states may subcontract the work to another agency such as a university, and several current contracts are of this nature. Proposals from other than a state fish and game department should be cleared in advance with the appropriate department, and should become joint proposals, since the departments will be the responsible agency regardless of who is actually performing the work.

Proposals should be prepared in brief outline form, with a concise statement of objectives and procedures, a cost estimate, and background information to help evaluate the project's potential. The proper route is to submit the proposal to the appropriate management unit technical committee for shore and upland migratory game birds. This group will determine the priority of all proposals in its geographic area and will forward the listing to the National Program Planning Committee. The final annual program "package" is then prepared, giving consideration to the merits of each proposal as well as to the immediacy of the need for the information to be acquired.

When funding has been obtained, the states are notified, and a detailed proposal outlining project objectives, procedures, and costs is submitted to the Bureau. If funds are relatively assured, as with projects to be funded from expiring contracts, this step may precede actual appropriations. Upon approval of the project plan, the Bureau prepares a contract which becomes the basic project document, with the project proposal appended as part of the contract. Project contracts are for a 1-year period. Subsequent annual appropriations are added by amendment, which also extends the expiration date.

In some instances, projects may be developed by the Committee, which then asks the states if they wish to participate. This has been the case with woodcock singing-ground route randomization and with mourning dove banding projects. The latter are in support of the Eastern Management Unit dove study, and involve mainly states which do not hunt mourning doves. Cooperative projects with more than one state are particularly appropriate to this type of funding. None is currently underway, but two will be funded in fiscal 1971.

NATURE OF CURRENT PROJECTS

Table 1 shows current projects and funding levels. It is apparent that the main thrust of this program is to develop, as rapidly as possible, the basic management information required to properly understand the status of populations and the influence of hunting upon these populations. While there are elements of research in all of these projects, it is without exception management-oriented research. Dove banding is in support of a large research effort to determine the influence of hunting upon mourning dove populations. The woodcock banding is management in the sense that one of its objectives is to increase the number of banded woodcock in the population, and research in the sense that it seeks to develop new capture techniques. The same is true of snipe banding, with the additional objective of developing sexing and aging criteria. Local studies, such as the woodcock telemetry study in Minnesota, are chiefly designed to provide a fuller understanding of the singing-ground survey. Similarly, the Missouri study seeks to provide insight into the relationship of the call-count survey to breeding populations and particularly to fall flights.

TABLE 1. STATE ACCELERATED RESEARCH PROJECTS UNDERTAKEN AS OF FISCAL YEAR 1970

Activity	State	Planned Length	Annual Amount	
WOODCOCK				
Banding	Maine	5 years	$ 5,250	
	New York	"	"	
	Pennsylvania	"	"	
	West Virginia'	"	"	
	Wisconsin	"	"	
Randomization of singing-ground survey	*Maine	2 years	$ 4,400	
	*Minnesota	"	"	
	*New York	"	"	
	*North Carolina	"	"	
	*Wisconsin	"	"	
	*Indiana	"	4,200[1]	
	Vermont	"	1,750[2]	
	New Hampshire	"	"[2]	
	Massachusetts	"	2,400	
	Ohio	"	"	
Behavioral study—telemetry	Minnesota	3 years	$14,000	
Habitat study—aerial photo	Minnesota	1 year	$ 2,400	
		3-yr. Woodcock total—		$159,350
COMMON SNIPE				
Banding	Florida	5 years	$ 4,450	
	Louisiana	"	4,400	
	Texas	"	"	
		3-yr. Common snipe total—		39,750
CLAPPER RAIL				
Development of census technique	New Jersey	3 years	$17,500	
		Clapper rail total—		52,500
MOURNING DOVE				
Determination of the effect of zoning regulations	Georgia	3 years	$22,000	
Banding in support of Eastern Management Unit special study	Illinois	5 years	$ 3,500	
	Massachusetts	"	"	
	New Jersey	"	"	
	Pennsylvania	"	"	
	Michigan	"	4,200	
	New York	"	"	
	Ohio	"	"	
	Wisconsin	"	"	
Evaluation of call-count census (pilot study)	Missouri	1 year	$ 5,000	
		3-yr. Mourning dove total—		$163,400
WHITE-WINGED DOVE				
Habitat evaluation	Arizona	3 years	$22,000	
		White-winged dove total—		61,000[3]
BAND-TAILED PIGEON				
Life history study	Washington	3 years	$13,500	
		Band-tailed pigeon total—		40,500
		PROGRAM THREE-YEAR TOTAL		$516,500

* Project completed.
[1] Funds originally intended for mourning dove banding.
[2] Funds originally assigned to Connecticut for mourning dove banding.
[3] $5,000 not obligated in first year.

While there are almost limitless opportunities for investigating unknowns concerning migratory webless game birds, and all proposals will be carefully considered, top priority must be given to those proposals which may have immediate management application. Caution should be exercised in attempting population studies of migratory birds on a local area, and generally studies of this type will be of much lower priority than those of management-unitwide application. While $1.3 million seems like a considerable sum, the immediate management needs for these species are great, and Accelerated Research funds must be carefully apportioned in order to obtain the most management information with the greatest speed.

ACCOMPLISHMENTS OF THE PROGRAM

Obviously, it is much too early to fully evaluate the Accelerated Research Program, but it is worthwhile to point out some of the accomplishments to date. Six states have completed randomization of their woodcock singing-ground routes with funds provided by the program, and four others will complete this work shortly. In addition to providing a much increased sample, the randomization will undoubtedly result in a significant improvement in the validity of this survey. Mourning dove banding contracts have greatly increased the number of these birds which are banded in the Eastern Management Unit, particularly in the states which do not hunt doves. This increase, and especially the improved geographic distribution of the banded sample, will increase the potential for significant findings from the Eastern Management Unit dove study. Similarly, the banding of woodcock by states under contract has greatly improved the distribution of the banded sample, and perhaps more significantly is developing a growing cadre of experienced woodcock banders. For the first time, significant numbers of snipe are being banded on the wintering grounds and considerable progress has been made in perfecting trapping techniques and in developing sexing and aging criteria. A study of great potential for additional applications has been the development of a clapper rail, audio-census technique. The use of electronic recording devices, if problems of cost and logistics can be solved, could conceivably eliminate most of the bias in such surveys caused by differences in audio perception between observers. Work on the utilization of habitat by Arizona white-winged doves is providing information needed to define more precisely the influence of habitat changes, particularly phreatophyte control in river bottoms, on these birds. The Washington band-tailed pigeon study is providing an opportunity to field-test an audio-census technique developed at

Oregon State University, and to work with a pilot wing-collection survey.

The above is but a sketchy listing of some of the areas under investigation. Final results of some of these studies will soon appear in published form. Not the least of the accomplishments of this program is the close communication now being maintained between those working on related projects; preliminary results, problems, and achievements are being shared as they develop.

FUTURE PLANS

The potential for migratory webless game birds to help meet the recreational demands of North American hunters appears to us to be very great. The Accelerated Research Program, through all of the cooperating agencies and individuals, is providing the first really concerted effort to broaden our understanding of populations of these species so that this potential may be fully realized without danger to the resource. We are a long way from that goal at present, but it is hoped that the Accelerated Research Program, adequately funded, and in concert with ongoing programs of the Bureau and the states, will permit us to achieve it.

LITERATURE CITED

Kiel, William H., Jr.
1961. The mourning dove program for the future. Trans. N. Amer. Wildl. Conf., 26:418-435.

DISCUSSION

DISCUSSION LEADER WIGHT: Mr. MacDonald has given us a very detailed and concise description of a project that is dear to the hearts of many of us and I am sure there will be some questions.

DR. WILLIAM G. SHELDON (Massachusetts): Would you elaborate a little on something? I notice, for example, that you had 32 percent in relation to the woodcock habitat study. Would you be more specific—where and just what is that?

MR. MACDONALD: I did not try to present all the information which will be available in my publication.

The major portion of that, of course, involved $25,000 annually in the Bureau study in Minnesota. This isn't entirely related to habitat and there was a small study in Maine also dealing with this matter.

A PROPOSED BAND-TAILED PIGEON CENSUS—A MANAGEMENT NEED[1]

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The Pacific coast race of the band-tailed pigeon (*Columba fasciata* Say) is a species of international status, distributed from southern British Columbia, through Washington, Oregon and California, and into northern Baja California, Mexico. The principal distribution is in the Coast Range and the western slopes of the Cascade-Sierra Nevada Mountains.

The bandtail is a migratory game bird, with an annual kill in Washington, Oregon and California approximating one-half million (Sisson, 1968). Present knowledge indicates that the bandtail has a very low reproductive potential and that hunting accounts for a sizeable portion of its annual mortality (Silovsky, 1969). Currently, there is no basis for evaluation of the impact of hunting mortality on the stability of bandtail populations. Methods for estimating the population status are of high priority in the development of needed management procedures for this species.

Late-summer counts of pigeons at a small number of concentration sites are employed in Oregon, and California has made post-season counts of wintering birds in an attempt to measure yearly population changes. At present, there is no indication that hunting is jeopardizing this species. However, the vast majority of hunting occurs at a small number of localized concentration areas, and the late-summer counts and estimates of the annual kill may not be efficient indices of the total population status.

Sisson (1968) studied the calling behavior of bandtails and suggested that call-counts may have potential value as a census index. The purpose of this paper is to report on a subsequent study of calling by free-living pigeons in westcentral Oregon in 1967 and 1968. In addition, recommendations for the conduct of an audio-index technique for detecting fluctuations in bandtail populations are presented.

Consideration of the audio-index as an indicator of bandtail abundance or relative abundance has several aspects. First, one should verify the proposition that the index (calls heard or calling pigeons

[1]Technical Paper 2865 of the Oregon Agricultural Experiment Station, Corvallis. This study was supported by the Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service. We also acknowledge Leslie Ann Keppie for assistance in preparation of this manuscript.
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heard) is related in an appropriate manner to the population numbers. We have assumed that this proposition holds, with partial substantiation by the work of Sisson (1968). Second, it is necessary to construct the index so as to achieve the greatest possible efficiency over all possible constructs. Associated with the development of the index is the attempt to evaluate the efficiency of the method in terms of the precision that may be obtained for a prescribed cost or effort. The present study addresses the second and third aspects.

METHODS OF STUDY

Call-Count Routes

To determine the extent of those factors affecting the numbers of pigeons heard and calls heard on a census route, a single route—in the McDonald State Forest, Benton County, Oregon—was intensively studied in 1967. This area was chosen because it was known to be a bandtail breeding area, probably typical of that in western Oregon, and it was easily accessible.

An "over-and-back" route design in the McDonald Forest in 1967 emphasized the study of "time effect": the influence of the time of day on the calling of pigeons. A 5-mile route consisting of ten stations one-half mile apart was conducted in the over-and-back procedure to produce 20 listening intervals. On each successive call-count the starting point was advanced six stations. In this manner, each station was sampled twice in a morning; and over a 10-day period each station was sampled once at each time interval. Therefore, "station effect" influences (the influence of the "quality" of the station-location upon the number of pigeons present, and thus calling) were assumed to be uniform at each time interval on the call-count, permitting the detection of time effect on calling activity. Sixty call-counts were conducted during June 12-August 17, 1967, producing six successive 10-count periods. All call-counts began at one-half hour prior to official sunrise and lasted until one and one-half hours after sunrise. Numbers of pigeons and calls heard were directly comparable for each ten-count period but were not comparable between the individual call-counts within the period because each was started at a different station.

In 1968, call-counts were conducted during May 14-August 17 on the following areas (Benton, Lincoln and Linn counties, Oregon): McDonald Forest (19 call-counts), Marys Peak (16), Burnt Woods (12,) Cougar Ridge (6), Blodgett (6), and Dawson (6). All routes were 10 miles in length (the 1967 McDonald Forest route was extended 5 miles) and consisted of 20 stations. All call-counts began at station number 1 and proceeded through station number 20, with each station sampled once in a morning. Therefore, numbers of pigeons heard and calls heard on successive call-counts in 1968 were directly comparable. All call-counts were conducted between 18 minutes prior to sunrise and 102 minutes after sunrise.

A 3-minute listening interval at each station was used both years. The numbers of pigeons heard and calls heard at each station were recorded. In 1968, the calling heard was recorded as occurring during the first 2 minutes, or as occurring during the third minute (referred to later as "structural counts"). The time of all calling on routes and point observations was recorded and plotted by Pacific Standard Time. In both years, a 3-minute interval was allotted for traveling the one-half mile between stations.

Air temperature, cloud cover (on an ascending scale of cloudiness of 0/10 to 10/10), and wind velocity (using the Beaufort scale of estimation) were recorded at the start and finish of all call-counts. Additional notes on weather factors was recorded whenever conditions changed markedly. Barometric pressure records, for the periods of study in both years, were obtained from the Agricultural Service Weather Bureau on the Oregon State University campus.

Point Observations

A point observation was made by continuously listening for an extended period of time at a single location. This provided data on the distribution of calling by bandtails by time of day.

All point observations in this study, McDonald Forest and Burnt Woods areas, began at one-half hour before sunrise; and lasted until sunset (n=3, July 17-August 15, 1967), or for 2 hours (n=9) or three and one-half hours (n=27) (April 24-August 18, 1968).

The numbers of pigeons and calls heard were recorded at consecutive 1-minute intervals. Weather factors were recorded in the same way as on call-counts (and at 1-hour intervals).

RESULTS AND DISCUSSION

Characteristics of the Call

The call of the band-tailed pigeon has been well described phonetically (particularly by Sisson, 1968), but its variability needs emphasis. Characteristics of 584 calls of free-living bandtails were recorded in 1968. There was a range of 1 to 12 audible notes per call, and a four-note call was heard most frequently (n=173). A two-syllable note was characteristic, although a one-syllable note was frequently heard. Whether a single one-syllable note was heard or a series of 12 two-syllable notes were heard, each was considerd to be a *single* call and was recorded as such.

The call was of low intensity and was audible only a short distance even during favorable listening conditions. Wind was the greatest disturbing factor to the audibility of the call. Even slight environmental sounds, including that of song birds and flying insects, reduced its audibility. In four instances in 1968, distances to the calling pigeon were obtained: 300, 250, 225, and 175 yards. We believe the maximum distance a band-tailed pigeon call is audible is approximately 300 yards.

Calling Rates

Calling rate is defined as the number of calls per calling pigeon per 3-minute listening interval.

The mean rate of calling during 464 intervals in 1967 was 1.95. In 1968, during 223 intervals the rate was 1.85.

TABLE 1. MEAN CALLING RATES OF BAND-TAILED PIGEONS, RELATING TO THE NUMBER OF PIGEONS HEARD CALLING AT CALL-COUNT STATIONS. JUNE 12–AUGUST 17, 1967, AND MAY 14–AUGUST 17, 1968

Number of calling pigeons per station	Number of stations (1967, 1968)	Mean calling rate	
		1967, McDonald Forest	1968, all routes
1	(249, 171)	1.66	1.74
2	(113, 41)	2.11	1.87
3	(56, 10)	2.11	2.47
4	(13, 1)	2.17	1.25
5	(3, 0)	2.22	—
2 or more		2.12	2.00

Data from this study (Table 1) demonstrated that there was an increased rate of calling as the number of calling pigeons increased. There was a greater rate of calling (27.7 percent in 1967 and 14.9 percent in 1968) when two or more pigeons were calling at a station than when a single pigeon was calling. Thus, there may have been a contagious influence present in the calling by pigeons at a station. This situation does not fulfill Heath's (1961) basic assumption that, for an audio-index, the average calling rate is independent of the number of calling birds. However, for the audio-index to be used as an index to numbers, it is only necessary that a one-to-one relationship exist between numbers of pigeons and the expected number of calling pigeons. We presently see no evidence that this is not the case.

Seasonal Distribution of Calling

The greatest level of calling by bandtails in 1967 occurred in July. And analysis of the data presented in Figure 1 demonstrated that the intervals of July 4-15 and 16-27, 1967, were the ten-count periods of

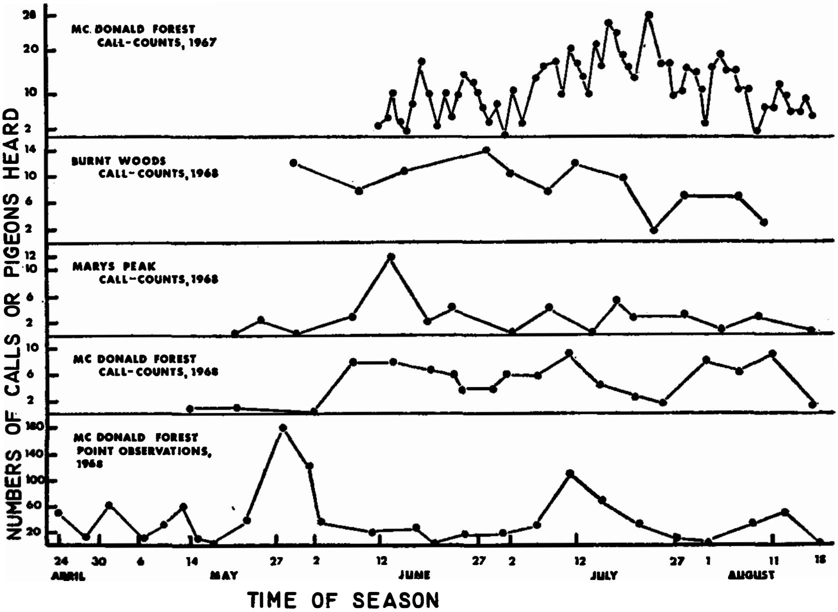

Figure 1.—Seasonal distribution of numbers of band-tailed pigeons heard (call-counts) and numbers of calls heard (point observations), 1967 and 1968.

the greatest numbers of pigeons calling and calls heard, and the periods of the lowest coefficient of variation in the numbers of pigeons and calls heard on successive call-counts.

In 1968, the seasonal patterns of numbers of pigeons heard and calls heard (Figure 1) were not similar to the pattern in 1967. Calling was quite variable on successive observations on the same area, and between areas through the 1968 season. However, by analyzing the calling by 15-day periods, mid June to mid July generally was the best time of 1968 for hearing calling pigeons. For each of the three routes conducted through the 1968 season, the 15-day period with a high mean number of pigeons heard and a relatively low coefficient of variation of numbers of pigeons heard on successive call-counts was: McDonald Forest, July 28-August 11; Marys Peak, June 13-27; and Burnt Woods, June 28-July 12. The periods of June 13-27 and June 28-July 12 were also favorable on the McDonald Forest route.

The mid summer period of greatest calling activity observed in this study is similar to the findings of three other authors. Glover (1953) and Houston (1963) reported a late June to early July peak in calling of pigeons in Humboldt County, California. A June and early July peak in the calling of pigeons at Berkeley, California was illustrated by Peeters (1962).

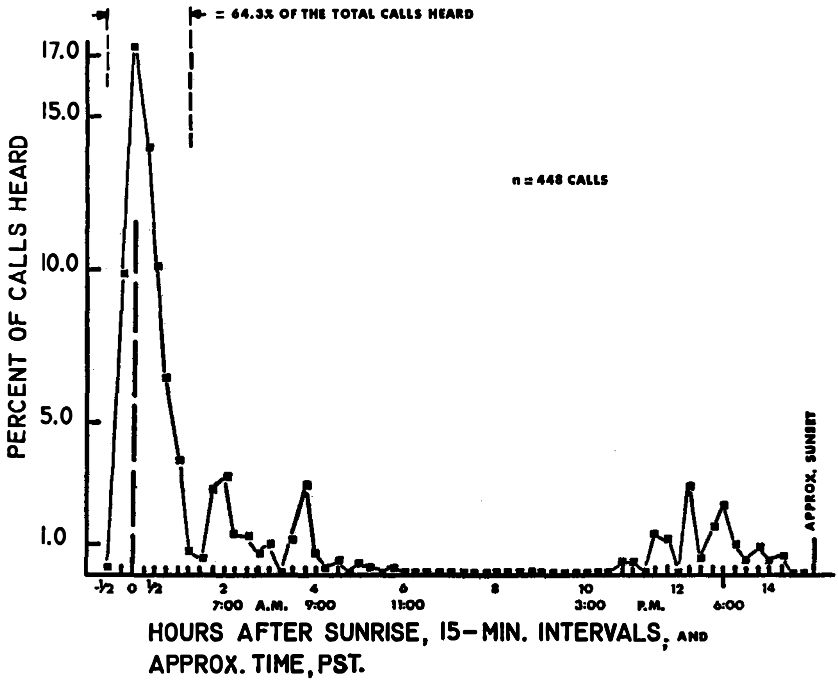

Figure 2.—Percent distribution of band-tailed pigeon calls heard, by 15-minute intervals, during three all-day point observations. McDonald Forest area; July 17-August 15, 1967.

Diurnal Pattern of Calling

Of the 448 calls heard on three all-day point observations in 1967, 64.3 percent (288) occurred between one-half hour prior to sunrise and one and one-half hours following sunrise (Figure 2). Calling was relatively infrequent in the morning following the first 2 hours of listening on the all-day point observations (18.5 percent of the total calls) and in the late afternoon (17.2 percent), and completely absent during the midday (approximately 11 a.m. to 3 p.m., PST). The pattern of the calls heard on the 27 three and one-half hour point observations in 1968 (McDonald Forest and Burnt Woods routes, April 24-August 12) also indicated a greater calling activity in the very early morning. The percentages of the 1,164 calls heard, that occurred during each one-half hour period were: 4.8 (prior to sunrise); 31.7, 18.6, 14.4, 12.5, 8.5, and 9.5 (successive one-half hour periods after sunrise).

The early morning peak of calling observed in this study is completely different from that reported by three other investigators. Glover (1953) and Houston (1963) reported that the greatest calling activity of pigeons, in Humboldt County, California, occurred in the late morning. Peeters (1962) stated that pigeons called most frequently about 5-6 p.m. at Berkeley, California. We cannot evaluate their reports however, since Houston and Peeters did not mention the duration of their listening through the day, and Glover apparently did not listen prior to 7 a.m.

From a study of captive bandtails, Sisson (1968) concluded that the 2-hour period from one-half hour prior to sunrise to one and one-half hours following sunrise was the time of greatest calling activity in the morning.

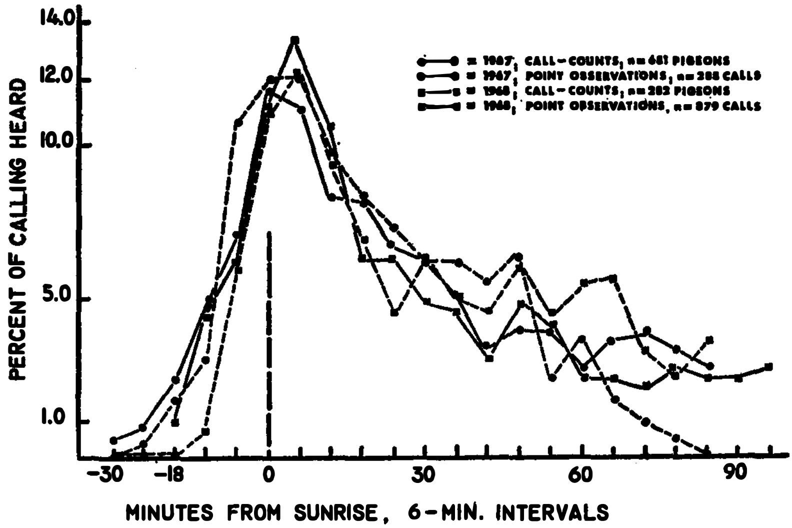

Figure 3.—Percent distribution of band-tailed pigeons heard and calls heard, by 6-minute intervals, during the early morning. McDonald Forest call-counts (n=60; June 12-August 17, 1967) and point observations (n=3; July 17-August 15, 1967); McDonald Forest, Marys Peak, Burnt Woods, Cougar Ridge, Blodgett and Dawson call-counts (n=65; May 14-August 17, 1968), and McDonald Forest and Burnt Woods point observations (n=36; April 24-August 18, 1968).

During the 2 years of this research, 164 observations were conducted to study the distribution of calling by pigeons through the early morning. All resulting patterns were very similar and demonstrated that the one-half hour beginning at the time of sunrise was the period of greatest calling activity in the early morning (Figure 3). The patterns illustrated in Figure 3 substantially demonstrate a relation of calling by bandtails in the morning to the time of sunrise.

The "probability of hearing a call" has relevance to a call-count system. It is defined as the expected frequency with which at least one call will be heard at a station, given the time of observation, and is estimated by the number of times at least one pigeon is heard during a 3-minute listening interval divided by the number of times that time interval (relative to sunrise) is sampled. In 1968, a 0.165 probability value for 65 call-counts (all routes) over the entire season indicated that pigeons were heard at an average of 3.3 (16.5 percent) of the 20 stations per route. During the mid June to mid July period, 1968, (which was stated to be generally the most favorable interval in 1968 for calling pigeons) the mean probability value for call-counts ($n=17$; McDonald Forest, Burnt Woods and Marys Peak routes) was 0.263.

Relation of Weather Factors to Calling

In this study, linear regression analyses were made between individual weather factors and the calling of pigeons on call-counts and point observations over the entire season. This procedure has limitations in that it does not demonstrate any influence from the interaction of two or more weather factors nor any influence of time of season on the effect of a weather factor.

Light intensity and cloud cover affected the time of morning pigeons began to call (unpublished data), although these relationships have no practical importance in the conduct of a call-count.

There was no meaningful influence of cloud cover, barometric pressure and temperature on the number of pigeons or calls heard on morning observations, based on seasonal linear regression analyses.

Wind velocity appears to be a major influence on the numbers of pigeons heard and calls heard. This was due to noise created by wind passing through the trees. We believe that wind velocities greater than 7 miles per hour (greater than Beaufort 2) seriously reduced our ability to hear a band-tailed pigeon call; however, we were unable to demonstrate this conclusively by regression analyses due to the small volume of relevant data.

In general, we do not believe fog markedly inhibited the calling of pigeons or our ability to hear the call. This is in contrast to Glover (1953) and Houston (1963) who suggested that fog disturbed the normal distribution of calling by pigeons through the day. Pigeons have frequently been heard, in this study, calling in a very dense fog (visibility to 100 yards), and engaged in display flights (indicated by the "chirping" sound, Peeters, 1962) in a very dense fog. In contrast, however, a very dense fog cover was probably the cause for delay in commencement of calling and the low number of pigeons heard on three observations in 1968.

Rain, of any intensity, may adversely affect the calling of bandtails and the ability to hear the calls. On three occasions, heavy overnight rain and light drizzle during the morning observation probably were factors in the delayed and low level of calling. However, individual pigeons have been heard calling on two occasions in a light drizzle and heavy rain.

Relation of Habitat to Calling Pigeons

Our comments on forest type and bandtails are primarily the result of subjective observations of forest type along the single route in 1967 and the six routes in 1968. The density and composition of the forest type are important factors in governing the suitability of habitats for bandtails. Douglas fir (*Pseudotsuga menziesii*) was the dominant tree species in the foothill and mountaineous study areas of this project. The greatest numbers of pigeons were observed and heard calling in two forest types: (1) mixed species composition of light to medium density Douglas fir, Oregon white oak (*Quercus garryana*), and red alder (*Alnus rubra*); and (2) stands of densely stocked, pure, young Douglas fir (as young as 15 years of age) with scattered, taller individuals.

Five consecutive stations on the Marys Peak route were located in a block of medium dense, pure, 110 to 120-year old Douglas fir. On only 2 of the 80 observations at these stations were calling pigeons heard. In contrast, pigeons were frequently heard calling in the densely stocked, young, pure Douglas fir stands, and in the lightly stocked, mixed-aged stands of Douglas fir adjacent to this block of pure, mature Douglas fir.

Pigeons commonly were observed calling from lightly stocked, 100+ year old Douglas fir. These trees invariably were located in stands of mixed species composition, or located as scattered individuals in a densely stocked stand of pure, young Douglas fir.

We conclude that large blocks of pure, mature Douglas fir may not be a favorable habitat for band-tailed pigeons in the summer. Young stands of Douglas fir regrowth, 15-20 years of age, provided suitable habitat for calling pigeons, when scattered, mature trees were present. Because clear-cut logging practices and the fast regrowth of Douglas fir can quickly change the forest type over large areas, timber-type information must be considered in establishing and maintaining call-count routes for bandtails.

The Relation of Calling Activity to Population Numbers

The call index, whether based on total calls or number of calling birds, is predicated on the assumption of a one-to-one relationship between the expected value of the index and the population level. It is not necessary to assume strict proportionality, but it is necessary to assume that an increase in the index implies an increase in the population density, and vice versa.

Potential complications must be noted. If the index is to accurately reflect a change from one year to another, then it must be assumed that the *relationship* between index and population is unaffected by the experienced differences in weather or other environmental forces. Similarly, in making comparisons from region to region or habitat type to habitat type, it must be assumed that the *relationship* is unchanged by the transition.

We are not able to evaluate these assumptions at present, or to modify the index to account for these suspected influences. Comments on the effects of weather have been previously made. The spatial effects of habitat may be to some degree concealed by the mobile nature of at least some of the population, as evidenced from observations of concentrated flocks (up to 100 birds, including many males) actively feeding at that time of morning when they theoretically should have been dispersed and calling. In addition, actively calling males have been observed to stop calling and fly completely out of sight. Apparently, some male bandtails are not closely associated with a specific area for calling activity even in the early morning.

Precision of the Audio-Index and Estimates of Sample Size of Routes

The precision of the audio-index technique is related to the inherent variability of the numbers of pigeons or calls heard on call-counts and the number of routes to be used. The choice of a route sample size is based on a specified, true population difference of magnitude δ, such that an estimate of this difference will be significantly different from zero, according to a specified test, at the 1-α level, 1-β percent of the time.

Reference was made to Snedecor and Cochran (1967: 111–114) for a general model of sample size determination, $n = (Z_\alpha + Z_\beta)^2 \sigma_D^2/\delta^2$. The specific model used in this study for estimation of route sample sizes was provided by the assumption, $\sigma_D^2 = \frac{2}{n}\left[\frac{s_d^2}{k} + s_{ry}^2\right]$, for each route con-

TABLE 2. ESTIMATES OF THE NUMBER OF ROUTES, N, REQUIRED TO DETECT VARIOUS PERCENTAGE DIFFERENCES OF THE NUMBER OF PIGEONS HEARD ON CALL-COUNTS BETWEEN YEARS, WHEN THE SAME ROUTES ARE CONDUCTED K TIMES EACH IN EACH YEAR

Probability of detecting the specified change	Estimated n, for a specified change in index to be detected					
	10%	15%	20%	25%	30%	40%
0.90						
k = 1	526	234	131	84	58	33
k = 2	361	161	90	58	40	23
0.50						
k = 1	192	85	48	31	21	12
k = 2	132	59	33	21	15	8

ducted k times each (Table 2). That is, it is assumed that the comparison is based on the same n routes conducted k times in each of 2 different years. Data of numbers of calling pigeons in this study were essentially from a single "region" (all routes were within a 25 mile radius of Corvallis, Oregon), and comparison of population differences between regions in the same year would require different variances than we have defined. Reference should be made to Keppie (1970) for the estimation of s_d^2 (10) and s_{ry}^2 (6), used in the sample size estimates, and for a discussion of the validity of the method.

The estimates presented in Table 2 were computed by using a $Z\alpha$ for a two-tailed test, that is, for detection of a population fluctuation in either direction. The estimates demonstrate a comparison of the minimum sample size possible for a specified precision (that is, when there is only a 50 percent probability of detecting a true population fluctuation of level δ) and the required sample size for a commonly used probability level ($1\text{-}\beta = 0.90$).

The most efficient procedure is to conduct each route once per year. An analysis of variance of bandtails heard on 47 call-counts in 1968 (McDonald Forest, Marys Peak, and Burnt Woods routes) demonstrated that there was a greater mean square for "between routes" (140.84) than for "within routes" (10.46). Thus, the allocation of call-counts should be directed towards reducing the "between route" variance by conducting each route only once. The greater efficiency resulting from increasing the number of routes and conducting each only once a year has been previously demonstrated for mourning dove (*Zenaidura macroura*) coo-counts (Southeastern Assoc. . . . , 1957) and for band-tailed pigeons (Sisson, 1968). In addition, assuming it requires approximately the same effort and cost to set up all routes the first year and conduct the same routes in 2 consecutive years, conducting each route once would require fewer units of effort and cost than conducting each route twice per year. However, there may be value in running each route twice per year, if it is impossible to locate the proposed number of routes if each were to be run only once per year.

Selection of Call-Count Routes

Certain considerations should be given to procedures for selection of call-count routes for bandtails. There may be the practical problem of locating enough accessible roads through pigeon habitat. Extensive, purely agricultural areas, such as the central Willamette Valley, Oregon, should be completely excluded from any sampling design. Likewise, consideration should be given to the possible omission from the sampling design of valleys within the Coast Range and Cascade-

Sierra Nevada Mountains that are devoted to agriculture (including orchard crops).

Randomly chosen routes, within the acceptable major sampling regions, should be confined to narrow valleys (probably no more than 1-2 miles in width), foothills, and mountainous areas, where coniferous trees or coniferous-hardwood mixed composition types predominate. Randomly chosen routes in which all stations are situated in cropland will be useless.

Until additional information is available concerning the eastward distribution of the bandtail, the most practical eastern boundary for call-count sampling (with respect to Oregon) would probably be the summit of the Cascade Mountains. There is information regarding the bandtail's presence east of the summit, but the extent of the distribution and the magnitude of numbers is not known.

In future years it may be desirable to stratify the allocation of call-count routes in an attempt to increase the precision of the technique. We believe that the composition and density of the forest type would be valid guidelines.

Procedures for Conducting Call-Count Routes

It is proposed that standard call-count routes, 10 miles in length, consisting of 20 stations, at one-half mile intervals, be set up. If it is impossible to locate a sufficient number of 20-station routes, consideration could be given to using routes of fewer stations. Methods developed for the analysis of call-count data, such as calibration techniques, may facilitate this flexibility in route design (Keppie, 1970). A suggested call-count route form and an instruction sheet for conducting the call-count have been provided (Keppie, 1970).

We believe it will take considerable experience for a new observer to become efficient at hearing a bandtail call. This is partially due to the variable nature of the call and its low audibility. It may be desirable to persuade new observers to gain experience by conducting two call-counts prior to the one that is formally submitted.

The first half of July was a favorable time of season for numbers of calling pigeons and uniformity in numbers of calling pigeons on successive observations in both years of this study. A slightly earlier period than found in this study may be more appropriate in California, and a later period for Washington and British Columbia. A 15-day period should be sufficient for a person to complete the route(s) assigned to him, and yet be short enough so any inherent variance of calling due to time of season is acceptable.

It was evident in this study that there was little value in listening for calling bandtails prior to 12 minutes before sunrise (Figure 3).

Further, an analysis of various 2-hour periods in the early morning (between 18 minutes prior to sunrise and 126 minutes after sunrise) demonstrated that the period of 6 minutes prior to sunrise to 114 minutes after sunrise generally provides the highest mean number of calls and highest mean probability of hearing a pigeon. It is suggested that cooperators consult the same source for a table of times of local sunrise, such as the U.S. Naval Observatory.

A calibration technique for adjusting call-count data of bandtails for the influence of time effect has been developed in this study. This proposed technique is an alternative to the usual practice of standardizing the route so as to standardize the influence of time of day on observations. This technique will be presented in a separate paper.

The call-count route should not be conducted when the wind velocity on the route is greater than 7 miles per hour (greater than Beaufort 2). The Beaufort scale should be used to estimate wind velocity.

The call-count route should not be conducted during rain of any intensity, primarily because the ability of hearing a call is reduced.

The light intensity, cloud cover, air temperature, barometric pressure and the presence of fog should not affect the decision to conduct a call-count route.

Our analyses indicates that a 3-minute listening interval is optimal. This conclusion was arrived at by calculating (on the basis of the structured counts of 1968 and the point observations of 1967 and 1968) the expected number of pigeons heard for a 25-station route with 2-minute listening intervals. This number (5.8) is compared to the expected number (6.6) heard at 20 stations under a 3-minute interval. Analyses show that a 3-minute interval is also more efficient than a 4-minute interval.

It is suggested that the number of pigeons heard be used as the population index. During both years of study, the coefficient of variation of numbers of pigeons heard on routes was less than the coefficient of variation of numbers of calls heard (Table 3). Further, there will probably be less confusion in recognizing the number of pigeons calling than the actual number of calls produced.

TABLE 3. COEFFICIENTS OF VARIATION FOR NUMBERS OF BAND-TAILED PIGEONS HEARD AND NUMBERS OF CALLS HEARD ON CALL-COUNT ROUTES. JUNE 12–AUGUST 17, 1967, AND MAY 14–AUGUST 17, 1968

Source	Coefficients of variation (%) per route						
	1967	1968					
	McDonald Forest	McDonald Forest	Burnt Woods	Marys Peak	Cougar Ridge	Blodgett	Dawson
Pigeons heard	57.79	63.43	41.56	114.1	180.6	59.11	100.67
Calls heard	65.51	70.48	44.88	122.6	187.3	62.24	121.31

The primary recommendations for conducting call-counts for bandtails are summarized:

1. Routes should be conducted between July 1 and July 15.
2. A *standard* call-count route should consist of 20 stations at one-half mile intervals. Deviations from this format will require some form of calibration.
3. The starting time for each standard route should be 6 minutes prior to the time of local sunrise. Adherance to the recommended time is stressed. This restriction may be relaxed if a calibration technique is employed in the future.
4. A listening interval should be 3 minutes per station. The travel interval between stations is also 3 minutes.
5. At each station, tally should be made of 1) the number of pigeons heard, and 2) the total number of calls heard. Note the distinction made earlier between calls and notes.
6. Record only those calls *beginning* within the 3-minute interval and only birds for which at least one call is recorded.
7. Call-counts should not be conducted if the wind velocity on the route exceeds 7 miles per hour (greater than Beaufort 2) or during rain of any intensity. If wind increases past Beaufort 2 or if rain begins during the conduct of a route, the route should be aborted.
8. Interfering noise at a station (e.g., a flowing stream) should be recognized and the station moved accordingly. A record of this change is to be noted.

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DISCUSSION

CHAIRMAN TOMLINSON: I take it that the roads you went over were mostly macadam. Is it feasible to go into all types of bandtail habitat? The reason I ask is that in Arizona and New Mexico many of the roads in bandtail habitat are almost impassable.

MR. KEPPIE: All of the routes worked up were on dirt roads, and at times they were very inaccessible. You get the impression from the State of Washington that it is not impossible to locate enough roads or routes. In the Northwest it is probably much easier to find accessible routes than in the other areas.

DISCUSSION LEADER WIGHT: I would like to have you comment on the evidence that you obtained that there were some contagious effects in one bird stimulating a second bird to call more frequently that the single-bird calling rate.

MR. KEPPIE: In both years there was a significantly higher rate of calling when two birds were heard calling at a station. When three birds were calling, or four or five birds were calling this was also the case. Frequently I can recall instances where I definitely felt birds were calling back and forth to one another.

In connection with this technique, if you use the index for calls heard, the calling rate depends on the number of birds calling. Therefore, we can partially get around this by using as an index the number of birds calling. Further, we have no evidence at this time that there is not a one-to-one relationship between the number of birds calling and the number in the population. This helps us get away from this problem where there seems to be a definite increase in the rate of calling as the number of birds calling increases.

WHITE-WINGED DOVE NESTING COLONIES IN NORTHEASTERN MEXICO[1]

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The eastern white-winged dove (*Zenaida asiatica asiatica*) is a migratory game bird which breeds in concentrated nesting colonies in the Lower Rio Grande Valley of Texas and in northeastern Mexico. The relationship of the Mexico breeding populations to breeding and hunting-season populations in Texas has intrigued sportsmen and game biologists for years. Increased clearing of nesting habitat in the Mexican nesting colonies during the past 15 years has aroused the concern of conservationists of both the United States and Mexico.

This study was begun in 1966 with the following objectives: (1) to determine the location, history of use, and populations of white-winged dove nesting colonies in northeastern Mexico, (2) to determine to what extent vegetation type and condition, food and water supplies, predation, and other factors influence location, permanence, and populations of nesting colonies as well as length, progression, and success of the nesting season, and (3) to obtain by banding or color marking, information on Mexican whitewing movements and possible affinities to the Texas whitewing population.

During the spring and summer of 1966 a survey was made of

[1]Partial results of a study financed by grants from the Caesar Kleberg Research Program in Wildlife Ecology, The Rob and Bessie Welder Wildlife Foundation, World Wildlife Fund, the Wildlife Management Institute, and Texas A & M University. Funds for the companion banding study are being provided by the U. S. Bureau of Sport Fisheries and Wildlife.

Tamaulipas, eastern Nuevo Leon, northern Vera Cruz, and northeastern San Luis Potosi in an effort to locate any unreported colonies. Eight major colonies were located, all in Tamaulipas, and efforts were begun to study each one. An additional colony was located from the air in extreme southern Tamaulipas, but the area was cleared before it could be visited on the ground. Studies of nesting activities, population levels, and habitat conditions were continued in 1967 and 1968. Additional observations were made during banding activities conducted in the region in 1969.

MAJOR WHITEWING COLONIES

The whitewing colonies are all located in the portion of Tamaulipas lying between the Sierra Madre Oriental and the Gulf of Mexico. The vegetation of the northern portion of this area was classified by Leopold (1959) as mesquite-grassland and the southern portion as tropical thorn forest. The species composition of vegetation used for nesting varies considerably between the colonies but the structure is much the same, intertwined shrubs and small trees forming a dense thicket 10 to 20 feet in height. Vegetation of this type covers thousands of square miles in northeastern Mexico, but the whitewings choose to clump together in small isolated breeding sites which appear to be little different from the surrounding areas. All the colonies are located at altitudes of 500 feet or less. They are all located on or near a source of fresh water.

This latter factor, proximity to fresh water, seems to be the most important common characteristic of the colonies. The location of food supplies appears to be of much less importance as whitewings are both willing and able to fly long distances to feed. Flocks of whitewings in Tamaulipas have been followed on feeding flights over 40 miles in length one way. Undisturbed flocks were clocked at flight speeds of 45 to 50 miles per hour using a truck speedometer over a distance of six miles.

In the following individual discussions of colonies lists are presented of plant species occurring on each area. These lists represent the more common shrubs and trees which were of sufficient size to provide nesting substrate for whitewings. In general the more abundant species are listed first. The figures for number of stems per acre represent trees and shrubs five feet or over in height.

San Fernando Hill-top Colony

A large number of whitewings have been known for many years to nest in the area just east of the town of San Fernando. Between 10 and 15 years ago the present colony concentrated on the crest of a flat-topped hill some three miles east of San Fernando. In the breeding seasons of 1966, 1967, and 1968 the colony included some 1,200 acres and had annual breeding populations estimated at 240,000 whitewings. In 1969 the colony covered some 1,600 acres and the breeding population was estimated at 320,000 birds. Nesting concentrations on this area range as high as 150 pairs per acre

This colony was unique in that each year 82 to 92 percent of the sampled nests were located in large prickly pear cacti which ranged from 6 to 12 feet in height. Common species of shrubs and trees were: *Opuntia lindheimeri, Opuntia leptocaulis, Capparis incana, Randia laetevirens* and/or *Randia rhagocarpa, Forestiera angustifolia, Helietta parvifolia, Bumelia* sp., *Cordia boissieri, Leucophyllum frutescens, Pithecellobium flexicaule, Pithecellobium pallens, Diospyros* sp., *Prosopis glandulosa, Cercidium macrum, Caesalpinia mexicana, Karwinskia humboldtiana, Condalia* sp., *Acacia wrightii, Castela texana, Adelia vaseyi, Celtis pallida, Salvia ballotaeflora, Lantana velulina,* and *Porlieria angustifolia.* The number of shrub and tree stems per acre was calculated at 12,202.

The hill-top colony seems fairly safe from immediate clearing. However, a few ranchers have cleared land for improved pasture in the San Fernando area and, if they are successful, the future of this colony is likely limited.

San Fernando Lake Colony

This colony is located on the south shore of a large fresh-water lake some 20 miles east of San Fernando. In 1966 this colony covered some 300 acres and held an estimated 60,000 breeding birds. Approximately 200 acres of this area were cleared the following winter, and in 1967 and 1968 the remaining 100 acres and two small adjacent areas were estimated to hold 40,000 breeding whitewings. Nesting densities reached 200 pairs per acre. The vegetation species composition is similar to the hill-top colony but more dense. Here about 25 percent of the nests were in prickly pear cacti.

This colony is located in the midst of several thousand acres of cleared land, which is irrigated from the lake. Sorghum and corn grown on this land provide ample food for the colony, much to the local farmers' distress. The birds feed heavily on the grain before it can be harvested. The farmers use car horns, flags, home-made exploding rockets, and field-hands popping bullwhips to try to frighten the birds from the fields, all with little success. On two occasions pickup trucks were seen with the beds several layers deep with whitewings which had been shot in the fields. This colony seems to be in grave danger of being cleared for cropland or just to remove the birds from such close proximity to the grainfields.

Padilla Colony

The Padilla colony is located 0.6 mile north of the town of Padilla on the east side of highway 101. It occupies some 55 acres of heavy brush along a small swampy stream. Common plants in the nesting area are: *Amyris texana, Condalia hookeri, Acacia berlandieri, Prosopis laevigata, Pithecellobium flexicaule, Pithecellobium pallens, Acacia wrightii, Forestiera angustifolia, Acacia farnesiana, Celtis pallida,* and *Leucophyllum frutescens.*

The population of the Padilla colony has declined each year from an estimated 10,000 birds in 1965 to 2,000 in 1968. This is believed to have resulted from very heavy nest predation by great-tailed grackles (*Cassidix mexicanus*).

Rio Purifacacion Colony

This area is located northwest of Padilla and just north of the Rio Purifacacion. In 1966 this colony occupied some 800 acres and had an estimated population of some 32,000 birds. In 1967 only 20 acres on the west end of the old colony had whitewings in any number, and this was only some 20 pairs per acre. The same was true in 1968. Apparently the birds moved to this green area during the drought period prior to 1966 and then left with the breaking of the drought.

A dam is now under construction on the Rio Soto la Marina just below Padilla. The lake formed by this dam will cover part if not all of the Padilla and Rio Purifacacion colonies.

Agua Marina Colony

This colony is located east of Ciudad Mante with the Mante-Tampico highway roughly forming the north boundary and the Rio Guyalejo forming the eastern. Scattered nesting begins about nine miles east of Mante and generally increases eastward toward the river. The colony extends about 4.5 miles south of the highway and there is only limited nesting north of the highway. Much of this total area has been cleared or does not support good whitewing habitat. Total area used by the whitewings is about 11,500 acres. There is a high density area of about 2,800 acres with an average population of at least 50 pairs/acre and the remainder has a density of about 20 pairs/acre for a total population estimate of some 650,000 birds.

The habitat of this colony has been greatly reduced in the past 15 years. Most of the level land along the river and on the west and south has been or is being cleared for crops such as cotton and sorghum. The birds now mainly occupy the hilly and more rocky land, but this is currently being cleared and put into improved pasture. It seems quite likely that unless some of this area is preserved, this colony will be completely destroyed. There are still some large tracts of undisturbed brush which have pockets of high nesting density and which would seem capable of supporting much more extensive high density nesting if the birds would move there when displaced elsewhere.

The vegetation in the nesting area is very dense with the number of tree and shrub stems calculated at 17,636 per acre. The dense growth forms a continuous thicket from 12 to 20 feet high. Isolated specimens of *Elaphrium simaruba* and *Cassia emarginata* from 30 to 40 feet tall emerge above the thicket at intervals of 30 to several hundred yards.

Other tree and shrub species which contribute to the nesting area vegetation are: *Exostema caribaeum, Capparis incana, Helietta parvifolia, Diospyros* sp., *Zizyphus amole, Randia laetivirens, Randia rhagocarpa, Cordia boissieri, Cordia pringlei, Pithecellobium unguis-cati, Pithecellobium flexicaule, Pithecellobium pallens, Leucophyllum frutescens, Tecoma stans, Bumelia* sp., *Chiococca alba, Euphorbia schlechtendalii, Cercidium macrum, Neopringlea integrifolia, Colubrina elliptica, Castela texana, Xylosma flexuosa, Phaulothamnus spinescens, Forestiera angustifolia, Citharexylum berlandieri, Phyllostylon brasiliense, Karwinskia humboldtiana, Agonandra obtusifolia, Lippia graveolens, Prosopis laevigata, Parthenium* sp., *Crescentia alata, Zanthoxylum fagara, Pisonia aculeata, Croton cortesianus* and several *Croton* sp.

Lacaille Colony

This large colony is located some 13 miles northeast of Ciudad Mante on the north side of the Rio Guaylejo. It covers some 8,000 acres and has increased in population from an estimated 550,000 breeding birds in 1966 to 750,000 in 1967 and 1,600,000 in 1968. Much of this increase is attributed to an influx of birds from the San Jose and La Encarnacion colonies.

The Lacaille colony is very similar in vegetation to the Agua Marina area with which it was probably once united before the land between them was cleared. The ranchers who own the area of the Lacaille colony plan to clear the bulk of the land in the next few years.

La Encarnacion Colony

This colony, located near the village of La Encarnacion about 69 miles north of Manuel, covered a very large area in 1966 with an estimated 54 square miles and a population of 1,200,000 whitewings.

This dropped to an estimated 600,000 birds in both 1967 and 1968. The cause was unknown.

The vegetation in the nesting area includes: *Diospyros* sp., *Zanthoxylum fagara, Pithecellobium unguis-cati, Randia laetivirens* and/or *Randia rhagocarpa, Karwinskia humboldtiana, Chiococca alba, Pisonia aculeata, Celtis pallida, Cordia boissieri, Opuntia* sp., *Condalia* sp., *Forestiera angustifolia,* and *Croton,* sp.

The 9,553 stems per acre calculated for this area gives a false impression. The whitewings here nest in dense mots or clumps of trees and shrubs which are separated by almost open areas up to 30 yards wide. The density of stems in the clumps is comparable to that of the other colonies.

This colony is traversed by a new paved road from Ciudad Victoria to Manuel. If the usual pattern follows, all the land along the road will rapidly be cleared. Clearing of land has been observed on all sides of the colony but none yet in the nesting area itself.

San Jose de las Rusias Colony

The San Jose colony is located between the Rio Soto la Marina and one of its southern tributaries, and about seven miles south of the town of Soto la Marina. The village of San Jose de las Rusias is just south of the area. The colony measures five miles north to south and is estimated to be at least 2.5 miles wide. In 1966 this area had an average density of 20 pairs per acre for a total population of 320,000 birds.

The fall hurricane of 1966 created many small lakes in this colony. One large lake was created by damming of a small stream by a new roadbed. A huge colony of whitewings formed around this lake and the breeding population was estimated at near one million birds.

A fall hurricane in 1967 caused floods which washed out the roadbed at San Jose and so drained the lake. Apparently as a result the birds abandoned the area and in 1968 the population was estimated at no more than 50,000 breeding birds. In 1969 the population had dwindled to no more than 5,000 birds.

Vegetation at San Jose was calculated to have a density of 11,869 stems per acre. The species represented were: *Diospyros* sp., *Randia laetivirens* and/or *Randia rhagocarpa, Celtis pallida, Pithecellobium flexicaule, Helietta parvifolia, Karwinskia humboldtiana, Pithecellobium pallens, Zanthoxylum fagara, Capparis incana, Caesalpinia mexicana, Prosopis laevigata, Castela texana, Croton* sp., *Bumelia* sp., *Cercidium macrum, Cordia boissieri, Opuntia leptocaulis, Opuntia* sp., *Leucophyllum frutescens, Forestiera angustifolia,* and *Chiococca alba.*

This colony is also bisected by the new highway and so is also in danger of being cleared. A new dam was placed across the stream in 1969. If a large lake reforms it will be most interesting to see if the birds return.

TABLE 1. POPULATIONS OF MEXICAN WHITE-WINGED DOVE COLONIES

Area and year	Breeding populations	Young fledged per adult	Total young fledged	Total population
San Fernando Hill–66	240,000	1.23	295,200	535,200
San Fernando Lake–66	60,000	.77	46,200	106,200
Padilla area–66	125,000	.50	125,000	250,000
San Jose–66	320,000	.69	220,800	540,800
La Encarnacion–66	1,200,000	.69	828,000	2,028,000
Aqua Marina–66	650,000	.54	351,000	1,001,000
Lacaille–66	550,000	.57	313,000	863,000
Totals	3,145,000		2,179,200	5,324,200
San Fernando Hill–67	240,000	1.20	288,000	528,000
San Fernando Lake–67	40,000	.77	30,800	70,800
Padilla area–67	125,000	.50	125,000	250,000
San Jose–67	1,000,000	.69	690,000	1,690,000
La Encarnacion–67	600,000	.69	414,000	1,014,000
Aqua Marina–67	650,000	.54	351,000	1,001,000
Lacaille–67	750,000	.57	427,500	1,177,500
Totals	3,405,000		2,326,300	5,731,300
San Fernando Hill–68	240,000	1.19	285,000	525,000
San Fernando Lake–68	60,000	.77	46,200	106,200
Padilla area–68	125,000	.50	125,000	250,000
San Jose–68	50,000	.69	34,500	84,500
La Encarnacion–68	600,000	.69	414,000	1,014,000
Aqua Marina–68	650,000	.63	409,000	1,059,500
Lacaille–68	1,600,000	1.0	1,600,000	3,200,000
Totals	3,325,000		2,913,700	6,239,200

Post-Breeding Populations of Whitewing Colonies

Estimates of post-breeding season populations of the colonies are presented in Table 1. Population estimates for a large area of scattered nesting between San Fernando and Padilla were added to the estimates for the Padilla area in this table. It can be seen in Table 1. that the total breeding population figure has remained almost constant despite large fluctuations in individual colonies.

NESTING STUDIES

Spring Arrival

The whitewings arrive in the nesting areas from their Central American wintering grounds in early or mid-April. In the southern colonies initiation of nesting efforts depend on the condition of the vegetation. The thorn forest is largely dry-season deciduous, and until the spring rains cause a flush of growth the birds coo a great deal but do little else. If the vegetation is green when they arrive, they will begin nesting almost immediately. Nesting in the southern colonies tends to be limited to a single effort since long dry periods following the spring rains often cause the vegetation to defoliate again. When this occurs, nesting activities rapidly decrease, often ending in June.

The cactus-nesting birds of the San Fernando area seem to pay much less attention to the condition of the other vegetation and nesting activities regularly begin there during the last week of April or the first week in May. Nesting activity is much more prolonged, extending well into August and often exhibiting two peaks of activity. The southern colonies also exhibited a tendency toward two peaks in 1966 when conditions were ideal with plenty of moisture and abundant food.

Nesting Habits

Most whitewing nests are located between 5 and 10 feet from the ground with extremes of 2 and 25 feet being recorded in this study. The nests may be built in almost any possible situation which would offer some promise of support. In general, however, the nests in the Mexican colonies seem to be more substantial and larger than those in the Lower Rio Grande Valley of Texas. Exceptions would be some of the nests located in prickly pear which consist of only scattered twigs laid on a horizontal pad.

Nests are often located quite close together, and occasionally one may be constructed directly above the other, separated by as little as 10 inches. Several nests were recorded which were separated by 14 to 18 inches horizontally. The large prickly pear cacti often held three to five active nests at one time. Few territorial conflicts were observed, which is in contrast to observations in Texas colonies (Cottam and Trefethen, 1968).

Nest Transect Studies

Belt transects, 121 yards by 10 yards and covering 1/4 acre each, were established in five colonies in 1966 and 1967 and in three colonies in 1968. These transects were checked weekly or as often as possible and each nest numbered and the contents recorded. The height of each nest and the plant species were also recorded.

Data from these transects are presented in Table 2 and Table 3. Table 2. gives the number of nests which were active, that is containing eggs or young during each week of the nesting season. Table 3. presents average peak nests per acre figures which aid in population estimates and figures indicating nesting success. Most of the loss of eggs and young is attributed to predation.

TABLE 2. AVERAGE NUMBER OF ACTIVE NESTS ON THE TRANSECTS BY WEEKS—1966,[1] 1967,[2] 1968[3]

Area, year, and No. of transects	4/17	4/24	5/1	5/8	5/15	5/22	5/29	6/5	6/12	6/19	6/26	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28
San Fernando Lake (1) 1966	0	0	1	0	1	3	6	25	25	30	11	11	20	21	23	25	8	7	0	0
San Fernando Hill (2) 1966	0	7	12	21	19	17	29	20	20	23	27	25	25	23	20	21	12	8	3	1
Padilla (2) 1966	0	1	6	11	10	11	10	3	5	5	6	5	4	3	2	0	0	0	0	0
Lacaille (2) 1966	0	7	15	23	13	16	9	7	1	2	1	2	9	5	5	5	3	1	0	0
Agua Marina (2) 1966[4]	—	—	—	—	—	—	—	—	—	1	3	7	8	7	5	5	2	0	0	0
San Fernando Hill (2) 1967	0	0	0	2	12	17	30	29	33	29	30	21	17	9	9	4	4	2	0	0
Padilla (2) 1967	0	0	1	4	5	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Lacaille (2) 1967	0	0	33	29	33	24	15	1	0	0	1	0	0	0	0	0	0	0	0	0
Agua Marina (2) 1967	2	25	25	31	24	13	3	0	1	2	3	2	0	0	0	0	0	0	0	0
San Jose (2) 1967	0	0	0	0	0	0	4	10	22	21	15	22	4	0	0	0	0	0	0	0
San Fernando Hill (2) 1966	0	0	6	2	6	6	10	14	23	23	23	12	17	19	23	14	11	0	0	0
Lacaille (3) 1968	3	11	32	29	32	18	15	17	15	12	2	1	0	0	0	0	0	0	0	0
Agua Marina (2) 1968	1	2	13	10	16	11	12	9	8	6	6	8	1	1	1	0	0	0	0	0

[1] Wet spring and summer, abundant food.
[2] Dry spring and summer in southern colonies, poor food conditions.
[3] Wet spring and summer with poor mid-summer food conditions in southern colonies.
[4] Established late in the breeding season.

TABLE 3. SUMMARY OF WHITE-WINGED DOVE NESTING STATISTICS FROM NORTHEASTERN MEXICO—1966, 1967, 1968

Area and No. of transects	Average peak active nests/acre	Total eggs on transects	Total young on transects	Total young fledged on transects	Average % of eggs hatched	Average % of young fledging	Average % eggs fledging young
1966							
San Fernando Hill (2)	110	245	167	136	68	81	56
San Fernando Lake (1)	114	135	65	44	47	70	33
Lacaille (2)[1]	90	148	71	61	48	86	41
Agua Marina (2)[1]	—	43	23	18	53	78	42
Padilla (2)	38	63	23	19	37	83	30
1967							
San Fernando Hill (2)	132	276	188	159	68	85	58
Lacaille (2)	136	150	105	77	70	73	51
Agua Marina (2)	122	144	82	66	57	80	46
Padilla (2)	24	29	0	0	0	0	0
San Jose (2)	96	97	71	66	73	93	68
1968							
San Fernando Hill (2)	96	264	140	120	53	86	45
Lacaille (3)	136	347	239	204	69	85	59
Agua Marina (2)	70	128	51	44	40	86	34

[1] Established late in nesting season.

Predation

The most important predator on whitewing nests in northeastern Mexico is believed to be the Mexican crow (*Corvis imparatus*). This bird was seen on all the whitewing nesting areas and was particularly common in the San Fernando area. Crows were observed flying with whitewing eggs and young in their bills on numerous occasions. This action was observed 26 times in one day near San Fernando. Ten crows were shot in one morning on the San Fernando hill-top area and the stomachs of seven contained nestling whitewings. All 10 crows had been feeding on cactus fruits.

Another important nest predator in the areas from Padilla southward is the brown jay (*Psilorhinus morio*). These large jays were observed taking whitewing eggs near Mante and particularly at Padilla.

Great-tailed grackles (*Cassidix mexicanus*) were observed on all areas, but were numerous only in the San Fernando lake colony and the Padilla colony. Grackles were observed feeding on whitewing eggs on numerous occasions at Padilla.

Green jays (*Xanthoura yncas*) were observed on all colonies but were not common. They probably take some eggs and young but are not particularly important.

Coachwhip snakes (*Masticophis flagellum testaceus*) were common on all areas and were observed climbing through the trees on three occasions. There is little doubt that these snakes prey on eggs and nestlings.

The natives in the areas of the colonies stated that the ring-tailed cat (*Bassariscus astutus*) was an important whitewing nest predator. Several other mammals were observed in the colonies including: coatis (*Nasua narica*), weasels (*Mustela frenata*), jaguarundis (*Felis yagouaroundi*), bobcats (*Lynx rufus*), gray foxes (*Urocyon cinereoargenteus*), and opossums (*Didelphis marsupialis*). All of these probably prey on whitewing eggs and young and occasionally on incubating adults.

BANDING

A trial effort to trap and band whitewing adults and flying young in the Mexico colonies was undertaken in 1966. This effort was quite successful with 4,792 whitewings banded. These results encouraged an expanded trapping program which was financed largely through U.S. Bureau of Sport Fisheries and Wildlife contract funds. Under this program 22,152 whitewings were banded in 1967, 24,359 in 1968, and 15,012 in 1969 for a total of 66,315 whitewings banded to date. This program is scheduled to continue at least through 1970.

Preliminary analysis of band recoveries received by October 1, 1969 indicates the Mexican whitewing colonies may contribute many more birds to both the breeding and hunting season populations of Texas than was earlier suspected.

CONCLUSIONS

It is evident that the large white-winged dove populations of northeastern Mexico face an uncertain future due to the almost certain clearing of the areas now used for colonial nesting. It seems likely that the birds will move to new nesting areas, but in time the supply of new land suitable to the whitewings may well become limited. It would seem desirable to preserve some of these nesting areas, not only for the whitewings, but also to preserve many of the other interesting and unique plants and animals which occur on these areas. There would be opposition to such action and not without cause; a million whitewings can eat 22 tons of grain sorghum in one day. One should not overlook the potential income from sport hunting, however.

Most of the native whitewing habitat has been cleared in the Lower Rio Grande Valley of Texas but it was replaced in many areas with a substitute, the citrus grove, to which the whitewing adapted. This is not the case in Mexico. The whitewing has not yet learned to nest in sorghum, corn, or cotton fields.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. J. G. Teer and Mr. W. H. Kiel for their advice and assistance in planning and conducting this project. Special thanks go to Dr. Rodolfo Hernandez Corzo, Director General of the Mexican Department of Conservation and Propagation of Wildlife, for his cooperation in providing permission for this study. Thanks go to Mr. Bruce Duke, Mr. Kenneth Matthews, Dr. Harold Irby, and the many undergraduate students involved in the banding program for their able assistance in the field. I am also most grateful to Dr. M. C. Johnston for his help in plant identification.

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DISCUSSION

MR. JOHN OLIVER (Western Pacific Conservancy): Recognizing the future problems that you described, what has been the position of the state governments and the Mexican Government on this?

MR. BLANKINSHIP: The Mexican Game Department has expressed definite interest in establishing some refuges, and there has been some effort along this line, working through the World Wildlife Fund. However, I understand that there have been some problems with the ability of the Mexican Government to guarantee that these areas can be preserved for a long period of time or in perpetuity as refuges and this has held up acquisition.

FROM THE FLOOR: Are there any unifying ecological attributes that make a colony?

MR. BLANKINSHIP: The only thing I can find is a physical appearance of the brush. Here I have reference to the structure which is the dense thicket type of vegetation in proximity to a supply of fresh water. There are many places in northeastern Mexico which would seem to meet the requirements but the whitewings are not there. Leopold observed this in his book on wildlife in Mexico. For some reasons, the birds pick these places, and I have not been able to find any definite reasons as to why these places were selected.

However, there is an indication that if these areas are destroyed the whitewings will move to other areas, some of which have not been occupied before.

CHAIRMAN TOMLINSON: I would like to know whether all these birds are migratory; whether some birds stay there during a certain period of time.

MR. BLANKINSHIP: The populations in Texas and Northern Mexico are virtually entirely migratory. They leave the areas. They arrive at the areas in early April and then remain until late July or sometimes as long as November. However, generally, they migrate into extreme southern Mexico and Central America and into Guatemala and other areas.

DISCUSSION LEADER WIGHT: How about numbers? In other words, do you have a lot of movement between colonies by year or would you have a trend established that you could report on?

MR. BLANKINSHIP: Yes, the breeding populations have remained remarkably stable even though there has been great migration between the colonies. The breeding population total estimated for 1966, was 3,145,000; for 1967 it was 3,405,000 and for 1968 it was 3,325,000, which is remarkably constant. The estimates of the post-breeding population range from 5,324,000 to a high of 6,239,000.

MR. AL JONEZ (Bureau of Reclamation, Nevada): In your discussion on banding, you mentioned that there is apparently very little population interchange in Texas.

MR. BLANKINSHIP: Yes. We would expect, however, that some interchange took place, that some birds from Mexico moved into Texas during the hunting season but to what extent we do not know. Our banding recoveries indicate this may be ranging in the neighborhood of perhaps 8 percent. We are still working on that and still getting a lot of recoveries. Therefore, it is a little early to make a statement.

Also, there are some birds coming from Mexican colonies which were either hatched or bred there at one time. They have been captured in Texas breeding areas.

DISCUSSION LEADER WIGHT: Thank you very much for a most interesting report.

CHARACTERISTICS OF A HEAVILY HUNTED WOODCOCK POPULATION IN WEST VIRGINIA

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An objective of *Man's Stake in a Good Environment* is to provide maximum "outdoor" recreation for "sportsmen" from wildlife resources. It must be recognized that different populations of game animals and different hunter-interest groups have unique characteristics. Consequently, one of management's objectives is to enact regulations which permit a liberal harvest without adversely affecting future population levels or the aesthetic values derived from hunting.

Research on migratory game birds has shown that prehunting season banding, plus production data, provides useful information for management purposes. Recoveries from bandings reveal that mortality rates, production rates, shooting pressures, distribution of the harvest, and hunting vulnerability may differ between: population segments, periods of the hunting season, and by age and/or sex categories.

Hunting is usually considered "additive" to annual *waterfowl* mortality and "compensatory" for most *nonmigratory upland* game birds. To determine vital statistics characterizing a heavily hunted "resident" population of *migratory upland* game birds and the effect of concentrated hunting pressure on hunter behavior, an intensive woodcock (*Philohela minor*) banding and data gathering program was initiated in the Canaan Valley of West Virginia in 1966.

STUDY AREA

The Canaan Valley is a cigar-shaped basin of approximately 40-square miles "perched" about 3,200 feet above sea level in the mountains of northeastern West Virginia. Its landscape consists of low smooth hills and wide stream bottoms. The northern half is composed of poorly drained organic soils, while well-drained soils predominate in the southern portion. Vegetation is common to more northern environments in spite of its relatively southern latitude of 39°05′. Thornwaite (1948) classified the climate as cold and humid—slightly warmer than his "tundra" classification. Daily maximum temperatures during the summer average 75° to 78° F; the frost-free season extends for about 4 months. Average annual precipitation is 53.53 inches and evenly distributed throughout the year. More complete descriptions of the Canaan Valley's geography, soil, vegetation, and climate are found in Phillips (1921) and Weedfall and Dickerson (1965).

METHODS

Trapping Techniques

Initial attempts to trap woodcock in 1964 and 1965 were primarily with mist nets and in ground traps. These techniques were described by Liscinsky and Bailey (1955), Sheldon (1960), and Clark (1966). When intensive banding commenced in 1966, an effective method of nightlighting was developed by Rieffenberger and Kletzly (1967). This method was based on techniques originally developed on the woodcock's wintering grounds (Glasgow, 1958) and demonstrated to be successful on breeding areas by Martin and Clark (1964).

Hunter Interviews

An intensive effort was made to contact hunters, examine woodcock, procure bands, and obtain hunting experience information during the 1966-1969 seasons. This was accomplished by checking stations, questionnaires placed on automobile windshields, and signs posted throughout the Study Area requesting hunters' cooperation. Hunter interviews solicited data on the number of: (1) parties, (2) hunters, (3) hours hunted, (4) woodcock flushed, and (5) woodcock killed.

Analysis of Data

This paper involves band recoveries received through February 1970. Terminology used in the analysis of recoveries was defined by Moisan *et al.* (1967).

Preseason ("resident") woodcock population estimates were determined from indirect procedures as described by Kaczynski and Geis (1961) and Davis (1963). These two approaches were based on bandings during the "summer" (April 15-September 20) and their subsequent direct recovery during the first 7 days of hunting. The Lincoln Index method utilized the relationship that:

$$\frac{\text{"Summer"–Banded Woodcock}}{\text{"Resident" Woodcock Population}} = \frac{\text{Banded Woodcock Reported Shot}}{\text{Total Woodcock Reported Shot}}$$

Results from the harvest rate method depended on the accuracy of estimating retrieved kill and band reporting rates:

$$\text{"Resident" Woodcock Population} = \frac{\text{Estimated Retrieved Kill}}{\text{Recovery Rate} \div \text{Estimated Reporting Rate}}$$

Another population estimate was obtained from counts of singing males. "Routes" were systematically distributed, randomly selected, and conducted on foot because road systems were not conducive to this type of survey. Restrictions on conducting counts were as described by Goudy (1960) and Duke (1966).

Average annual mortality estimates were calculated by the relative recovery rate method from techniques described by Geis and Taber (1963) and refined by Miller *et al.* (1968). Estimates were determined for each age and sex class and an overall rate obtained by weighting each category with population composition data.

A. D. Geis (pers. comm., 1969) provided a procedure for estimating the extent to which the breeding population of a migratory bird study area is supplemented by birds produced elsewhere. This analysis was based on the following theory: If all surviving woodcock that bred or were produced in the Canaan Valley one "summer" were present the next "summer" (and no birds from elsewhere moved into the area) the percent of the kill that was banded during the preceding "summer" should be the same. The extent to which the "adult second-year percent of the kill banded" was less than the "all age

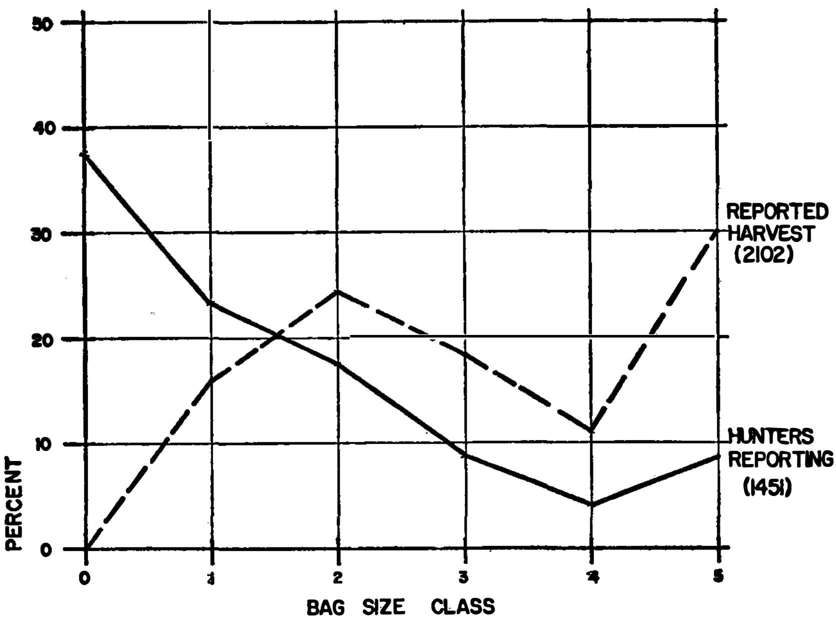

Figure 1
Woodcock harvest and hunter "success" by bag size class in the Canaan Valley, W. Va. (1966-1969).

first-year percent of the kill banded" was used as a reflection of movement of "new" adults into the Valley.

RESULTS AND DISCUSSION

Hunting Results and Hunter Behavior

During the 1966-1969 seasons, 1,451 hunters reported killing 2,102 woodcock in the Canaan Valley. Harvest and hunter "success" by bag size classes are shown in Figure 1. Almost 38 percent of the hunters were unsuccessful and less than 9 percent obtained the daily bag limit. Note, however, that this 9 percent of hunters accounted for 30 percent of the total harvest.

Hunting pressure fluctuated during the 4 years with 1968-1969 indicating a substantial increase over 1966-1967. Most of this increase was due to implementation of a 7-day mid-September season, as opposed to the 1966 and 1967 mid-October opening. The additional September season increased the mean days hunted from 29 in 1966

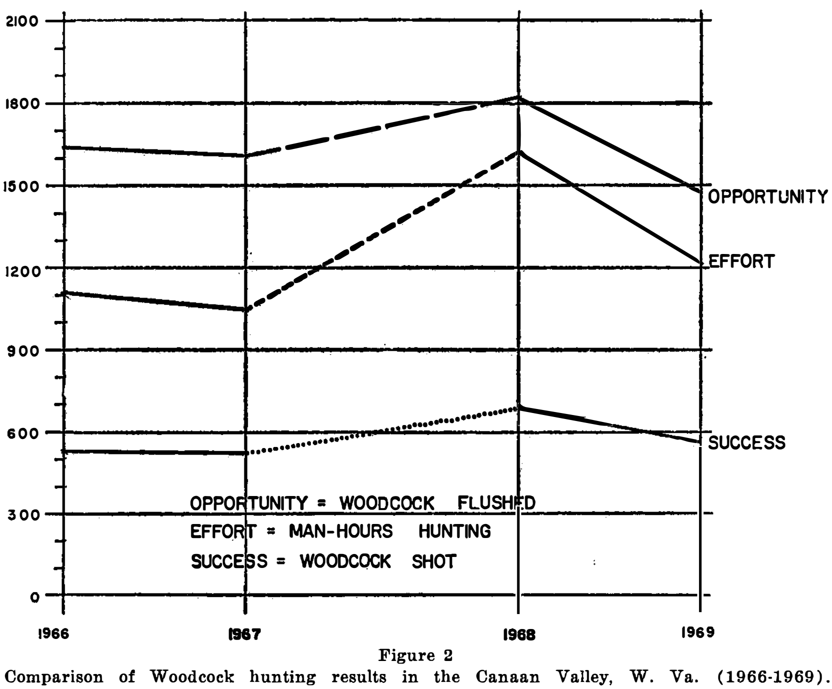

Figure 2
Comparison of Woodcock hunting results in the Canaan Valley, W. Va. (1966-1969).

and 1967 to 37 in 1968 and 1969—gun-hours increased 24 percent during 1968-1969.

Woodcock flushes showed the same trend as hours hunted; however, kill-per-hunter and kill-per-season did not change significantly (Figure 2). The Canaan Valley has a limited amount of optimum diurnal habitat ($\pm$ 5 square miles); therefore, an increase in hunting pressure does not necessarily increase the harvest.

High hunting pressure adversely affected hunter attitudes. In 1966 and 1967 many hunters reported "good" hunting, while in 1968 and 1969 many of the same individuals were disgruntled due to competition for coverts and "wildness" of the birds. The percent of hunters in bag size classes 1 through 4 was lower in the 1968-1969 seasons and 27 percent higher in the zero category. Even though the average annual harvest increased 15 percent in 1968-1969, a 24 percent rise in gun-hours resulted in many hunters being dissatisfied.

Hunting success increased as the season advanced. During the September season almost 70 percent of the hunters were unsuccessful, and only 3 percent obtained a bag of 4 or 5. After October 26th both availability of woodcock (immigration) and visibility (leaf-fall) improved. During late October and early November, 16 to 17 percent of the hunters killed 4 or 5 birds per day.

Definitions of the Population

The Canaan Valley "resident" woodcock population has been sampled by the banding of adults and immatures since exploratory attempts in 1964 and 1965 when 70 birds were "marked." During 1964-1969, 1,634 woodcock were banded in the Study Area. However, this paper involves only birds banded as "residents" (April 15-September 20) in 1966 through 1969—1,015 woodcock, of which 252 have been reported shot.

Examination of band recovery rates suggested some age and/or sex categories were more likely to be shot than others. Chi-square tests comparing recovery rates with age and sex ratios in the preseason population revealed significant differences ($p > 0.05$): Immature males were most vulnerable to hunting, adult males more vulnerable than females, with no difference detected in hunting vulnerability between adult and immature females. This should be cautiously interpreted since changes in age and/or sex ratios between the banding period and the hunting season must be considered.

The Canaan Valley "resident" population fluctuated annually but did not change measurably from a mean "summer" population of 1,200 to 1,400 woodcock during the 4 years of intensive hunting. The harvest rate method resulted in significantly (p > 0.05) higher preseason population estimates than the Lincoln Index technique. This difference was because the former included estimates of nonreported bands and total harvest. Estimates derived by segregrating age and sex categories (recognizing differential vulnerability to hunting) were consistently higher than those obtained from combined data (Figure 3).

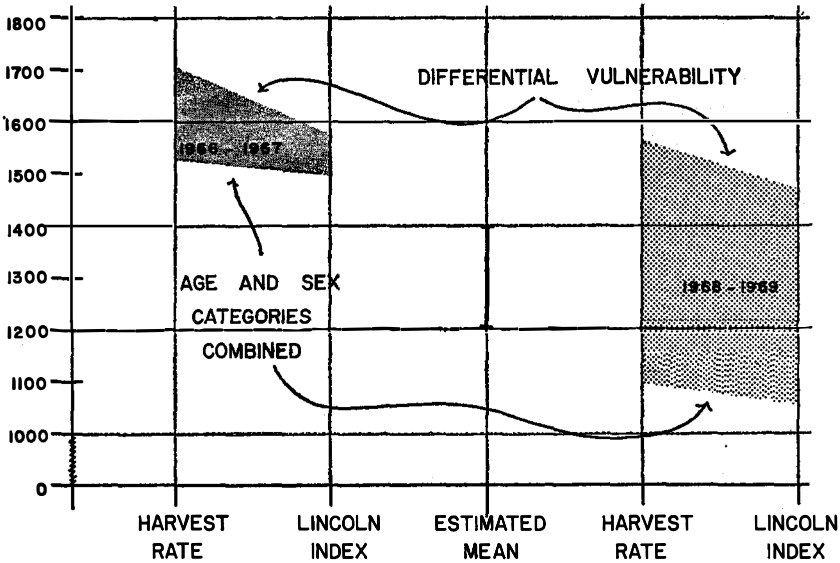

Figure 3
Preseason (resident) Wooddock population estimates in the Canaan Valley, W. Va. (1966-1969).

Preseason Population Composition

Data from 1966-1969 were pooled to obtain estimates of age and sex ratios in the preseason population. Age and sex ratios in the kill during the first 7 days of hunting were adjusted for differential vulnerability using recovery rates obtained during the same period. Estimates of preseason population composition during the 4 years were 16 percent adult males, 30 percent adult females, and 54 percent immatures, resulting in an age ratio of 1.17 immatures per adult and 1.80 immatures per adult female. Sheldon (1967:140) indicates overall average annual productivity for this species is about 50 percent.

When the proportion of adult males (16 percent) was applied to the estimated average annual "resident" population (1,300), the resulting adult male population estimate was 208. This was 31 percent higher than the singing-ground survey population estimate; thus, supporting Sheldon's (1967:47) and Modafferi's (1967:42) contention that there may be surplus males in the breeding population.

Mortality Estimates

Average annual mortality rates of "resident" woodcock in the Canaan Valley were higher than expected from observed production rates and relatively stable preseason population estimates. As estimated by the relative recovery rate method, annual mortality rates were 72 percent during 1966-1968 when weighted with preseason population composition data. Reliability of this parameter was affected by lack of indirect recoveries. However, it is becoming apparent that "resident" woodcock banded as adults in the Canaan Valley have lower mortality rates than immatures, and immature males have the highest rate of mortality. Martin *et al.* (1969) showed that average annual mortality rates of adult females banded on Louisiana wintering grounds during 1948-1966 were approximately 40 percent, and suggested adult male mortality exceeded that of females.

Mortality Versus Production Plus Adult Recruitment

Comparison of the mortality rate (72 percent) with the average annual production rate (54 percent) implies that the "resident" population was not maintaining itself and should have declined rapidly. However, preseason estimates reflected a stable "resident" population that fluctuated ($\pm$ 15 percent) around a mean of 1,300.

The inconsistency of population, production, and mortality data suggests: (1) Mortality estimates were inflated because of some woodcock not returning to the Valley after their first summer, and/or (2) the breeding population received recruitment from birds not produced in the Study Area.

It seems reasonable to postulate that woodcock, like some species of waterfowl, have a wide distribution of recoveries during the second and later seasons after originally being banded on their natal areas. Woodcock not returning to the Valley were, presumably, subjected to lower shooting pressure which reduced indirect recoveries and thereby increased mortality rate estimates.

The extent to which the Canaan Valley preseason adult population from 1966 through 1969 was supplemented by woodcock that moved into the Study Area from elsewhere was estimated on the following relationships (A.D. Geis, pers. comm.):

$$\frac{CR_1}{CK} = PK_1;\ \frac{AR_2}{AK} = PK_2;\ \frac{PK_2}{PK_1} = APY;\ 100\% - APY = SFE$$

where:

CR_1 = Combined direct recoveries of "residents" for all age and sex categories during first week(s) of the hunting season in 1966–1969.

CK = Combined reported kill for all age and sex categories during first week(s) of the hunting season in 1966–1969.

PK_1 = Percent of direct recoveries in reported kill for all age and sex categories combined that were banded as "residents" and recovered during first week(s) of the hunting season in 1966–1969.

AR_2 = Adult and immature (when banded) second-year recoveries during first week(s) of the hunting season in 1967–1969.

AK = Adult reported kill (adjusted for unknown age and/or sex categories) during first week(s) of the hunting season in 1967–1969.

PK_2 = Percent of second-year recoveries in the adjusted reported kill of adults and immatures banded as "residents" and recovered during the first week(s) of the hunting season in 1967–1969.

APY = Percent of "resident" adults present in the Canaan Valley in a particular year that were also present in the Study Area during the preceding "summer."

SFE = Percent of the Canaan Valley's preseason adult population during 1966 through 1969 that moved into the Study Area from elsewhere.

An estimate of adult recruitment was determined from "summer" bandings and the reported kill in September and through the first 7 days of hunting in October. Results indicated that approximately 56 percent of the adult population at this time each year represented woodcock that had moved into the Canaan Valley from elsewhere. Because data for banding rates, recovery rates, years, and age and sex ratios were combined in spite of differences known to exist, the percent of adult increment was only a reection of actual recruitment. However, considering stable breeding population indexes, logical production rates, and unrealistically high mortality estimates, it seems valid to assume that there was a substantial annual recruitment of adult woodcock into the Canaan Valley breeding population.

Mortality Due to Hunting

The percent of average annual mortality due to hunting in the Canaan Valley is apparently increasing. Goudy *et al.* (1969) reported 29-30 percent of adult male, adult female, and immature female mortality, plus about 41 percent of immature male mortality, was due to hunting during 1965-1968. Calculations of these rates from 1966 through 1969 indicated an overall hunting mortality rate of 38 percent. This was comprised of 34 percent adults, 36 percent immature females, and 44 percent immature males. While it is likely true that "shooting probably is not a major cause of mortality in the overall population" (Martin *et al.*, 1969), it is submitted that heavy hunting pressure can increase annual mortality rates for endemic populations of woodcock. Sheldon (1967:150) states " . . . heavy gun pressure on local coverts before migration begins may cause heavy decimation of native woodcock. We have no evidence, however, that the continental population is noticeably decreased by hunting."

RECOMMENDATIONS

Endeavoring to satisfy hunter-attitudes, while still maintaining biologically and/or ecologically balanced breeding levels in wildlife populations, is one of the difficult tasks of game management. Clement (1969) reflected on this problem while discussing some of the sociological and psychological aspects of hunting. To corroborate effects of regulations on woodcock survival and hunter behavior, the following changes are recommended for an extended 2-year Canaan Valley woodcock study: (1) reduce daily bag limits from 5 to 3 in September and October, and (2) increase the daily bag to 10 in November.

It is believed a more obtainable bag limit of three will provide more hunter satisfaction in September. Almost 70 percent of September hunters have been unsuccessful, and only 3 percent achieved the maximum bag allowed per day (Figure 4). A reduced daily bag will probably not be as readily accepted by hunters in October because of increased woodcock availability; however, to test effects of hunting on annual mortality, this reduction is necessary. By November most "resident" woodcock have emigrated from the Valley, and (due to immigration) a daily bag of 10 is often obtainable. Nevertheless, this large a daily kill may not be aesthetically acceptable to the majority of woodcock hunters. This experimental change in regulations should help to ascertain the maximum and minimum daily bag acceptable, for whatever reason, to woodcock hunters.

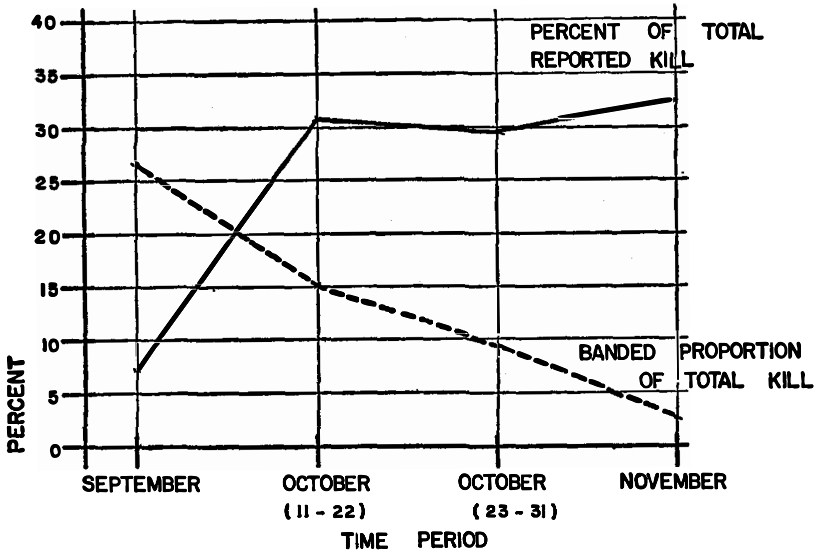

Figure 4
Relationship between total reported kill and proportion of resident banded Woodcock by different times of the season in Canaan Valley, W. Va. (1966-1969).

SUMMARY AND CONCLUSIONS

The effect of heavy hunting pressure on a "resident" migratory upland game bird population was evaluated on the basis of 1,015 woodcock bandings and 1,451 hunter interviews in the Canaan Valley of West Virginia during 1966-1969. From these activities, an estimated 94 percent of the total harvest in the Study Area was reported, including 252 "summer"-banded birds.

Analyses of band recoveries and data collected from hunter interviews resulted in the following conclusions:

1. High hunting pressure had a detrimental affect on hunter attitudes and did not appreciably increase the total harvest.
2. Hunting success increased as the season advanced, until mid-November when most woodcock had immigrated farther south.
3. "Resident" populations did not change measurably from 1966-1969 when between 1,200 and 1,400 woodcock were present during the "summer."
4. The Valley's preseason population consisted of 16 percent adult males, 30 percent adult females, and 54 percent immatures.
5. Average annual mortality rate estimates for 1966-1969 (72 percent when weighted with preseason age and sex ratios) were higher than expected from the production rate (54 percent) and relatively stable "summer" population estimates.
6. "Resident" woodcock banded as adults had lower average

annual mortality rates than immatures, and immature males had the highest rate of annual mortality.

7. The Canaan Valley population of breeding adults was supplemented annually by woodcock produced elsewhere.
8. Hunting accounted for 38 percent of all woodcock mortality in 1966-1968; immature males were most vulnerable to the gun, while females of both age classes were least susceptible.
9. A study to determine an aesthetic as well as biological daily bag size for woodcock is recommended.

The crux involved in studying migratory game bird populations in endemic situations was illustrated by this study. It is virtually impossible to ascertain with certainty the entire population dynamics of woodcock on the basis of numerous observations in a few, limited locations. Migratory game birds must be managed on a regional basis—pointing up the wisdom of establishing waterfowl flyways and mourning dove management units.

ACKNOWLEDGMENTS

This study was conducted by the West Virginia Wildlife Resources Division in cooperation with the U.S. Bureau of Sport Fisheries and Wildlife and is a contribution of Pittman-Robertson Project W-37-R. Fant W. Martin and James M. Ruckel developed the project outline. Aelred D. Geis assisted with initial data analyses and provided unpublished techniques to interpret various aspects of this study. Robert L. Smith, John D. Gill, and Jack Ward Thomas critically reviewed the manuscript. Editorial assistance was provided by Beverly R. Shipe. Illustrations were constructed by James F. Haden and Gary L. Stevens, while Charles D. Waggy conducted statistical tests. T. R. "Pete" Samsell, Peter E. Zurbuch, and F. B. "Mickey" Schuler provided administrative guidance.

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DISCUSSION

DISCUSSION LEADER WIGHT: I am sure this paper will generate some questions.

DR. WILLIAM G. SHELDON (Massachusetts): I thought this was a very interesting paper. Could you elaborate a little on how you measure vulnerability, either at certain age classes or otherwise? Are there migration patterns or other things that you can use to gauge these things?

MR. GOUDY: These estimates were based on banding during the summer, April 15th to September 20th, and then determined from the first week of hunting—the first seven days. There is a possibility of error if the pre-season population does change prior to the hunting period. We feel that these estimates are pretty close to being accurate.

MR. ROBERT L. SMITH (West Virginia University): There are several different methods that can be used to estimate mortality from banding data. By using your same data which you have access to in constructing a so-called both dynamic and time-specific life tables, you get an estimate of mortality at 87 percent. Do you feel that your mortality of juveniles is too low or do you think that the mortality actually lies somewhere between 72 and 87 percent?

MR. GOUDY: The 72 percent mortality rate was based on separating immature and adult males and adult females and is an average mortality rate based on the recovery rate method. The reason we did not calculate these figures using the time specific and dynamic approach was because of the underlying implications of the population not being altered and that we did have a change in hunting pressure.

MR. SMITH: Based on the hunting mortality of birds in the valley, you do get a rather high immigration of new birds in the valley for next breeding season? Would you encourage other areas to go into this early resident bird hunting prior to the migratory birds coming in?

MR. GOUDY: I feel quite certain in areas as heavily hunted as this valley you can decrease the local population, but due to our situation, which is located south in the breeding range, we were able to, we feel, pick up birds that are migrating north in the spring. This fills in the void we have created the previous year, especially in order to test some of the theories that we were going to use that would reduce daily bag.

MR. SMITH: One final question. Do you think that we should continue to popularize the woodcock hunting among the masses of hunters in view of the hunter attitude survey that we took among the dyed-in-the-wool woodcockers?

MR. GOUDY: I don't think we can say that they are all dyed-in-the-wool woodcockers. Based on 38 successful hunters we found, for example, that there were only 9 percent who attained the maximum daily bag limit. However, it seems likely that I personally feel that there is nothing wrong with popularizing woodcock hunting or most any other sport. I think this all goes back to the idea that we do need more data from other areas throughout the range. I also think we should have management units. There is none at the present time.

MR. HENRY SHAEFFER (New Jersey): I would like to know if you received band returns from areas north of West Virginia. Also a suggestion on this ten-a-day bag limit proposed for November: Where I come from we have a very high concentration of woodcocks in the late fall extending well into winter, where it would be possible to shoot a large number of birds on any given day, maybe twenty or thirty. We adhere to a federal bag limit of five. We believe that the birds we get in this area are birds that have not hatched in our area but come to us from northerly breeding grounds, and we have always been under the impression that most of our woodcock come from the Maritime Provinces.

I think if you tried to make an exception in the case of West Virginia, with a daily bag limit of ten, you will start something in other areas which might make a lot of people unhappy.

We have a lot of woodcock hunters and, as I say, we do have a lot of birds in November and December in the Cape May County area.

MR. GOUDY: To clarify your second question first, this was proposed only as an experimental study in this area of West Virginia and, further, it is to study the effect of bag limits on hunter attitude. In other words, is it aesthetically feasible for any woodcock hunter to want to kill 10, 20, or 30 woodcock? These are some of the things we would like to find out.

In relation to the band recovery north of West Virginia, the data you have seen in this paper were based on summer banding of resident birds. We have also banded in the fall, primarily in October and November, and from these birds we have had northern recoveries. We have not received any from summer bandings to the north of us. They have only been located or shot or recovered farther south and after the summer period.

There is evidence, however, there was an immature bird banded and found ten miles from the study area and which was reported shot the following fall in New York. This goes back to what we were talking about—the exaggerated mortality rates. These young birds, in particular, do not return to the valley.

Now, as far as the other factors are concerned, the hunting pressure is quite likely to be less outside of the valley than inside the study area.

MR. WILLIAM KIEL JR. (Texas): I would like to ask you if you obtained your band recovery through check stations in relation to a uniform method, because this might have an effect on the calculated mortality of the birds?

MR. GOUDY: Yes, we estimate it is about 94 percent. It is done through check stations and very closely watched. Most of the hunters know what we are involved in. It hasn't changed and we get most of them.

RUFFED GROUSE: AN INDICATOR OF ENVIRONMENTAL CHANGE

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The response of ruffed grouse (*Bonsas umbellus*) populations to environmental change is well documented (Bump *et al.* 1947:54). Historical records indicated that grouse were not abundant in the extensive climax forests. Pre-settlement populations probably were highest along streams and in ecotones between coniferous and deciduous forests. Grouse numbers increased noticeably in second-growth timber following settlement and lumbering, but the birds disappeared where land clearing was intensive.

Ruffed grouse response to environmental change has been varied. Where soil and climate resulted in the complete conversion of forests to agricultural lands, the ruffed grouse is eliminated. However, partial disturbance by burning and logging in the northern boreal forests is followed by increasing grouse numbers.

This paper reports, with special emphasis on Missouri, some environmental changes that have occurred and how they have affected ruffed grouse populations.

INDICATOR CONCEPT

Using ruffed grouse as an indicator species of environmental change may be a new idea, but the concept of plants and animals as indicators of specific environments isn't new. Clements (1928:234) reported that plants and animals are products of their environment and are thereby indicators of these conditions. Dansereau (1957:326) gives the definition of an indicator as "an organism of narrow ecological amplitude whose very presence (or abundance) reveals the character or intensity of an element in the ecosystem."

Animals as indicators of environmental conditions are subordinate to plants because they depend on plants for food. Any major environmental change will ultimately be reflected by the replacement of one plant species by another or one plant community by another. The ultimate in plant development is the climax or mature community. The climax community will persist until there is a change in the environment (Shelford 1963:6).

The ruffed grouse is well qualified as an indicator of environmental change. Be it known as the "woods pheasant" of the Ozarks, or the "pat" of the Lake States, it occupies a wider range of environmental types than any other non-migratory game bird in North America. (Bump *et al.* 1947:48). Though grouse are found across a broad geographical area their habitat requirements are very specific. This bird, with 13 recognized subspecies, is the most racially variable of all North American Tetraonidae (Aldrich 1963:529).

A classic example of plants and animals responding to environmental change is Grange's (1948:206) study of man's influence on two townships in central Wisconsin.

Before settlement, this area was forested. Fire, lumbering, drainage and agriculture changed the forest to a prairie. Prairie chicken (*Tympanuchus cupido*) and sharptails (*Pedioecetes phasianellus*) became abundant. Most of the area was marginal for farming. A disastrous fire in 1920 hastened abandonment of farms. Succession made the area marginal for prairie grouse, but it became good ruffed grouse habitat.

In summarizing the habitat chronology for the area, Grange indicated that it was difficult to look back and visualize the enormous vegetational changes that had occurred over the years. To the present generation, the country has always existed as it is seen today. The open-vista fire-burned country of yesteryear is not perceived when one looks out on the landscape.

Ruffed grouse have demonstrated responses to environmental changes in other regions of the country, but histories are not as complete as reported by Grange.

Sharp (1963:664) reported grouse became abundant in Pennsylvania and other eastern states following forest fires, timber operations and abandonment of farmlands prior to 1910. During the next 40-60 years succession changed the environment and grouse population declined.

Agricultural developments eliminated grouse from an area starting in western Ohio, extending westward to Iowa and south to Arkansas and western Tennessee (Edminster 1954:199). Bump *et al.* (1947:50) mentioned that the elimination of grouse in the central Midwest was largely complete by 1900 except in a few restricted areas where they continued to survive for a number of years.

Leopold (1931:149) indicated that the small remnant grouse populations found in ungrazed wooded areas along the river bluffs of Iowa, Illinois, and Indiana were strongly suggestive of a special affinity by grouse for this type of habitat. He had the opinion that the center of the north-central region was the optimum range for ruffed grouse, and that the bulk of its present distribution occurred in marginal environments. In support of this hypothesis, Leopold (1933:59) suggested that ruffed grouse in northern habitat demonstrated cyclic behavior typical of a species on the edge of its range; while in the southern part of their range they did not.

Historical accounts disagree about the relative numbers of the "woods pheasant" in Missouri. Alphonso Wetmore in 1830 related that the pheasant "has followed the settler and multiplied greatly in the country within the last five years. The old inhabitants do not remember to have seen one here in the early settlement of the country" (McKinley, 1960). A farmer in Franklin County Missouri in 1835 said that "the forest pheasant was frequently seen in the valley bottoms in flocks of 8 to 10." He also noted that the cock would make a noise similar to that of distant thunder. There isn't much doubt that this farmer was referring to the ruffed grouse and that he specifically located the birds in the bottomlands.

The report of Otto Widmann as related by McKinley (1960) makes specific reference to grouse and habitat. He claimed that grouse were never found on the wide dry ridges of the Ozarks. Comparisons made by Steyermark (1959:61) of present-day forests with those from the early settlement period showed no change in the distribution of the forest cover or in the species composition. He reported that what is prairie now was prairie then, and what is forest today was forest then. Although Widmann's observations of grouse and habitat was general, it would appear from Steyermark's report and other research that he was fairly accurate.

Grouse or the "woods pheasant" was apparently still common in Missouri till about the turn of the century. By 1905, grouse became so scarce that the season was closed. Grouse numbers continued to decline despite season closure. Bennitt and Nagel (1937:42) reported that the most obvious factor responsible for the decline of grouse, apart from the illegal kill, was destruction of habitat. Originally nearly three-quarters of Missouri (32 million acres) was forested. This vast forest was looked upon as an obstacle to settlement and agriculture. Half of the 32 million acres was cleared and most of the remaining timber areas were cut over, burned and grazed.

By 1929-39, Leopold (1931) reported grouse to be present in only nine Missouri counties. A more intensive survey of resident game population was made in 1934 showed that perhaps fewer than 100 grouse were left in the state (Bennitt and Nagel, 1937).

A few birds apparently persisted in some areas through the years. Grouse was observed on the Daniel Boone Forest, Warren County in the spring of 1955, prior to recent stocking efforts.

Efforts to re-establish grouse in Missouri were made in 1940-43. Birds obtained from the Sandhill Game Farm, Inc., Babcock, Wisconsin, were released on three refuges in the southern Ozark region of the state. These birds persisted for some time but finally disappeared. An evaluation of these early releases was not made and nothing is known about the reasons for failure.

Missouri's forest-game habitat has changed considerably during the last 20 years, because of improved forestry practices and a reduction of free-range grazing. As a result, it has been possible to restore white-tailed deer (*Odocoileus virginianus*) and eastern wild turkey (*Meleagris gallopavo silvestris*) to much of the original range (Murphy 1965:142, Lewis, 1961:507-509).

Encouraged by the improved prospects for forest game, the Missouri Department of Conservation initiated an experimental ruffed grouse re-introduction program. Wild grouse trapped in southern Indiana and Ohio and birds from northeastern Iowa were used as stock.

STUDY AREAS

Ruffed grouse were released on five areas of Missouri from 1959 to 1966: (1) The Ashland Wildlife Research Area, Boone County, 2,240 acres; (2) The Daniel Boone Memorial Forest, Warren County, 2,600 acres; (3) Carmen Springs Refuge, Howell County, 8,000 acres; (4) Logan Area, Lincoln County, 1,800 acres; and (5) DuPont Area, 1,200 acres (Figure 1). Dates of releases and numbers of birds

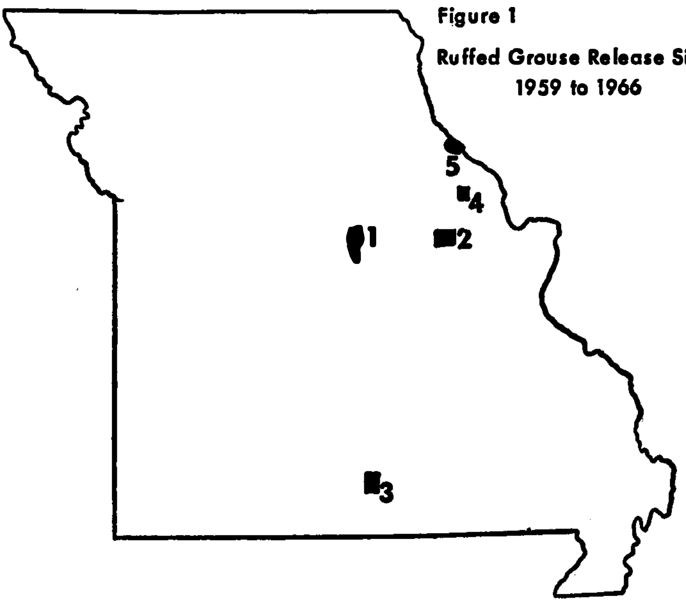

Figure 1
Ruffed Grouse Release Sites
1959 to 1966

comprise Table 1. All of these locations were selected because the vegetation was similar to that of good grouse range in Indiana and Ohio; and that they were protected from fire, grazing and other disturbances.

TABLE 1. SCHEDULE OF RUFFED GROUSE RELEASED IN MISSOURI FROM 1959—1966

Area	Release Period	Source of Grouse	Number (by sex) M	F	Unknown	Total
1. Boone	Fall 1959	Ohio	8	8	2	18
	Fall & Winter 1960–61	Ohio	30	32	1	63
	Fall & Winter 1961–62	Ohio	41	21	—	62
	Area Totals		79	61	3	143
2. Ashland	Fall 1959	Ohio	20	19	—	39
	Fall & Winter	Ohio	32	30	1	63
	1962–63	Indiana	8	9	—	17
	Area Totals		60	58	1	119
3. Carmen Springs	Fall & Winter 1963–64	Indiana	40	30	—	70
	Fall & Winter 1964–65	Indiana	44	20	2	66
	Area Totals		84	50	2	136
4. Logan Tract	Fall & Winter 1965–66	Indiana	25	13	—	38
	Fall 1966	Indiana	14	13	—	26
	Area Totals		39	25	—	64
5. DuPont	Fall & Winter 1965–66	Iowa	10	24	—	34
	Fall 1966	Iowa	1	4	1	6
	Area Totals		11	28	1	40

To measure the progress of the recent releases, efforts have been made to define winter range by tracking birds in snow, from flushing records, roost locations, and by an annual survey of drumming logs within a mile of the release site.

Intensive evaluations of ruffed grouse re-introductions in Missouri have been limited to the Daniel Boone Forest and Ashland Areas. These were chosen because they were the first areas to be stocked and data obtained should be typical of those from the other areas.

The most noticeable physiographic features of the Ashland Area and Boone Forest are the narrow ridges, deep steep-sided draws and relatively small moist valleys. Some of the broader ridges were farmed but have been abandoned now for approximately 30 years. One major difference between the two areas is the amount of land in old fields; only 6 percent of the Boone Forest is in clearings while 50 percent of the Ashland Area is in old fields. Neither area has been burned or grazed for approximately 30 years.

The forest overstory on the uncleared ridges and upper slopes is primarily white oak (*Quercus alba*) and shagbark hickory (*Carya ovata*). The more mesic lower slopes and bottoms support sugar maple (*Acer saccharum*), northern red oak (*Q. rubra*), basswood (*Tilia americana*), and bitternut hickory (*Carya cordiformis*).

The forest understory of both areas is well developed because of the absence of fire and grazing for many years. Principal species, especially on lower portions with north and east aspects, are sugar maple, hop hornbeam (*Ostrya virginiana*), blue beech (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), and shadbush (*Amelanchier arborea*). The abandoned ridge fields contain red cedar (*Juniperus virginiana*), smooth sumac (*Rhus glabra*), sassafras (*Sassafras albidum*), and persimmon (*Diospyros virginiana*). For additional information on the study areas see Korschgen, 1966:86-87).

ESTABLISHMENT AND DISPERSAL

Results of the 1959 release on both areas were discouraging. Very few wintering grouse were observed on either side, and no drumming was heard in the spring of 1960. In the fall of 1960, one grouse was seen 1.1 miles from the Ashland Area release site.

Ten grouse were found on the Boone Forest during fall and winter of 1960-61 (second release period). These birds frequented the tops of white oaks which had been cut the previous summer, and through leaf retention provided excellent winter cover. During fall and winter of 1961-62 (third release period), about 25 grouse were located on the Boone Forest.

Only three grouse had been observed on the Ashland Area before the fall of 1961. During the fall winter period of 1961-62, four birds were found. Three drumming males were heard in the spring of 1962 (before the second Ashland release).

Records of grouse flushed at Ashland during 1963-65 showed that the released birds and their progeny were gradually spreading from the release site. By 1965, (after 3 years), grouse were sparsely distributed in suitable habitat throughout the study area. Little egress onto surrounding lands could be detected. With two exceptions, all grouse observations in the Ashland Area were made less than 2 miles from the point of release. In 1964, one grouse was observed 4.8 miles from the Ashland release site, and in 1966 a bird was observed 8.0 miles away

The Boone Forest release site records of dispersal of released grouse and progeny were similar to those of Ashland.

The locations of new drumming activity centers further reflected dispersal and establishment. On the Ashland Area 41 activity centers were found from 1962-1969. By 1967, activity centers had been found in most suitable parts of the area. On the Boone Forest, 35 activity centers were located between 1961-1969.

Although some dispersal of grouse from the Ashland Area has obviously occurred, few grouse appear to be well established outside the area boundary. The known exceptions are close to the boundary in habitat similar to that occurring on the area. Elsewhere, the land is more intensively farmed, and the woods, narrow valleys, and old fields are often heavily grazed.

McGowan (1966) measured the effects of grazing on the plant composition on and off the Ashland Area. He found that the dominant overstory species were essentially the same in the grazed and ungrazed areas except in the valleys. Basal area in the grazed areas was considerably lower Overstory dominants varied widely between the grazed and ungrazed valleys. In the grazed valleys maple, basswood and red mulberry (*Morus rubra*) were absent; they were common in the ungrazed valleys on the Ashland Area. Red cedar was common on the grazed lower slopes and valleys but was not found in the ungrazed area. Grazing affected the valley understory the most. The variety and numbers of species in grazed areas were greatly reduced, and most of the common understory plants found on the ungrazed plots were absent in the grazed areas. Dansereau (1953:284) reported that just grazing in a maple forest obliterated many of the delicate shade and humus-loving climax species.

Leopold (1931:156) reported that the distribution and abundance of ruffed grouse in southern Wisconsin was in inverse ratio to the development of the dairy industry and woodlot grazing which accompanied it. Where woodlots were small and grazed there were no grouse. Where woodlots are large and frequent and ungrazed, grouse occurred. Intensive grazing, however, resulted in the elimination of grouse.

The inclusion of the maple-basswood faciation in the oak-hickory association throughout much of the central United States apparently is confined to the more mesic sites. This view is supported by Braun's (150:168) statement that the more mesophytic slopes within Missouri's forests have a rich, luxuriant undergrowth resembling that of eastern forests. These forested slopes differ in species composition from the prevailing oak-hickory forest of the ridges and upper slopes and provide attractive habitat for grouse.

This mixed hardwood type of habitat is very limited in Missouri comprising only 4 percent (662,000 acres) of the commercial forest (King *et al.*, 1949). The original midwestern limit of ruffed grouse range reported by Bump *et al.* (1947:50-57) was in eastern Kansas, Nebraska and the Dakota's where a few birds survived in brushy cover along streams. They considered the Ozarks in Missouri and north western Arkansas as a part of an extensive area of more uniform grouse range. Their view does not agree with Widmann (1906:80) who indicated that grouse were never found on the wide dry ranges in the Ozarks "where conditions do not seem to suit them." Several other early observations of grouse drawn together by McKinley (1960) specifically associated them with stream-bottom-habitat. These early reports are difficult to evaluate, but it would appear that Missouri grouse range has always been something less than uniform.

DISCUSSION AND CONCLUSION

Ruffed grouse have been successfully reintroduced into Missouri based on the stable numbers of drumming males and evidence of reproduction. The extension of range beyond the release areas has been slow, and current population levels are low.

The key to re-establishment of ruffed grouse in Missouri seems to be the narrow mesic valleys that have been protected from fire and grazing for long periods. Studies have shown that grouse use the valleys almost exclusively in the summer for brood rearing and roosting. The lush understory vegetation in the valleys and on lower slopes supplied grouse with most of their food (*Korschgen,* 1966).

I believe that fire and grazing apparently changed the environment of these small moist valleys in Missouri to such an extent that grouse were eliminated. The fact that grouse are now surviving in areas where they had been absent for over 50 years, indicates a changed environment now capable of supporting grouse.

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DISCUSSION

DR. C. M. KIRKPATRICK (Purdue University, Indiana): I am interested in what you say about the relationship of grouse habitat to the exclusion of fire.

We have had two studies going in southern Indiana over the last five or six years—one of them being an extensive study on about a thousand acres and our populations are denser in the areas which have been burned over about fifteen years ago and this is related, apparently, to certain vegetative characteristics of those areas.

MR. LEWIS: I am not well acquainted with Indiana although I have been there. I think the area that I looked at was in Brown County and from what I could tell, the rich areas supported a situation more comparable to an area in which we were finding our grouse in Missouri.

We do not have in our state the lush type of undercover that you have in Indiana. I was talking to one individual from Wisconsin not so long ago and he indicated that in extreme southern Indiana that the establishment of grouse populations had been where they had small or narrow valleys. They did not have any establishments outside of those areas.

DISCUSSION LEADER WIGHT: I would like to ask John about the future status of grouse in Missouri. Certainly there has been, as evidenced by John's report here today, considerable effort devoted to the species, and I suspect that the State of Missouri will hereinafter be known as a state with a great deal more interest devoted to this particular bird. This answers, I think, to some degree, the criticisms leveled at game departments, that their programs are oriented principally to consumptive recreation and I think this is an excellent example. However, I am a little disappointed here because inasmuch as this is a game bird that it is going to be viewed as an effort in behalf of a consumptive recreational form.

MR. LEWIS: Of course, I think, when we started the program, that we were hopeful of obtaining large populations. It is questionable now, after ten years, that the numbers will ever be sufficient to hunt them, probably because the environment just isn't capable of supporting large numbers. Certainly I think the department isn't downgrading this effort at all because we feel that simply the re-establishment of the bird in the state has been worthy of the effort involved and, further, there are a lot of people interested in this bird right now.

DISCUSSION LEADER WRIGHT: Would you comment on the attention given to ruffed grouse by the people who enjoy watching them? Do you see people, for instance, making trips to ruffed grouse habitat to see grouse?

MR. LEWIS: Well, that is not very great right now. We have some using various areas for this purpose. For example, the Audubon people have been involved in this. There have been people near St. Louis who have come out to look for the bird, but the grouse seem to be very shy and are not readily accessible from the car or from the road. Therefore, I don't believe these individuals have had much success in locating them or even hearing them.

EFFECTS OF SAGEBRUSH CONTROL ON SAGE GROUSE[1]

HAROLD D. CARR[2] AND FRED A. GLOVER[3]
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In recent years, use of 2,4-D (2,4-Dichlorophenoxyacetic acid) to kill sagebrush has become a practical means of increasing grass production for livestock. However, such projects could endanger sage grouse (*Centrocercus urophasianus* Bonaparte), a species dependent on sagebrush ranges. The Colorado Game, Fish and Parks Division, in cooperation with the Bureau of Land Management, began this study to determine the effects on sage grouse of sagebrush control with 2,4-D. Much of the background information referred to in this paper was based on an earlier, pre-spray study conducted by Gill (1965).

The study area (Figure 1) encompassed about 60 sections in northcentral Colorado's North Park, a bowl-like area surrounded by mountains rising to 13,000 feet. The study area ranged from 8,000 to 9,000 feet. Its interior was upland benches and ridges with intervening draws. Its south, east, and west edges were flatter lowlands bordering the major drainages.

The uplands were mainly sagebrush-grassland ranges and the majority of the plants were of the big sagebrush group; the dominant species was *Artemisia tridentata vaseyana* (Beetle, 1960) with rabbitbrush (*Chrysothamnus viscidiflorus*) a sub-dominant. The lowlands were moist meadows interspersed with rabbitbrush (*Chrysothamnus nauseosus*), greasewood (*Sarcobatus vermiculatus*) on alkaline soils, and willow (*Salix* spp.) along the streams.

After a two-year pre-spraying study of sage grouse in North Park, Gill (1965) recommended the areas to be sprayed and the patterns to be used for spraying the sagebrush. Following Gill's recommendations the Bureau of Land Management sprayed about 4,000 acres (Figure 1) with 2 pounds iso-octyl ester of 2,4-D in 4 2/3 gallons of water per acre. The herbicide was applied from a fixed-wing aircraft between June 2 and 5, 1965. To minimize drift of the chemical, it was sprayed only when winds were calm during the early morning.

Of the four areas sprayed, Area A (500 acres) and Area B (1800 acres) were sprayed completely. Each area contained a strutting ground. They were separated by 900 acres of untreated sagebrush. The other areas (C and D) were strip-sprayed. Area C had 1,200 acres sprayed in 50-yard wide strips alternated and parallel with

[1]Contribution of the Colorado Cooperative Wildlife Research Unit; Colorado State University; Colorado Game, Fish and Parks Division; Wildlife Management Institute; and U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, cooperating.

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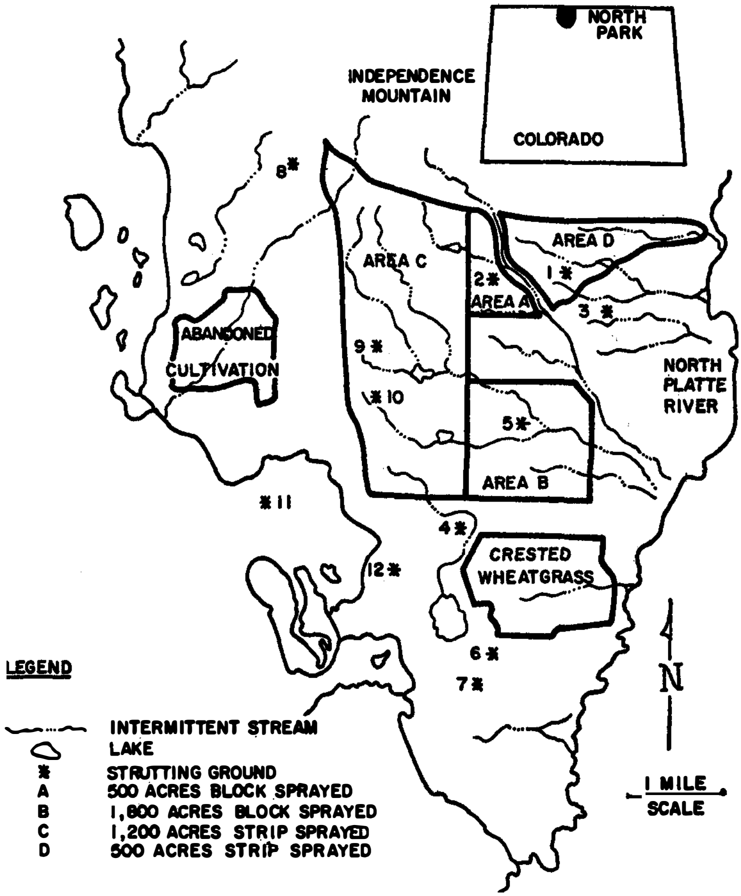

Figure 1

150-yard wide untreated strips. Two strutting grounds were in this area. Area D had 500 acres sprayed in strips of various widths (four of 50, four of 100, four of 150, three of 200 and two of 250 yards) alternated with 200-yard wide untreated strips.

Investigation in 1966, one year after spraying, showed that shrubs and forbs generally were less frequent and grasses more frequent on sprayed than on unsprayed areas. As measured by density (living plants per 100 square feet), the overall kill of sagebrush was about 72 percent (Carr, 1967). Regeneration of sagebrush should be slow on most sites.

PROCEDURES

Residues of 2,4-D

In the Spring of 1966, 11 months after spraying six sage grouse from sprayed and six from unsprayed areas were collected. They were frozen until August, when the brains and 100 gram samples of breast muscle were excised for 2,4-D analysis. The brains were combined into two samples (sprayed and unsprayed), and the muscle into three from unsprayed and four from sprayed areas. Twelve 100 gram samples of sagebrush leaves and twigs were collected in October 1966 (16 months after spraying), frozen and subsequently analyzed for 2,4-D residues. Samples were analysed by Spectran Laboratories, Inc., Denver, Colorado.

Population Level and Productivity

Trends in population level were determined by censusing strutting grounds every two or three mornings throughout the strutting season. In both 1965 and 1966, nesting use and success on sprayed and unsprayed areas were determined by two searches for nests on sixty 5-acre plots (27 in sprayed and 33 in unsprayed areas). The plots were located within 1¼ miles of a strutting ground, and in cover similar to what Gill (1965) found to be favorable for nesting.

Throughout the summer brood production and number of chicks per brood were determined by a weekly census of each of the five brood routes. Each route, about 20 miles long, sampled a different portion of the study area and was censused while driving along the route at 10 to 20 miles per hour during the last 2 or 3 hours before dark. All meadows were scanned with binoculars, and the direction of travel was alternated each time a route was run.

Distribution and Movements

During the study, 107 grouse were trapped mainly by "spotlighting," mostly on strutting grounds. They were banded, individually marked with poncho tags or patagial tags similar to those described respectively by Pyrah (1963) and Knowlton *et al.* (1964), and then released. Nine grouse were equipped with radio transmitters.

Distribution and movements were determined by observing marked birds, mapping sage grouse observations (particularly on brood routes), and by following and observing flocks of birds. Winter distribution was determined largely from three survey flights. Observations were made from a Cessna 180 flown at 80 miles per hour and 100 feet above the study area on transects one-half mile apart.

RESULTS AND DISCUSSION

Residues of 2,4-D

Although the highest level of 2,4-D in sage grouse breast tissue was found in a sample collected from an unsprayed area, samples from sprayed areas generally contained more 2,4-D. Four samples from sprayed areas contained 0.3, 0.4, 1.1 and 2.2 p.p.m. Of three samples from unsprayed areas, 2.7 p.p.m. were detected in one, and none in the other two. The composite brain sample from the sprayed area contained 6.0 p.p.m., about 19 times the 0.3 p.p.m. 2,4-D found in the control sample. Since sage grouse range widely, they probably were exposed to both sprayed and unsprayed areas; consequently the data are variable and of limited value for comparison. Similar to Higby's (1965) data, they proved that 2,4-D accumulated in a sage grouse, but showed nothing of its effects.

Residues of 2,4-D in sagebrush leaves were generally higher on sprayed areas (5.0, 2.8, 2.5, 5.5, 2.0, 5.5, and 3.5 p.p.m.), but all untreated samples had some (1.7, 22, 1.4, 1.8, and 3.6 p.p.m.). One sample, containing 3.6 p.p.m. 2,4-D, was collected 2½ miles from the sprayed area. These data indicate that 2,4-D had permeated much of the surrounding area, and they help explain the 2,4-D residues in sage grouse from control areas.

Henderson (1966) found 11.8 p.p.m. of 2,4-D in sagebrush 15 days after spraying. Sixteen months after spraying, sage grouse were ingesting sagebrush which still contained residues of 2,4-D but by this time the highest level (5.5 p.p.m.) was barely above the 5 p.p.m. limit allowed in certain fruits for human consumption (Crafts and Robbins, 1962) and below the 20 p.p.m. permitted in some livestock forage crops (U.S.D.A., 1968). Although the tolerance of various species differs, it seems unlikely that sage grouse would be harmed seriously by 2,4-D applied for sagebrush control (Carr, 1968). Nevertheless, the long-term effects should be evaluated.

Population Level and Productivity

The year after spraying, the maximum count of strutting males increased from 166 to 234, and the number of active strutting grounds (Figure 1) increased from four to eight (Table 1). Populations remained constant on SG (strutting ground) 2 and 5 in the completely sprayed blocks, while increasing from 52 to 97 on SG 9 in the strip-sprayed area and decreasing slightly on SG 4 in the unsprayed area. Three of the reactivated grounds were on unsprayed areas and one on a strip-sprayed area.

TABLE 1. MAXIMUM NUMBER OF MALE SAGE GROUSE COUNTED IN 1965 AND 1966 ON STRUTTING GROUNDS IN NORTH PARK, COLORADO

	STRUTTING GROUND NUMBER								
	Sprayed Areas				Unsprayed Areas				
Year	2	5	9	10	4	6	8	11	Total
1965	9	52	52	0	53	0	0	0	166
1966	9	54	97	6	47	2	6	13	234
	(18)[1]	(12)	(21)	(0)	(11)	(0)	(0)	(12)	(16)

[1] Percent subadults in parenthesis.

Calculated from the highest count for each group (adults and subadults) on each strutting ground, subadult males comprised 16 percent of the strutting males in 1966. This seemed low for a population that increased 40 percent, but probably was due to mis-classification of subadults; however, this error was probably consistent on all grounds. Patterson (1952) found about 20 percent subadults in a static population.

Although age ratios varied on different strutting grounds (Table 1), subadults certainly did not avoid sprayed strutting grounds. Since subadults will strut on them, strutting grounds on sprayed areas should remain active after the present adult birds have died.

The pattern of strutting ground attendance by females, and for adult and subadult males was similar to that described by Gill (1965) prior to sagebrush control. Sage grouse abandoned small grounds earlier than large ones (about April 30 compared to May 25) but this was related to breeding behavior and not sagebrush control.

In 1966, sagebrush control did not appear to be detrimental to strutting activities, and strutting grounds were not obviously altered. However, the population in spite of the 40 percent increase was still at its second lowest point in 7 years of recording; this probably was a natural fluctuation unrelated to sagebrush control. To properly evaluate the effects of sagebrush control on population level, the population will have to be censused over a longer post-spraying period to differentiate effects of sagebrush control from normal fluctuations.

On sixty 5-acre plots (27 on sprayed and 33 on unsprayed areas) we found 23 nests of the year in 1965 and 10 in 1966, a 56.6 percent decrease in spite of the increased population. This apparently was not a result of sagebrush control, because we found only 33.3 percent fewer nests on sprayed plots (12 in 1965 and 8 in 1966), but 81.8 percent fewer on unsprayed plots (11 in 1965 and 2 in 1966). Pre-spraying data (1965) were comparable with post-spraying data (1966), but plots on sprayed areas were not directly comparable with plots on unsprayed areas, largely because of plot variation and the small sample.

Possibly fewer nests were found in 1966 because of drier weather conditions than existed in 1965. These conditions might have induced hens to nest nearer the moist meadowlands close to permanent water, and off the arid interior of the study area where the nest search was conducted. Although some authors believed that nesting distribution is unaffected by water, Patterson (1952) noticed distributional changes in response to annual moisture variation.

Five of 23 nests (21.7 percent) were successful in 1965, and 2 of 10 (20 percent) in 1966. However, nesting success on sprayed areas decreased from 5 of 12 nests (41.6 percent) in 1965 to 2 of 8 nests (25 percent) in 1966. Although nesting success decreased on sprayed areas, a similar reduction, if it occurred, could not be detected on unsprayed plots since all nests on these plots were unsuccessful in both years. Consequently, the decreased nesting success on sprayed plots cannot be attributed definitely to sagebrush control.

We did not ascertain the original causes for nest destruction or desertion, mainly because of the time lapse between nesting and the nest search. However, Gill (1965) believed that badgers (*Taxidea taxus*) and ground squirrels (*Citellus richardsoni*) were the most common causes of destruction of sage grouse nests in this area.

Seventy-two percent of 11 nests found on sprayed areas (not just sprayed plots) were beneath dead sagebrush. However, 8 of the 11 nests were within 100 yards of extensive patches of living sagebrush, and also within 200 yards of unsprayed areas. This suggests that central portions of large, completely sprayed areas are unsuitable for sage grouse nesting.

Although we were unable to definitely relate changes in nesting to sagebrush control, our sample might have been too small to demonstrate such a relationship. This may become more obvious as dead sagebrush deteriorates, particularly when growing conditions are poor and cover is sparse.

From 1965 to 1966, observations of broods increased from 28 to 45, and of young from 96 to 181 respectively. The miles per brood decreased from 44.8 to 31.2 These data primarily reflected the increased population, but perhaps were exaggerated because of an underestimation of brood numbers in 1965. Because abundant moisture resulted in luxuriant vegetation in 1965, summer migration to meadows (Gill, 1965) may have been less prominent and the chances of seeing sage grouse may have been smaller than in 1966. Average brood size decreased from 5.6 in 1965 to 4.7 in 1966. This includes all broods completely counted throughout the summer, and was not restricted to observations on brood routes.

Comparison of individual brood routes did not help to determine the effects of sagebrush control on brood production. Four of the routes sampled primarily meadowlands and unsprayed sagebrush. Only route 2 actually sampled upland sagebrush range and the sprayed areas.

No sage grouse were observed on this route in 1964 prior to sagebrush control. In 1965, 41 birds were observed, but mostly along intermittent drainages. The others were two groups of hens without broods and one newly hatched brood, all seen in June. In 1966, 116 birds were seen on route 2, 111 of them by July 15, and all in the same intermittent drainages where water or succulent plants were available. Thus, the increased observations on route 2 do not mean spraying improved this area for summer range. Although sagebrush control with 2,4-D increased grass production (Carr, 1967) the sprayed areas were still arid rangeland and probably would not substitute for moist meadows utilized by sage grouse for summer range. Also, fewer forbs grew on sprayed areas, further reducing their summer range potential.

Brood production and survival were not noticeably affected by sagebrush control with 2,4-D. The number of broods observed in 1966 was greater than in 1965, but mostly because of population level and weather. The percentage of successful hens calculated from observations of females with and without young was 30.1 of 144 in 1965 and 22.3 of 328 in 1966, both of which lie between the high and low successes of the pre-spraying study (Gill, 1965). Average brood size was smaller in 1966 than in 1965, but in both years it was greater than the pre-spraying years of 1963 and 1964 (Gill, 1965).

Distribution and Movements

As in the pre-spraying study (Gill, 1965), distribution and movements of male sage grouse were oriented to strutting grounds in early spring, but less rigidly so as strutting activities waned after the peak of mating. Daily cruising radii of males from SG 2 and 5 on the completely sprayed areas, and from SG 9 on a strip-sprayed area and from SG 4 on the unsprayed area were ascertained: SG2—7/8 mile, SG 4—1 mile, SG 5—1 mile, and SG 9—1 1/8 miles. Unfortunately, these figures were not too reliable, since each represented only a few days of observations of a few birds each day and did not adequately account for time relative to the peak of mating. Because the birds sometimes "disappeared," the figures represented the last place they were seen, not necessarily the greatest extent of the day's movements.

Although of questionable significance, birds with the shortest and longest cruising radii came from strutting grounds with the smallest and largest populations respectively; whereas birds with intermediate cruising radii came from the two medium sized grounds. This could have been caused by range limitations, or a manifestation of species saturation point forcing birds from larger strutting grounds to disperse over a greater area. Cruising radii did not seem to be related to sagebrush control, but sage grouse movements were affected.

Birds from SG 2 in Area A (Figure 1) were never observed to spend an entire day on the area. Whenever the grouse were observed leaving SG 2, they flew onto strip-sprayed Area D or the unsprayed area. Some birds from SG 5 in Area B spent all day on this area until mid-April (peak of mating), when they increased their cruising radii, and spent the mid-day period on the unsprayed area or strip-sprayed Area C. After the peak of mating, we never observed sage grouse on Area B later than 10 a.m.

Apparently, the completely sprayed blocks were satisfactory for strutting, but not for other activities. Sufficient cover remained so that adult sage grouse could readily cross a mile of sprayed sagebrush enroute to strutting grounds. Although the birds usually moved in short flights, the sprayed blocks may become a barrier to movements once the dead sagebrush deteriorates.

Birds from SG 4 in the unsprayed area spent the day in unsprayed sagebrush. Although some occasionally moved towards the nearby sprayed block, none was seen within it. Most birds from SG 9 on strip-sprayed Area C, moved west to the unsprayed area as they did prior to sagebrush control; however, some remained on the strip-sprayed area all day. Birds staying on strip-sprayed areas moved freely through the 50-yard wide sprayed strips, but they tended to congregate along the edges when feeding. Apparently, this was due to a lack of food in the sprayed strips and not to any movement barrier. Although the movements of adult sage grouse were not hampered by the 50-yard wide sprayed strips, the birds probably would not tolerate much wider strips before avoiding these areas as they did the completely sprayed areas.

Movements between strutting grounds were common (they involved 4 of 10 birds re-observed on strutting grounds), but might have been influenced by the poncho tags. Sagebrush control did not induce sage grouse to move to unsprayed grounds, because three of the four birds moved to SG 5 in Area A. No birds marked on SG 5 were observed on another ground. One bird moved to and one from SG 4 on the unsprayed area. Only one bird moved to SG 9 (on strip-sprayed area), but it subsequently moved to SG 5 as did two others; however SG 9 was the largest ground and perhaps lacked additional strutting territory.

During summer, Gill (1965) found that sage grouse concentrated on eight major meadow areas primarily along the major drainages and around the periphery of the North Park study area. After sagebrush control in 1965, we found only minor concentrations in three of those areas plus another meadow area, but this probably was due to the low population and wet weather which minimized summer concentrations. With dry weather and the increased population in 1966, broods again used most of the meadow areas.

Sage grouse were seldom seen on upland areas during summer, so it was difficult to relate summer distribution to sagebrush control. Excluding the strutting season, birds were observed on block-sprayed areas only twice during 1965 and 1966. Both were broods (possibly one seen twice) which were observed in June near a nest constructed prior to spraying. However, the summer absence of sage grouse from these areas probably was not due to sagebrush control, since they also used them sparingly prior to spraying.

A change in summer distribution after sagebrush control was indicated by a decrease of sage grouse broods using summer concentration areas along the North Platte River on the northeast side of the study area. Gill (1965) recorded about 17 broods there by August 15, 1964. By the same date only one brood was recorded in 1965 and two in 1966.

This may be partly due to a population decrease on SG 2 from 26 males in 1964 to 9 in both 1965 and 1966. However, Gill (1965) believed that broods migrated from nesting areas to summer regions via intermittent stream channels. All major intermittent drainages leading to this summer concentration area passed through some sprayed area (Figure 1); in fact, almost the entire sprayed portion of the study area drained toward this previously used summer concentration zone. Possibly, sprayed areas impeded normal migration of broods to this summer range. Unlike adults, young sage grouse are not strong fliers and are quite dependent on cover.

We were unable to relate the reduction in nesting density and success to sagebrush control, and there was no sign of excess brood mortality or non-brooded hens. Thus an impedition of brood movements provides the most likely explanation for the reduced use of this summer range. It also helps explain the increased number of birds observed on brood route 2. No birds were recorded on this route in 1964.

Although winter observations were limited to three aerial surveys and a 1½-day field trip, we never observed sage grouse on block-sprayed areas in winter, probably because sagebrush was not available. Sage grouse wintered on unsprayed and strip-sprayed areas on the northeast part of the study area. With live sagebrush available nearby, strip-sprayed areas apparently provided suitable winter range.

Sagebrush control did not induce sage grouse to leave strutting grounds in sprayed areas; in fact, the birds readily walked and flew across a mile of sprayed sagebrush enroute to strutting grounds. Except for strutting, sage grouse avoided sprayed blocks, probably because they provided insufficient sagebrush for food during spring and winter, and were inadequate for summer range whether sprayed or not. Sage grouse movements were not hampered by 50-yard wide sprayed strips, and these areas were used for winter range; however, birds probably would not tolerate much wider strips before avoiding them as they did the completely sprayed areas. Brood movements apparently were impeded by sagebrush control.

SUMMARY AND CONCLUSIONS

Residues of 2,4-D were detected in sage grouse muscle and brain, but its effects were not determined. By 1½ years after spraying, sagebrush control had not obviously affected strutting activities or grounds. Neither had it definitely affected nesting density or success; however, nests on sprayed areas tended to be near unsprayed areas. The effects of sagebrush control on nesting may become more evident as dead sagebrush deteriorates. Brood production and survival had not noticeably been affected. Sprayed sagebrush affected but did not hamper movements of adult sage grouse; however, they avoided block-sprayed areas (except for strutting), probably because necessary habitat requirements were lacking. Areas sprayed in 50-yard wide strips had no obvious effects on distribution or movements of adult sage grouse. Brood movements apparently were impeded by sprayed areas.

These conclusions are preliminary. The ultimate effects on sage grouse will be influenced considerably by future vegetation changes, particularly deterioration and reinvasion of sagebrush. To properly evaluate the effects of sagebrush control on sage grouse, the Colorado Game, Fish and Parks Division is collecting additional data as vegetation changes and populations fluctuate.

ACKNOWLEDGMENTS

We are indebted to many people for assistance with various phases of the fieldwork and for constructive criticism of this manuscript. Special thanks are extended to Messrs. H. Swope, R. Gill, R. Ryder, B. Poley, C. Henderson and R. Hansen.

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DISCUSSION

DISCUSSION LEADER WIGHT: A question comes to my mind immediately. Is this 70 percent control of vegetation on the land? When you say 70 percent of control of vegetation, I presume you are talking about 70 percent of sagebrush?

DR. GLOVER: That is correct.

VICE CHAIRMAN WIGHT: Now, secondly, is this an acceptable level of sagebrush control for the agencies that push this type of program or was this merely some type of control level designed to work at the minimum effect for the treatment of sagebrush?

DR. GLOVER: I cannot answer you directly on whether they consider this an effective level of kill or not, but you should be aware of the fact that you rarely if ever will get much better than this. Sometimes it is possible to get 80 to 90 percent but there is a mechanical factor that does not make it possible to get a complete kill. Also, you will find that the sprouting will come back in a year or two. However, the 72 percent is typical of what we are getting right now.

DISCUSSION LEADER WIGHT: To follow up on that, then, the usual next stage would be some type of mechanical killing. Is that correct?

DR. GLOVER: Not necessarily, because here we are getting into a higher cost factor, and this is something that time will not permit. You will recall that most other studies have indicated that the grass does come in under killed sagebrush and as such, it does improve the land insofar as livestock use is concerned. It does influence many other species as well.

DR. GLOVER: I might add that this particular study was done in an area which might have had, as far as sage grouse requirements go, too much sagebrush. On the other hand, this is not typical of all sagebrush range, nor should these results be applied broadly to all sagebrush range. I think the individual situation should dictate whether spraying by herbicides is either beneficial or harmful, and this is the point that we would like to make—that the evaluation of the area is probably the most important thing in a free-spraying consideration.

DISCUSSION LEADER WIGHT: Thank you very much for a most interesting presentation.

THE ECOLOGY OF THE WILD-TRAPPED AND TRANSPLANTED RING-NECKED PHEASANT NEAR CENTRE HALL, PENNSYLVANIA

JAMES E. MYERS[1]
Rhode Island Department of Natural Resources, West Kingston

This study was conducted under an assistantship from the School of Forest Resources of the Pennsylvania State University, with Dr. J. L. George, associate professor of wildlife management, as advisor. The project was designed and implemented by the Pennsylvania Game Commission, Harrisburg, Pennsylvania under the supervision of Fred E. Hartman, game biologist.

The purpose of this study was to evaluate the release of wild-trapped and transplanted pheasants (*Phasianus colchicus*) as a management technique to establish a shootable population capable of maintaining itself; and to study the population of wild-trapped and transplanted ring-necked pheasants in the Centre Hall, Pennsylvania area.

The introduction of ring-necked pheasants by the release of game-farm stock has failed to fill many areas apparently suitable to the bird. Centre Hall, Centre County, Pennsylvania, the area studied in this thesis, is one of those areas. It appeared to contain habitat suitable for the maintenance of an adequate pheasant population and is adjacent to class II pheasant range. However, documented reports indicate that the number of pheasants in this area has always remained at a low level.

The Pennsylvania Game Commission included this area in their regular pheasant stocking program about 1949. From 1949 to 1964, an approximate 3000 game farm pheasants, 65 percent males and 35 percent females, were released in the study area. Stocking was usually conducted in May, July, October, and November. In May, approximately 70 pheasants (30 males, 40 females) were released. These birds had been used as breeders at the Loyalsock Game Farm. In July, a local resident, through the Game Commission's day-old chick program, liberated 70 twelve-week old pheasants. (35 males, 35 females) per year, over the ten years from 1953 to 1963. Approximately 60 twenty-four week old males were stocked in October prior to the small-game season and in November, approximately 20 cocks were released in the hunting season during each of the 15 years. Few of the stocked pheasant survived the hunting season and they failed to establish a productive breeding population.

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The failure of game-farm birds to establish breeding populations led to a trial introduction of a total of 1006 wild-trapped pheasants into the area during the early springs of 1964, 1965, and 1966 to determine whether transplanted wild birds could establish themselves in this area.

Birds were obtained from the Southeastern and North Central Divisions of the state. In the southeast, birds were trapped at the Graterford Prison, Montgomery County, and the Ontelaunee Reservoir, Berks County. In the North Central Divisions, birds were obtained from the Lewisburg Penitentiary, Union County.

PROCEDURES

Data were collected by seven main methods: the true census, the hunter bag check, the door-to-door survey of landowners, trapping and marking of pheasants, crowing cock counts, nest observation, and brood counts. These methods were designed to provide information on population densities, hunting pressure, harvest levels, over-wintering population, movements, sex ratios, breeding populations, and reproduction success.

The true census was conducted prior to the opening of the hunting season in 1965 through 1969. This technique was again used during the winters of 1966 and through 1970.

A hunter bag check was conducted during the small game seasons of 1966 through 1969 by placing questionnaires on the windshields of hunters' cars.

After the small-game seasons of 1965 through 1969, a door-to-door survey was used to get additional data on pheasant harvest, the number of pheasants and nests sighted and/or destroyed, and the number of over-wintering birds. Information pertaining to crops was also recorded.

Trapping was conducted during the winters of 1966-67, and 1967-68 at four sites in the study area, to study the movements and range of resident birds. Each captured bird was banded with an individual numbered aluminum leg band furnished by the state, and also marked with a colored plastic back tag for visual identification.

During the first part of April to mid-May, 1967 through 1969, crowing cock counts were conducted to provide an index of the males that survived the winter. The number of cocks crowing multiplied by the number of females per male (which is determined in the true census for the previous winter) yields an estimate of the breeding population. The cock crowing survey, following the same route each year, is a reliable low cost population indicator.

A nest search was carried out using a dog to aid in the search.

Because of few sightings, landowner reports of nests and nest destruction were used and provided the majority of the nest data.

Brood counts, conducted from 1965 through 1968, provided the main observations of the reproductive phase of the pheasant life cycle. The counts were conducted for a period of two hours after sunrise and covered all the roads in the study area.

RESULTS

The 1969 pheasant population near Centre Hall, Pennsylvania is the highest on record for this area. It was suggested that the low bird number may have resulted from pheasants moving off the area. But the wild-trapped pheasants remained in the vicinity of their release site as indicated by observation of back-tagged birds and hunter-returned leg bands. All bands were recovered within two and one half miles from the trapping site, and most back-tagged individuals remained within a few hundred yards of the point of capture. This limited movement compares favorably with that of pheasants in areas termed "Prime range."

The winter count during snow cover showed an increase in the number of birds observed on the area. The pheasant number increased from 66 in 1969, 112 in 1967 to 201 in 1969. The sex ratio observed in the winter has fluctuated around one male to seven females during the six years of observation.

The number of crowing cocks has increased from 12 in 1964, 28 in 1967 to 41 in 1969. The spring crowing count of this year will indicate whether this population is still expanding; as the hunter kill was observed to be increased over that of 1968.

In 1965, the pheasant harvest per landowner contacted was 1.7. In 1967, this figure rose to 2.5, an increase of 47 percent; hunting success in 1969 per contact was 4.2, nearly double the 1967 figure.

Six to eight broods were observed along the roadside of the study area each year from 1964 to 1968. The average number of chicks per brood was 8.4.

The calculated breeding population for the study area was 96 in spring of 1964, 224 in spring of 1967 and 492 in spring of 1969. This is a total increase of 409 percent over the past four years.

CONCLUSIONS

1. The wild pheasants transplanted to the Centre Hall area during 1964, 1965, and 1966, have established a successful breeding population. In 1969 the population was the highest on record for this area, and with continued favorable conditions it is anticipated that popula-

tions might become larger. This should continue to provide a shootable surplus of birds.

2. The stocking of additional pheasants in this area is not necessary and would interfere with a long-time evaluation of the success of this population and the technique of establishing a population with wild-trapped birds.

3. The limited movement of the pheasants in the Centre Hall area compares favorably with that of pheasants in prime range.

4. Several years of severe winters would be needed to fully test the over-wintering capabilities of this population.

PHEASANT POPULATION DATA FROM CENTRE HALL, "TRAP AND TRANSFER" STUDY AREA, 18,121 ACRES. CALCULATED SPRING POPULATION IS DERIVED BY MULTIPLYING THE NUMBER OF CROWING COCKS TIMES THE SEX RATIO DURING THE WINTER CENSUS. THIS IS CONSIDERED THE BREEDING POPULATION[1]

	Winter Census			Spring Census		
Season	Average kill per landowner contacted	Number of birds seen	Sex ratio males to females	Number of crowing cocks	Calculated population on study area	Calculated breeding population per 1000 acres
Fall, 1964	2.0	—	—	—	—	—
Winter, 64–66	—	66	1 to 7	—	—	—
Spring, 65	—	—	—	12	96	5.3
Fall, 65	1.4	—	—	—	—	—
Winter, 65–66	—	121	1 to 11	—	—	—
Spring, 66	—	—	—	10	120	6.6
Fall, 66	2.5	—	—	—	—	—
Winter, 66–67	—	94	1 to 7	—	—	—
Spring, 67	—	—	—	28	224	12.4
Fall, 67	2.5	—	—	—	—	—
Winter, 67–68	—	112	1 to 4	—	—	—
Spring, 68	—	—	—	73	365	20.1
Fall, 68	2.9	—	—	—	—	—
Winter, 68–69	—	145	1 to 11	—	—	—
Spring, 69	—	—	—	41	492	27.0
Fall, 69	4.2	—	—	—	—	—
Winter, 69–70	—	201	1 to 7	—	—	—

[1] George, J. L., F. E. Hartman, and J. E. Myers. 1969 Wild Pheasants Establish Population after Move to Suitable Farmland, Science and Agriculture, 17 (1): 12.

DISCUSSION

DISCUSSION LEADER WIGHT: Well, it is enjoyable to hear such a story. It puts me in mind of some other success stories that can be related to this.

MR. JOHN OLIVER (Pennsylvania): Would you care to comment on trapping methods and the subsequent transplants of many of these pheasants in marginal pheasant areas such as are available in western Pennsylvania? In other words, do you think from the results gained at the present time it would be feasible for the Pennsylvania Game Commission to do this on a much larger scale?

MR. MYERS: At the outset, let me say that this area was largely suitable habitat. This was farmland that was not inhabited by pheasants. Of course, you are going to get some birds moving into some marginal areas but, on the other hand, it is not a cure-all.

MR. CHARLES SHAEFFER (Michigan): Can you comment as to why the game birds did not take hold in this area that was supposedly suitable for pheasants? It seems to me that they would take hold and do something. Would you like to comment?

MR. MYERS: Well, this was a problem. There were over three thousand birds released on the area of which 900 were females. Perhaps the birds were not hardy enough to make it in the wild. A wild bird in such a situation does much better. Of course, one or two of them did pull through but, in the final analysis, it was not a suitable population.

MR. SHAEFFER: Did you have some birds there when you released these other birds?

MR. MYERS: No. The game birds released in the previous years were gone. There was a small native population, very small, but the wild birds complemented this.

CHAIRMAN TOMLINSON: I would like to ask one question. Did you notice a great deal of predation?

MR. MYERS: This stocking had been going on for many years before I came on the scene. I have noticed this in my own state—where we do get a lot of predation of game-farm stock which is not even compatible with that which Pennsylvania has. However, I did not see any.

MR. KENNETH PETERSON (Flint, Michigan): I have two questions.

Would you characterize this area a little more definitively—the terrain and the type of agriculture—and, secondly, would you tell me the status of your game-farm program in other areas of Pennsylvania.

MR. MYERS: There were about 8,121 acres classified 30 percent home sites, wood lots and odd areas and 70 percent in crop lands. The area is quite flat. It is between two ridge areas.

As to the crops, most of it is mixed hay and 12 percent is composed of corn and 11 percent oats. Nine percent is in wheat and eight percent is barley. In other words, it involves a typical Pennsylvania area. There are also some outcroppings of limestone. The area seems to be suitable.

Now, this also brought up the problem of why the pheasant were not there. If it was not as good crop land as it was, I don't think the population could have taken hold as it did.

They do attempt to bring some wild birds into their populations but I am not that well acquainted with the game-farm program. Some of the people from Pennsylvania might be able to answer your question more clearly than I.

MR. PETERSON: I was curious as to why the game birds did not survive in this area? In other words, do they survive in other areas or what is the success of the program in other areas?

MR. MYERS: Well, being away from the area for some time, I would rather not make any comment on that.

MR. H. R. SIGLER (New Hampshire Fish and Game Commission): When you talk about "wild birds", how many generations are they removed from the game farm bird?

MR. MYERS: This is not information that I can give you exactly, but I can say they did originate from game-farm birds.

TECHNICAL SESSION

Tuesday Morning—March 24

Chairman: Russell A. Cookingham

Assistant Director, Massachusetts Division of Fisheries and Game, Boston

Discussion Leader: Howard R. Leach

Special Wildlife Coordinator, California Department of Fish and Game, Sacramento

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COASTAL AND MARINE RESOURCES

REMARKS OF THE CHAIRMAN

Russell A. Cookingham

In reflecting on events of the past years as related to Coastal and Marine Resources, and coupled with this year's Wildlife Conference theme, Man's State in a Good Environment, a technical session such as this takes on added significance.

The increasing need for more effective marine-oriented research to help understand and solve the complex environmental jigsaw becomes even more apparent.

In covering such a broad subject area, and with time allotted for only seven papers, the result was a selection of very diversified subject material. I think this is the way it should be in that marine and coastal resource workers, whether involved with basic fish or wildlife research projects or with the planning and administrative aspects of resource management, must relate their work to the total picture to fully understand the many aspects of marine science.

Several of today's papers delve into the extension aspect of resource management or describe programs whereby biological findings have been used as tools in the enactment of state laws designed to protect or manage coastal or marine resources. Such application of research findings are refreshing examples of where man's stake is being actively considered in working toward a good environment.

OREGON'S ALBACORE RESEARCH PROJECT

DANIEL A. PANSHIN

Sea Grant, Oregon State University, Corvallis, Oregon

INTRODUCTION

Oregon's commercial fishery for albacore tuna (*Thunnus alalunga*) is large and valuable. From July into early October, albacore are available in the general range from 50-150 miles offshore of Oregon.

In 1969, Oregon landings amounted to nearly 30 million pounds, worth about $6.75 million at dockside, the result of fishing by a fleet of some 750 boats. But during the 34-year history of the albacore fishery in Oregon, landings have fluctuated markedly from a low of 28 thousand to a high of nearly 38 million pounds. Despite the commercial significance of albacore, little is known about the complex environmental factors which determine their abundance and distribution.

There clearly exists a need to investigate the albacore tuna in relation to their physical and chemical environment, their predators and competitors, and their food supply, in an attempt to derive workable methods of predicting when and where albacore will be found off Oregon and in what quantities.

During the summer of 1969, therefore, Oregon State University organized and directed an extensive albacore oceanography project in the northeast Pacific Ocean. The project consisted of four interdependent phases:

1) Research ships: 10 cruises were conducted totalling 98 days at sea from May-October 1969 by OSU vessels *Yaquina* and *Cayuse*. The following oceanographic observations were taken at each station: temperature and salinity to 200 meters or greater, dissolved oxygen, nitrate, nitrite, phosphate, silicate, chlorophyll, concentrations of zooplankton and forage animals, and light attenuation and scattering. Research cruises were also made by Bureau of Commercial Fisheries research vessel *David Starr Jordan* and by Fish Commission of Oregon-chartered fishing boat *Sunrise*.

2) Remote-sensing overflights: 18 days of flights were conducted from 3 July-24 September, totalling 10,167 data miles, by aircraft from University of Michigan (C-47), National Aeronautics and Space Administration (Convair 240A), and U.S. Coast Guard (HU-16E, Grumman Albatross). All flights acquired continuous sea-surface temperatures at an altitude of 500 feet or 1000 feet by infrared radiometry (Barnes PRT-5) as well as both black-and-white and color photographs. During University of Michigan flights only (9 days,

4387 data miles), multispectral scanner coverage at 1000-foot and 10,000-foot altitudes was collected in 12 bands from 0.4-13.5 microns, with emphasis on the visible spectrum. In addition, two RB-57 NASA reconnaissance flights provided high altitude (60,000′) color photographs.

3) Cooperation with albacore fishermen: Through logbooks, fishermen contributed detailed catch data, plus concurrent information on sea-surface temperature and water color (as well as such other information as abundance of birds and forage animals). To date, 123 fishermen have reported 359 trips. Eleven of these fishing boats were also equipped with bathythermographs (8 mechanical, 3 expendable) by which they recorded and reported the vertical temperature structure of the ocean.

4) Albacore Central: This phase of the project functioned simultaneously with the research phases and operated as an information service to fishermen. To this end, Albacore Central transmitted radio broadcasts and issued bulletins and temperature charts on ocean conditions to the fishing fleet.

ALBACORE CENTRAL

Albacore Central was run by OSU's Marine Advisory Program, extension arm of Sea Grant, and part of Oregon's Cooperative Extension Service. The objective of Albacore Central was to provide real-time oceanographic and meteorological information of operational value to Pacific Northwest albacore fishermen. Albacore Central attempted to meet this objective by:

(1) Making available material from the Bureau of Commercial Fisheries, and

(2) Supplementing this material with local information, much of it research-derived and acquired by OSU from aircraft, research vessels, Fish Commission of Oregon, fish plants, Weather Bureau, Marine Advisory Program coastal agents, and fishermen themselves.

Fishermen are a hard-to-reach audience. During fishing season fishermen are where the fish are. They don't receive mail regularly, if at all, as most of them are not operating out of their home ports. They aren't available to attend meetings. And they can't be visited.

The primary product of Albacore Central was thus a daily radio message on ocean conditions (primarily temperature structure) and marine, or open-ocean, weather. Seven days a week, from 1 July-1 October, Albacore Central transmitted 92 consecutive messages through the Astoria Marine Operator, a special radio station operated by Pacific Northwest Bell Telephone Company as a radiotelephone service for ships at sea.

A secondary, or supporting, product of Albacore Central was a weekly printed bulletin which discussed oceanography and meteorology as they pertain to albacore, and which was accompanied by a sea-surface temperature chart. Thirteen bulletins and charts were prepared in 1969 and bulk-mailed to fish plants and Marine Advisory Program coastal agents for hand distribution to fishermen as they entered port.

REMOTE-SENSING INVESTIGATIONS

The scientific remote-sensing investigations focused on upwelling phenomena near the coast and on the Columbia River plume, the two dominant oceanographic features off Oregon during summer months. Upwelling is the wind-induced movement of deep, cold, salty water to the surface along the coast, creating an ocean front, or horizontal temperature discontinuity, where it borders the warmer water offshore. The plume, or fresh-water outflow from the Columbia River is warmer, less salty and less dense that the surrounding water and is sometimes detectable for as much as 500 nautical miles from the mouth of the river.

During the summer when winds are predominantly from the north, cold water upwells along the Oregon coast. The high nutrient content of this water contributes to the high biological productivity of the region. As the colder, green upwelled water moves offshore, a sharp temperature and color front may be formed with the warmer, blue oceanic water.

The Columbia River injects about twice as much fresh water into the Pacific Ocean as the combined discharge from all other rivers in California, Oregon, and Washington. The average flow of the Columbia River is 260,000 ft.^{3}/sec., reaching a maximum of 600,000 ft.^{3} /sec. during the period of May to July. In the early summer, a distinct plume of relatively fresh water protrudes far to sea and to the south and southwest of the river mouth off the Oregon coast. Because the plume waters have a strong vertical density gradient and a shallow mixed layer depth, the plume is heated more rapidly than the surrounding oceanic water and is therefore distinguishable as a tongue of warm water early in the summer (Owen, 1968). The plume is rich in suspended particles, and its muddy-green or green color may produce an obvious color front where it meets offshore waters.

Remote sensing from aircraft is an ideal way to obtain synoptic sea-surface information over the large area in which these dynamic events take place. At-sea experiments showed that aircraft infrared temperatures were within 1°F. of ground-truth reference temperatures.

The effects of both coastal upwelling and the Columbia River plume were obvious from remote-sensing overflights during the summer of 1969. Sharp temperature and color fronts were common. The sea-surface temperature pattern was complex and changed rapidly. Variations of sea-surface temperatures were evidenced by gradients which were more complicated than previously supposed (Pearcy and Mueller, 1969).

RESULTS

Initial analysis has emphasized the relationship between fish catches and sea-surface temperature because of the commonly accepted importance of temperature as the key determinant to abundance and distribution of albacore.

The only previous northeast Pacific investigations of albacore-temperature relationships of appreciable extent have been conducted by the California Department of Fish and Game (Clemens, 1961). The investigations reported data for California commercial landings of albacore for the years of 1954-1958. These data have been analyzed by the Bureau of Commercial Fisheries Fishery-Oceanography Center, La Jolla (Flittner, 1966).

The combined data for the five years have a mean of 64.0°F. and 94.8% of the fish were caught between 59.5°F. and 68.5°F. (There are, however, differences among the five years, varying from a low mean of 61.8°F. in 1954 to a high mean of 64.9°F. in 1957). In none of the years were commercial quantities of albacore taken at temperatures lower than 59.5°F. or higher than 70.5°F.

The Oregon State University data are for albacore which were caught during the summer of 1969 off Oregon, Washington, and Vancouver Island. The oceanic regime off the Pacific Northwest is different than that off California, and as might be expected, the relationship of albacore catches to sea-surface temperature is also different.

An analysis of the 1969 data shows three well-defined and significantly different subpopulations in terms of time of catch: early season (July), mid-season (August), and late season (September).

The mean temperature of albacore caught in July was 62.5°F. and the range was relatively small ($1\sigma = 1.0$°F.). The mean temperature of albacore caught in August was 61.7°F. and the range was relatively large ($1\sigma = 1.4$°F.). The mean temperature of albacore caught in September was 60.3°F. and the range was intermediate ($1\sigma = 1.2$°F.). No commercial quantities of albacore were taken from waters colder than 58.0°F. or warmer than 64.5°F.

An interpretation of these results suggests that albacore make their

July entry into the waters off the Pacific Northwest up the axis of the Columbia River plume. Waters off Oregon are generally cool in July and only in the plume are temperatures found as warm as those in which the majority of the albacore were caught.

The August results reflect the breakup of the Columbia River plume as the result of strong northerly winds, intensive coastal upwelling, and offshore advection of cooler water. The larger standard deviation indicates the widespread availability of albacore, and the lower mean temperature shows that albacore are closer to shore near the upwelling front separating the warmer ocean water from the colder upwelled water inshore which contains an abundance of forage animals.

The still lower September mean temperature reflects the start of fall cooling and the typical development of a nearshore, late-season fishery. The smaller standard deviation than August agrees with a fishing effort in a more concentrated area.

SUMMARY AND CONCLUSION

Much analysis remains to be done. Further processing and analysis will examine correlations of fish catches with water color, mixed layer depth, and hour of the day. Distributions of catch per unit effort will be examined as a function of temperature and of the temperature field. For the days on which remote-sensing flights flew over the fleet, microscale changes in catch per unit effort can be established. Finally, stepwise multiple regression will be used to seek out significant relationships between albacore catches and the various oceanographic variables measured by research vessels.

The clear conclusion is that temperature is a crucial factor in determining abundance and distribution of albacore tuna off Oregon, but that other significant factors are also operative concurrently. The goal of subsequent research is to establish what these other factors are in a quantitative sense.

Quite possibly the most useful result of the 1969 project will be the more specific direction of investigative efforts for next summer.

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DISCUSSION

DISCUSSION LEADER HOWARD R. LEACH: As the discussion leader, I should like to direct a question to Mr. Panshin, and that is, to what extent did you utilize remote sensing in the feedback to the fishermen?

MR. PANSHIN: We were using remote sensing both in a real-time sense as well as in a research sense.

We used the temperatures that we secured by remote sensing flights as a large part of the data bank for daily messages and our weekly charts to the fishermen. We also used them as an input to the research efforts that we were conducting at the same time.

BLACK BRANT ON THE MAINLAND COAST OF MEXICO

ROBERT H. SMITH

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G. HORTIN JENSEN

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It is not often that man has the opportunity to witness a major range extension of a wildlife species encompassed within the span of a few years—even in highly mobile migratory waterfowl, in this case the black brant, *Branta nigricans* (Lawrence). To be sure, most waterfowl are opportunists and are quick to occupy niches of new habitat within their established range as so often occurs when water is impounded in formerly waterless areas, or where former range is reöccupied after a drought. Here, however, we have an entirely different situation. Black brant, traditionally wintering on the Pacific coast from Puget Sound south to Baja California, (Leopold and Smith, 1953), moved to suitable habitat on the eastern shores of the Gulf of California bordering the Mexican mainland, Figure 1. Prior to 1958, there were no records of black brant on the mainland coast of Mexico. Six years later, an estimated one-eighth of the entire continental population of black brant wintered there. Since this time this tendency has continued. Table I shows the chronology of this movement and Table 2 shows the areas involved.

This occupation of new territory, beginning in a small way but growing into a sizeable population, poses a number of questions of particular interest to ornithologists and to game managers. Is this, in fact, an extension of range or a reoccupation of ancestral range? What triggered the partial shift of the Baja California population to the mainland? If this was a reoccupation of ancestral range, what drove the brant from the mainland originally? How did brant find this new habitat and by what route did they arrive?

Einarsen (1965) discussed the disuse of California and Oregon

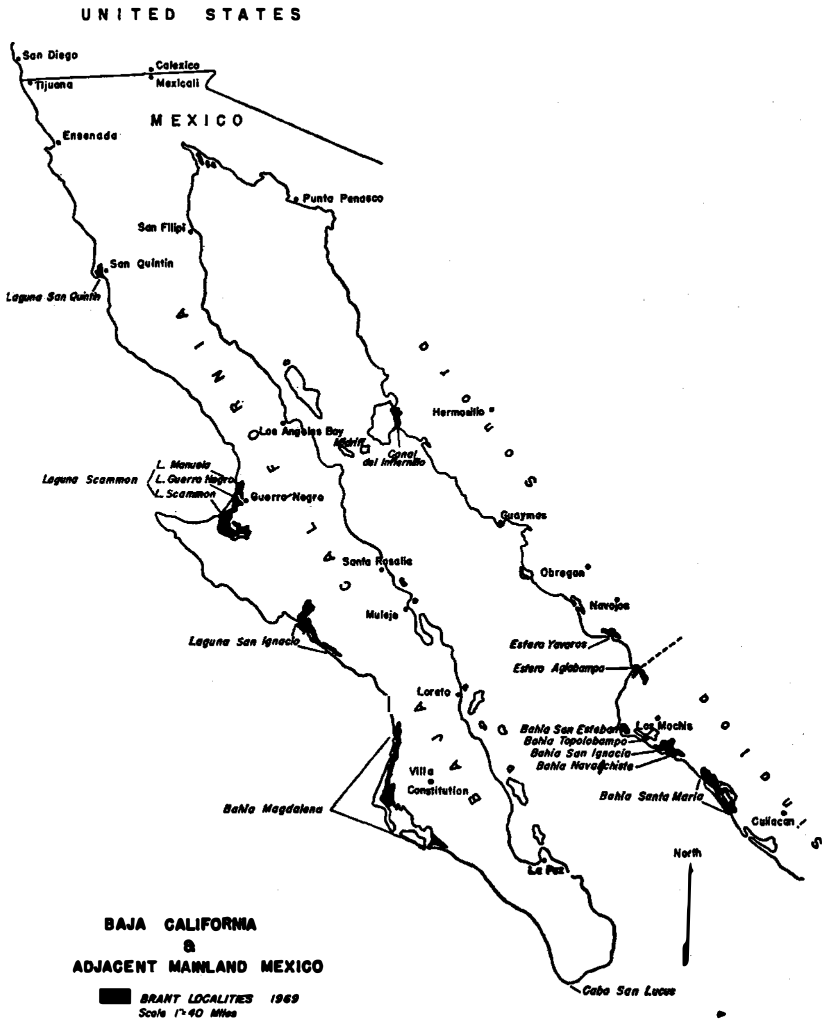

Figure 1

wintering areas by brant. The redistribution of brant from Canadian and United States wintering areas to Mexico (Table 1) was first apparent in 1959. Nineteen fifty-nine was also the first year that significant numbers of brant were found on the mainland of Mexico. The literature on the occurrence of black brant in Mexico is meager and relatively recent. The oldest published record is that of Price (1899) and refers to sightings of brant in the vicinity of the mouth of

TABLE 1. ESTIMATED WINTERING POPULATIONS OF BLACK BRANT IN NORTH AMERICA, 1951–69[1]

Year	Canada	United States	Mexico: Baja California	Mexico: Mainland Mexico	Mexico: Total	Grand Total
1951	3,200	71,900	93,200	—	93,200	168,300
1952	2,000	63,600	101,500	—	101,500	167,100
1953	200	66,500	87,900	—	87,900	154,600
1954	300	45,700	86,300	—	86,300	132,300
1955	800	57,700	76,700	—	76,700	135,200
1956	500	56,500	52,700	—	52,700	109,700
1957	100	58,000	81,400	—	81,400	132,500
1958	100	54,600	71,300	trace	71,300	126,000
1959	—	22,700	44,400	1,400	45,800	68,500
1960[2]	—	22,000	113,400	800	114,200	136,200
1961	100	24,900	138,900	4,200	143,100	168,100
1962	50	51,600	116,200	2,400	118,600	170,250
1963	—	24,800	101,600	13,200	114,800	139,600
1964	No Survey	44,500	115,500	25,300	140,800	185,300
1965	"	24,600	116,200	24,900	141,100	165,700
1966	"	26,300	105,200	25,400	130,600	156,900
1967	"	26,600	111,800	41,800	153,100	179,700
1968	"	18,300	111,600	24,400	136,000	154,300
1969	"	10,700	97,400	35,100	132,500	143,200

[1] Rounded to nearest hundred.
[2] Bahia Magdalena added to the survey.

TABLE 2. ESTIMATED WINTERING POPULATIONS OF BLACK BRANT, (*BRANTA NIGRICANS*), ON THE MAINLAND COAST OF MEXICO 1958–1969

Year	Localities: Canal del Infiernillo	Estero Yavaros	Estero Agiabampo	Bahia San Estaban San Ignacio Navachiste	Bahia Santa Maria	Total
1958			4			4
1959				400	1,000	1,400
1960				600	200	800
1961					4,200	4,200
1962					2,400	2,400
1963		800			12,400	13,200
1964	2,000	50	120	4,200	18,900	25,270
1965	1,500	1,100	30	5,700	16,600	24,930
1966	3,300	400	700	3,600	17,400	25,400
1967	5,400	1,300	300	14,500	19,800	41,300
1968	2,700	600	100	5,200	15,800	24,400
1969	10,000	600	75	5,200	19,200	35,075

the Rio Colorado and at Laguna Salada, the latter place being some 40 miles inland from the head of the Gulf of California. At the turn of the century, Laguna Salada probably received backwater periodically from overflow of the Rio Colorado, for then the Colorado was a wild river and flowed unimpeded to the Gulf. Now Laguna Salada is an alkali flat and the Colorado, in Mexico at least, is a mere trickle. Laguna Salada is not brant habitat now and probably wasn't at the time of Price's visit. The fact that brant were there, however, and in the vicinity of the Colorado delta indicates that they had successfully surmounted any barriers to the Gulf of California. Thus, the mainland habitat was easily accessible merely by following the coast around the head of the Gulf and down the mainland side. Other published records of brant on the mainland are those of Einarsen (1965) in which he refers to our 1958-59 sightings and to those of Dr. and Mrs. Plut at Acapulco in 1960. Recently, sightings in and near the Imperial Valley have been reported (Nowalk and Monson, 1965; Reynolds, 1966; and Banks, 1967). These were spring observations.

All other literature on brant in Mexico refers to known occurrences and records from the Pacific side of Baja California. Nelson (1921), in referring to Laguna San Quintin and Laguna Scammon, states, "These two bays are the main winter home of the black brant." Bent (1925) describes the winter range, "South to Lower California (San Quintin Bay and Cerros Island)" (probably Cedros Island near Laguna Scammon). Moffitt (1932) refers to brant migrations to the Pacific coast of Baja California. Goldman (1937), in discussing waterfowl of the Mexican mainland states, "No black sea brant were seen. They are known to winter on the Lower California coast." Kortright (1943) does not mention Mexico in his treatment of the black brant but shows their range, by map, to Laguna Scammon. Cottam, Lynch, and Nelson (1944), by word and map, indicate winter range south to Bahia Magdalena. The unpublished reports of the Fish and Wildlife Service, Saunders (1949) and Smith, *et al.* (1948-1965), covering the annual Mexican waterfowl surveys, do not mention black brant on the mainland until 1958. Leopold and Smith (1953) show brant only on the Pacific side of Baja California as do Arellana and Rojas (1956). Leopold (1959) states, "However, the species (brant) does not enter the Gulf of California nor is it known to cross to the mainland."

Historically, then, black brant were known to occur solely on the Pacific lagoons of Canada, the United States, and Baja California with not a single record from the mainland of Mexico prior to 1958. Price's records of 1899, recent spring sightings from the Imperial Valley, the Colorado delta, and the Laguna Salada are borderline between the peninsula and the mainland, but they are records from the Gulf side and indicate that at that time brant were within reasonable flight distance with no intervening barriers to mainland lagoons where brant populations are now established. Whether or not they did occupy the mainland habitat at an earlier time we shall probably never know, for had our beginning aerial surveys been after 1958, we would probably have assumed that brant had always wintered in the mainland lagoons.

Our present program of annual aerial surveys of wintering waterfowl populations in Mexico did not begin until 1947. Therefore, we can be only reasonably sure that brant were not present on the mainland between the years 1947 to 1958. If they were there prior to

1947, no one recorded the fact; but then probably no one visited these areas except native fishermen in their pongos. There were few roads leading to the lagoons that brant now inhabit, and these were more cart tracks passable only during dry weather. If, by chance, an itinerant ornithologist did find his way to one or more of the villages bordering the lagoons, he still would have found miles of open water between himself and the area frequented by brant, with no means of transportation except dugout canoes. Consequently, the dearth of records prior to 1947 may possibly be due to a lack of observers rather than absence of brant.

As to our aerial surveys, it should be pointed out that all the areas frequented by brant in Mexico, except for Laguna San Quintin, are so inaccessible as to preclude any other type of survey. Brant are indentified easily from the air even at considerable distances, having flight characteristics and mannerisms peculiar to brant alone and being distinctively marked—a small black goose with a white aftersection. They generally occur in small groups from a mere handful of individuals to flocks of a few hundred—rarely more than a thousand. This greatly simplifies visual estimates. Brant are spooky birds and invariably take flight at a distance from the aircraft; consequently, it is necessary to keep watch well ahead and on both sides. After being flushed from their feeding or resting areas, they generally return to the same place after the aircraft has passed. This limits the possibility of counting the same birds twice. In spite of the brant's inherent spookiness, we feel that our brant counts are among the most reliable of all of our aerial waterfowl surveys. While it is entirely possible to miss a few birds, the areas that are frequented by brant are also the habitats of diving ducks and, as such, have been covered intensively each January since the inception of the aerial surveys. Consequently, we consider it extremely unlikely that brant were present on the mainland lagoons between 1947 and 1958.

MAINLAND BRANT HABITAT

The newly occupied brant range on the mainland is quite similar to that found on the peninsula with the exception of Canal del Infiernillo, a narrow, shallow channel between Isla Tiburon and the mainland. All other areas are large tidal lagoons opening to the Gulf by one or more passes, or *bocas,* through the barrier beach. They have winding, narrow channels of deep water bordered by mud or sand flats, parts of which may be exposed at low tides. All have relatively clear water and a submerged aquatic plant growth that we presume to be eelgrass, *Zostera marina* L., although no specimens have been collected. All areas have exposed bars or isolated strands of sand beach where brant can obtain grit or rest at high tide without being molested. On each area, including the peninsular habitat, redhead ducks, *Aythya americana* (Eyton), are found in association with the brant—not mingling but favoring the same feeding areas. Other sea ducks may or may not be present, but usually a few buffleheads, *Bucephala albeola* (L.), goldeneyes, *Bucephala* spp., surf scoters, *Melanitta perspicillata* (L.), and mergansers, *Mergus* spp., are found along with rafts of greater scaup, *Aythya marila mariloides* (Vigors).

Canal del Infiernillo, the most northerly of the recently occupied brant habitats on the mainland, is atypical in being a part of the Gulf of California rather than a tidal lagoon. It is protected from the surge of the open Gulf by Isla Tiburon and by Punta Sargento on the mainland. It is, as its name suggests, a relatively narrow channel between the island and the mainland, containing many shoals and bars cut by winding deep-water channels that are navigable to small craft. The brant occupy an area roughly 19 by 5 miles, which coincides with the distribution of the beds of aquatic vegetation. Although there is a Seri Indian fishing camp, El Desemboque, on the nearby mainland and an airstrip adjacent on Tiburon Island, very little human activity has been noted. As Bahia Kino, a few miles to the south, becomes more popular as a launching site for sport fishermen and boaters, more and more molestation of the brant can be expected. Brant numbers, first noted here in 1964, have varied between 1500 and 10,000.

Estero Yavaros, the next mainland brant area down the coast, is a typical tidal lagoon that is roughly six by six miles and protected from an open bight of the Gulf by a narrow barrier beach. The entrance, Boca de Santa Barbara, is narrow and shoal and offers passage only to small boats and shallow-draft commercial fishing vessels. The main body of the lagoon is quite shallow with extensive flats that are exposed at low tide. Brant have been noted here since 1963 in numbers varying between 50 and 1300 and are usually found on the flats near the entrance opposite the village of Yavaros. On the open estero only native fishermen in skiffs and pongos have been noted.

Estero de Agiabampo, 16 miles down the coast from Yavaros, a separate waterfowl survey unit since 1951, has been surveyed intensively for redheads, scaup, and widgeon, *Anas americana* (Gmelin); and it was here that the first brant on the mainland were seen in 1958. This lagoon with dimensions 8 by 23 miles is open to the gulf by a wide entrance through the barrier beach, the deep water being near the entrance and in numerous meandering channels through the flats. Though shoal enough for the submerged vegetation to be visible, we have never seen exposed tidal flats. It is possible that the water over the flats is too deep for birds that do not regularly dive for their food. Brant numbers observed here have been low and erratic, varying between 400 and 700. It may be that this lagoon is used only occasionally during passage up or down the coast as a stopover between better feeding areas north or south. There is one permanent village on the shore of the estero and a native fishing camp that is occupied seasonally. Local fishermen in their pongos are generally seen working their nets in the vicinity of the entrance; and during the past few years we have seen a few tourist boats that are either hunting or fishing.

Just a few miles south of Estero Agiabampo, across a low range of cactus-covered mountains, is the waterfowl survey unit with the name of Topolobampo, consisting of the delta of the Rio Fuerte with its rich agricultural lands, irrigation outfalls, and associated tidal lagoons. Bahia San Esteban is on the northwest. At the extreme southern end are two interconnected open water bays, Bahia de San Ignacio and Navachiste. In greatest dimension these lagoons embrace an area roughly 10 by 60 miles. Bahia San Ignacio abuts against a low mountain range, the Sierra de Navachiste, part of which protrudes from the water as rocky, precipitous islands. Bahia Navachiste also contains a number of islands but they are low and flat, some of which support nesting colonies of frigate birds, *Fregata magnificens* Mathews. A dune-covered barrier beach protects the areas from the open gulf, and there are wide entrances through which the tidal currents ebb and flow. Tide flats are extensive, and there are widespread beds of aquatic vegetation dissected by deeper channels and tidal guts. Brant, first observed here in 1959, have fluctuated in numbers between 400 and 14,500 but have leveled off at an average of about 3600 during the past three years. There is a permanent village on each of these lagoons as well as several fishing camps that are occupied seasonally. So far, only native fishermen in pongos and skiffs have been seen operating on the important brant waters. However, not far-distant Los Mochis is an established center for waterfowl hunters; and it is only a matter of time before these brant will be located and exploited by local guides and outfitters.

Bahia de Santa Maria, a separate survey unit, is the largest and most southerly of the mainland brant areas. Its overall dimensions are 11 by 37 miles. A long spit with rather high dunes forms the barrier between the bay and the sea, and this is cut in two places by wide passes through which the bay receives its rhythmic tidal circulation. There are a number of low, flat islands, particularly in the northern end, and extensive areas of shallow flats shadowed here and there with beds of aquatic vegetation, probably eelgrass. Vast sections of the flats bare at low tide. Brant have been observed here regularly since 1959 in numbers varying between 200 and 19,800 and since 1964 have averaged 18,000 annually. Being only 20 miles south of Bahia Navachiste there is bound to be some trading back and forth between the areas; but as numbers observed here have been roughly three to fourfold greater than in the Topolobampo unit, about half of the entire mainland population, it is obvious that Santa Maria is the destination of most mainland brant. There are two villages bordering the bay and native fishermen from these, using dugout canoes, work their nets in the deeper water and channels. Thus far, we have not seen any sport fishing boats or hunters, probably because of inaccessibility and lack of tourist facilities. This status quo, however, cannot be expected to continue indefinitely.

It would appear that after several years of relative stability in brant numbers on the five regularly occupied mainland areas further expansion to new areas is unlikely. With a view to determining whether or not other mainland areas might be acceptable to brant as wintering areas, we have examined all other tidal lagoons and protected bays as carefully as possible during the course of our regular aerial waterfowl surveys, with a view to determining whether or not other mainland areas might be acceptable to brant as wintering areas. The prime prerequisites, of course, are water clear enough to allow the growth of submerged vegetation and shoal enough for the vegetation to be available as food to brant during low tide. Bahia Adair, an open bight at the extreme northern end of the gulf, meets the first of these specifications, but we are not sure of the second. The beds of vegetation are readily visible from the air, but we do not know if they are shoal enough to be available as brant food during low tide.

Farther down the coast, between Canal del Infiernillo and Estero Yavaros, are Estero de Lobos and Estero Siari, both marginal as far as water clarity and vegetation are concerned. The fact that redheads have been found on Estero Siari makes it appear likely that vegetation is present, to some degree at least, but it may be in water too deep to be utilized by brant. Estero Siari is utilized in total by fishermen and is small by comparison with other brant areas.

Southeast of Yavaros, down the coast to Laguna Santa Maria, all tidal lagoons with water clear enough for the growth of submerged vegetation are occupied by brant. Topolobampo Bay, however, is a fairway for a busy commercial fishing fleet and growing numbers of sport fishermen and hunters. It is possible that this constant disturbance and harrassment might drive the brant on to Bahia San Ignacio and Bahia Navachiste, only a few miles distant. Also, it is possible that the water in Topolobampo Bay does not shoal sufficiently during low tides to allow the brant to reach the food supply.

Beyond Santa Maria there are no lagoons that seem to be suitable for brant for approximately 1500 miles, primarily because of excessive turbidity. Mar Muerto, just beyond the Isthmus of Tehuantepec, and the largest of the mainland tidal lagoons, is the only area that appears to have all the necessary requirements: clear water, extensive beds of aquatic vegetation, some of which are exposed at low tide, isolation, and sanding areas. Perhaps it is too isolated from other occupied habitats to be discovered, yet the brant reported by Dr. Plut at Acapulco in 1960 (Einarsen 1965) had already covered two-thirds of the distance between Santa Maria and Mar Muerto. In 1964, we saw a group of five brant 100 miles southeast of Santa Maria in an estuary near Dimas which we assumed to be a scouting party. If brant can reach Maui in the Hawaiian chain, then, possibly, someday they will find Mar Muerto.

DISCUSSION

Considering the evidence, or the lack of it, the question as to whether the present occupation of mainland habitat by brant is a return to former range or is a range extension remains pure conjecture. In our opinion, the return to ancestral range is the logical choice for these reasons; it is axiomatic that any species of wildlife will occupy all of its available habitat within the broad limitations of its environmental requirements unless there are barriers beyond which it cannot or will not pass. Previously cited literature indicates that the barriers to the mainland lagoons were not insurmountable, and certainly our records since 1958 show that there are no effective barriers now. We think we must also assume that the mainland brant habitat has remained virtually unchanged over the millennia. While water levels are known to be rising over all the oceans, it is a very slow process and should affect equally all the lagoons which have had a continuous record of brant occupation, at least since the last century. Moreover, the lack of brant records from the mainland prior to 1947 would have no significance if we assume that no one was present to document their occurrence; and we consider this likelihood quite possible. This is akin to the proverbial tree falling in the forest—if there are no ears to register the vibrations, there is no sound.

If the assumption is correct that black brant are reoccupying their former range, then some catastrophe must have driven them from the mainland lagoons originally—possibly a failure of their food supply. The precarious status of Atlantic brant, *Branta bernicla hrota* (Muller), has been well documented, when eelgrass beds on the Atlantic seaboard were almost wiped out by an infestation of *Labyrinthula* beginning in 1931 (Cottam 1934-1935). Eelgrass beds along the California coast were also blighted by *Labyrinthula* during the late 1930's and early 1940's (Moffitt 1941-1943 and Moffitt and Cottam 1941), forcing brant in many areas to seek other sources of food. They invaded such unlikely habitat as pasturelands and golf courses in the process. These instances of eelgrass depletion in North America go back as far as 1893-94 (Cottam 1935) and have been noted in European waters on several different occasions from about the same time.

In addition to the possibility of blight, tropical storms of hurricane intensity ravage this coast periodically and may well deplete the food resources of the brant. We have seen shrimp trawlers—vessels up to 60 feet in length—stranded on the coastal plain three or four miles distant from the beach. It does not take much imagination to visualize the terrific surf that must batter the lagoons during storms of such force. Following such a storm in 1957, Laguna de Joya, once the locale of the largest shoveler concentration in North America, was rendered practically useless as waterfowl habitat for several years and was avoided by ducks of all species. As these storms are autumnal, occurring from September to November, it would theoretically be possible for brant to arrive at their favored feeding lagoons to find them completely stripped of all aquatic vegetation.

On the other hand, if black brant are actually pioneering new range then some stimulus must have triggered the movement from established wintering lagoons on the Pacific coast of Baja California. Again we might suspect a reduction in food supply, whether by blight or storm. It is generally recognized that brant habitat has deteriorated considerably in California and to some extent in Washington and Oregon. Dredging, filling, bulkheading, the general encroachment of industrial developments, subdivisions, and marinas all lumped under the illusion of "progress" are suspected. Furthermore, these and the constant harrassment of brant by hunters, fishermen, and boaters is a real problem as far south as Laguna Scammon in central Baja California. Being extremely shy creatures intolerant of constant disturbance and with part of their habitat being obliterated, brant would have to depend more and more on the unspoiled areas of southern Baja California, possibly to the point of overcrowding. These pressures, of course, might stimulate the brant to questing for more living space whether they were pioneering new range or reoccupying ancestral habitat.

The question as to how the brant found their new habitat and the route used in getting there is not only conjectural but somewhat academic. It is interesting to speculate on this because of the manner of population build-up and the nature of the terrain to be crossed or circumvented.

The pattern of their occupation of the new habitat suggests small scouting parties in the beginning, with larger and larger numbers each year, until in the seventh year a plateau was reached which generally has been maintained. Although the first brant were recorded in Estero Agiabampo, it is Bahia de Santa Maria that shows the most consistent pattern of usage and escalation of numbers. Since Bahia de Santa Maria harbors the bulk of the population, it is undoubtedly the best of the habitats available on the mainland.

Brant, like other geese, are long-lived creatures when given the opportunity to take advantage of this inherent characteristic. Consequently, if the mainland habitat was occupied sometime prior to 1947 (and Price's records from Laguna Salada and the Colorado delta at the turn of the century would seem to indicate that this might have been so), then it is not unreasonable to suppose that there were some brant remaining in the population that remembered their ancestral feeding grounds on the mainland and how to get there. Hochbaum (1955) has ably documented the role of memory in waterfowl migration and Sowls (1955) conclusively demonstrated the homing tendencies of many species of ducks. During the span of our work on the Mexican wintering areas it has become possible to forecast with reasonable accuracy the approximate numbers and the species composition of waterfowl that will be found on certain lagoons from year to year—strong evidence that identical segments of various populations find their way back to one particular spot season after season.

Another plausible explanation as to how the brant were able to find the mainland lagoons would be random dispersal from the established wintering areas of Baja California. This might explain such extralimital occurrences listed in the A. O. U. Checklist as the Hawaiian Islands and inland records, but these are more likely the result of storms blowing the birds far off course or stragglers joining up with other species of geese bound for inland areas. Edward J. O'Neill, biologist at Tule Lake Refuge in California, has reported sighting black brant with cackling geese on two separate occasions (letter 1966).

The possible routes followed in reaching the mainland habitat make interesting speculation when one considers the brant's penchant for following the coast—even to the point of detouring around jetties and headlands. Brant following down the Pacific coast of Baja California would be on familiar ground to the lower end of Bahia Magdalena, with feeding and resting areas enroute. From there on, if they followed the coast, they would have to round Cabo San Lucas, double back north to the head of the Gulf, then turn back south again down the mainland coast executing a "lazy S" maneuver. Via this route, the distance between established feeding areas would be over 1100 miles—Bahia Magdalena to Canal del Infiernillo. The distance could be shortened considerably by striking out across the Gulf to the mainland from any point after rounding Cabo San Lucas, the tip of the peninsula. To birds that annually make an open-ocean crossing from the Alaskan Peninsula to the coastal islands of British Columbia, or possibly the California coast (Hansen and Nelson 1957), the Gulf crossing would be a simple undertaking. This storm-battered sea is equalled in violence in this hemisphere only by the area of the Icelandic Low in the North Atlantic. If they crossed at the midriff, the narrowest part of the Gulf that also contains a number of islands, they would not only be within sight of land during the entire crossing, but the first sheltered water encountered on the mainland would be Canal del Infiernillo with its extensive beds of aquatic vegetation. Known occupancy by brant in this location dates from 1964.

A direct overland crossing of the peninsula would be by far the shortest route from any of the Pacific coast habitats: San Quintin, Scammon, San Ignacio, and finally Magdalena. This would involve an overland flight across the Desierto Viscaino and the Sierra Gigantea, some of the driest and roughest terrain in North America. For a species that we normally associate with the open sea, the surf lines, or tidal lagoons this would seem a most unlikely route. Yet some black brant regularly pass inland through the interior of Alaska, up the Yukon and Porcupine Rivers, across the Brooks Range through Anaktuvuk Pass and on to the Beaufort Sea in the Arctic. Cade (1951) presents historical data that this has been a regular spring route of brant for the past 100 years. Consequently, we must conclude that the overland route is possible, unlikely though it may be.

A more feasible overland route would seem to be from Santa Monica Bay across the Los Angeles metropolitan area, though San Gorgonio Pass, the Coachella Valley, across the Salton Sea, and on to the head of the Gulf of California. We do have some records of brant from the Salton Sea area during 1963, 1964, and 1967 (Prather 1966 and Banks 1967). As these sightings were made mostly in April and May they might indicate an attempt to make a spring passage via this route. It would seem, however, that if any numbers of brant passed this way, crossing the most densely populated area on the Pacific coast, someone would surely record the fact.

The end result of this occupation of new or former range by black brant is a good thing for the welfare of the species. Because they have such particular and narrow requirements for feeding grounds, anything they do to broaden their base of winter range can only be beneficial. As Americans continue to despoil the brant lagoons of our own Pacific coast by dredging, filling, pollution, and a host of water activities for both pleasure and profit, the brant will be forced to spend more and more time south of the border. Under the circumstances, the broadening of their range to include the mainland lagoons is both timely and fortuitous. We can only hope that the Mexican authorities will take better care of their brant habitat than have the Americans; for on this rests the future welfare of the North American black brant population.

SUMMARY

Black brant winter from British Columbia to Mexico. In Mexico, prior to 1958, brant were reported to winter exclusively on the coastal lagoons of the Pacific side of Baja California.

Beginning in 1958, black brant began a partial shift to lagoons on the Mexican mainland bordering the Gulf of California, reaching a plateau of relatively stable numbers in 1964 and persisting through the date of this writing (1969). This population involves approximately 25,000–35,000 brant, or roughly one-fifth of the known wintering population on the Pacific coast of North America.

Favorable mainland lagoons and a channel separating Isla Tiburon from the mainland are now occupied regularly by brant. Three other lagoons and an open bight appear to offer marginal habitat in the northern half of the gulf on the mainland side. South of Laguna Santa Maria, the largest, most heavily utilized, and most southerly of the occupied lagoons, only one area, Mar Muerto, appears to be potential brant habitat. Its distance from Santa Maria around the coast—over 1500 miles with no suitable feeding areas in between—makes its future occupancy doubtful.

Whether this shift is a range extension or a reoccupation of ancestral range is conjecture. In light of the meager evidence available, the hypothesis of reoccupation of former range is favored.

The stimuli that triggered the shift to the mainland are unknown, but the possible need for more living space and/or depletion of food supplies are suspected.

No direct information is available on the route followed to the mainland lagoons; but in view of the nature of the terrain and the peculiarities of the brant, the route following the coast around the peninsula and crossing the gulf at the "midriff" appears to be the most logical.

Broadening the base of the winter range of the black brant, already operating on the most restricted of habitats, is a good thing for continued welfare of the species.

ACKNOWLEDGMENTS

The information contained in this discussion is the result of the combined effort of many people representing many different organizations over a period of 20 years. George B. Saunders and David L. Spencer, both of the U.S. Fish and Wildlife Service, made the initial aerial surveys of Mexican waterfowl areas in 1947 and 1948. During February of 1948, the writer, Robert H. Smith, joined Spencer in a second coverage of all coastal waterfowl habitat in Mexico. Since then, those who have participated in the Mexican west coast surveys are listed below in the chronological order of their participation. Our thanks go to Floyd A. Thompson, U. S. Fish and Wildlife Service; John N. Ball, U. S. Fish and Wildlife Service; A. Starker Leopold, University of California, then representing the California Duck Hunters Association; A. Wendell Miller, California Department of Fish and Game; Wynn G. Freeman, Montana Department of Fish and Game; Ross C. Hanson, U. S. Fish and Wildlife Service; Henry A. Hansen, Washington Department of Game and now U. S. Fish and Wildlife Service; Wesley B. Fleming, Arizona Department of Fish and Game; Robert L. Salter, Idaho Fish and Game Department; C. Victor Oglesby, Nevada Fish and Game commission; John W. McKean, Oregon State Game commission; Donald A. Smith, Utah Fish and Game Department; John E. Chattin, U. S. Fish and Wildlife Service; Fred A. Glover, U. S. Fish and Wildlife Service; J. D. Smith, U. S. Fish and Wildlife Service; Gerald Pospichal, U. S. Fish and Wildlife Service; K. Duane Norman, U. S. Fish and Wildlife Service; and Donald N. Frickie, U. S. Fish and Wildlife Service. Thanks are due also to members of the staff of Region I, Bureau of Sport Fisheries and Wildlife for contributing material and stenographic assistance.

We are also deeply indebted to the Mexican wildlife authorities, particularly the late Sr. Luis Macias, Dr. Enrique Beltran, and Dr. Hernando Corzo for their aid and assistance in obtaining authorization for our flights into Mexico. Also helpful in these matters has been Milton Lindner of the U. S. Fisheries Mission to Mexico.

In 1957, the U. S. Fish and Wildlife Service did not make a survey in Mexico; but in that year, the California Department of Fish and Game made a survey of brant in Baja California. Those participating in the survey were Frank M. Kozlik, A. Wendell Miller, and A. E. Naylor. Their timely assistance provided an unbroken record of brant in Mexico since 1948.

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LONG-RANGE PLANNING FOR GREAT LAKES RESOURCES

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The University of Michigan, through participation in the Sea Grant Program administered through the National Science Foundation, is attempting to define the configuration of disciplines and individuals which will most effectively deal with long-range planning for development of environmental resources. In this type of endeavor universities have some unique contributions to make. The most obvious of these is that they are the primary source, through their educational programs, of the new manpower which will be required, in the long haul, to resolve the great variety of environmental problems which we face. Secondly, universities possess a unique range of disciplines which can be brought to bear on the problems that confront us. Thirdly, I think universities are uniquely able to deal, in a detached manner, with certain problems, such as questions about revision of our political institutions, which tend to be rather touchy when dealt with by the agencies of society which, themselves, may need to be reformed.

The primary objective of the Sea Grant Program is to focus attention on development of marine resources. This word "development" is the key term; and while defined differently in different institutional programs, at the University of Michigan we define "development" in terms of study of the interaction between human society and the environmental resources of the Great Lakes. Our program emphasizes optimal utilization of environmental resources rather than exploration and exploitation. First, I will present the perspective on environmental resources development which constitute the philosophy of our program and then sketch, briefly, the program itself.

We might begin by drawing a lesson from nature. If we look about us we see that animal populations, for the most part, are fairly gracefully equilibrated with the environmental resources on which they depend. The potential for explosive growth of populations is rarely realized. Limitation of environmental resources sets an upper limit on population size, usually well before the population threatens to destroy its environmental resources. The process which is central in affecting this adjustment is competition. I will mention just a few examples from intensively studied natural populations.

Forest insects, which in large numbers have the capability of stripping the forests bare, usually are limited in abundance primarily by predation, parisitism and disease.

Territorial fishes tend to be limited by a scramble for space among the new recruits; the intense competition is reflected in an infant mortality rate usually in excess of 98 per cent.

Deer populations in midwestern North America are food limited. The nutritional state of the animals controls reproductive rates, and strongly influences survival during severe winters.

An example that is perhaps closer to home for some of us is that of the granary insects. Some of the classical laboratory population work was carried out here by Professor Thomas Park, at the University of Chicago, using flour beetles as experimental animals. These insects in their flour-bin universe might seem at first blush to have circumvented the natural controls to which other populations are subject, for in the medium of flour they find shelter, space, and food. But, alas, while they hide, play, and eat in this cozy flour-bin universe they, at the same time, defecate and spray a variety of exotic metabolites there, thus fouling their world and thereby limiting their own abundance.

These are just a few examples of the devices by which natural populations are equilibrated with environmental resources. These immediate equilibrating devices are backed up by adaptive evolutionary change which enables populations to meet sometimes profound environmental shifts, which occur gradually and over long periods of years.

We might contrast the examples of these natural populations with that of our own human population, which is expected to double within the next 40 years, and which is triggering both local and global environmental changes at an unprecedented rate. We can attribute this to man's dedicated application of medicine, technology, and sex. Through this dedication we have managed to attain a temporary immunity from the natural controls which might otherwise force us to some accommodation with our environment. We manage, through many clever devices, to insulate ourselves from the environmental problems that we cause—problems arising from population growth; industrialization; urbanization; and our high standard of living. In effecting this insulation we shut out the warning signals fed back from a disturbed environment, which should constitute negative feedback, leading the human population to equilibrate itself with its global resources.

Through this insulation, mental if not physical, we are able to largely ignore the rapid consumption of non-renewable resources. We are able to ignore the 142 million tons of air pollutants added to the atmosphere annually in the United States. We are able to ignore 74 million cans and bottles discarded annually in our environment, and rapidly piling up. We are able to ignore the pollution of 600 billion gallons of water each year. Looking at the record, I think we must admit that we have very definite flour beetle tendencies.

Another sobering consideration is that the rate of environmental change that we are triggering greatly exceeds the maximum rate of evolutionary change for the human species and hence it is going to be ordinary man, as we know him today, rather than some specially-selected man, who must face problems of environmental adaptation for which no precedents exist in our evolutionary history.

With immediately responsive natural environmental controls on man circumvented by our technological cleverness, and with evolutionary adaption unworkable because of the rapidity of change that we bring about, we can define several possible alternatives for mankind.

One could be that environmental conditions will be changed so drastically that extinction will result.

A second alternative could be that man will persist and ultimately reach such a high density that natural controls on population will be re-established, competition dictating the conditions of equilibrium between man and environmental resources on its own terms. These terms might very well be bestial by our society's present standards.

A third alternative is that man will substitute for the natural regulatory processes which have been circumvented, some set of rationally determined constraints on his own activities—substitute for the ecology of nature an ecology of reason. This synthetic ecology would have to be designed into all of the activities pursued by man which threaten our environment directly or indirectly. Exploitation of living and non-living natural resources, disposal of wastes, the use of new compounds and new processes, the direct alteration of natural systems, all these would be restrained by this rational or synthetic ecology.

To implement this third alternative, which I think most people would agree is the most attractive of the three that I have sketched, will require a vast body of new knowledge derived from many disciplines. Presently, we do not really know how to mesh the contributing disciplines. We do not know how to synthesize and apply the body of knowledge that will be required. Inquiry into this range of problems is the substance of the Great Lakes Program being undertaken at the University of Michigan with Sea Grant support.

It is implicit in this type of approach that established theories, customs, and values be re-examined, and many of them, perhaps some of our most cherished ones, may be discarded. Emphasis must shift from the pioneering goals of incessant numerical growth and ever-increasing consumption of raw materials to establishment of equilibrium in human affairs. This equilibrium emphasis leads to a focus on optimization of the use of resources in a longer time frame and within a much more comprehensive set of values than is currently popular. It leads to definition of consequences of different alternatives open to society in exploiting resources—a sort of "look-before-you-leap" strategy; and it leads to recognition of ultimate ecological limitations which man cannot escape. The problem stated in this way is one of jointly managing the socio-economic system of man, and the interlocking and only arbitrarily differentiated natural ecosystem.

In dealing with Great Lakes' resources in this program's context, we face the problems of managing the largest body of fresh water in the world, serving in our nation a population of 30 million people (14 percent of all our citizens), which is expected to double in the next 50 years. The quantity of fresh water available during this period of expansion is judged to be completely adequate, but there are severe threats to the quality of the water and related resources.

The problem that we sense already, and which we expect to be aggravated in the future, derives from the fact that impacts on the system generated by man tend to trigger unanticipated consequences, sometimes highly undesirable ones, throughout the system.

Thus, we take advantage of favorable climate to grow fruit on the shoreline of the Great Lakes, The orchard monoculture is accompanied by problems of insect infestation. These problems are countered by use of pesticides, which are subsequently discovered in very small amounts in the waters of the Great Lakes, and in alarmingly large amounts in fish. Part of the price we pay for the fruit is the destruction of commercial and sport fisheries.

To take another example out of a long, long list, a one-inch rise in the water level on the Great Lakes will allow an increase on the average of 100 tons in the capacity of large bulk carriers on the lakes. One hundred tons per trip translates into a substantial economic gain. This same one-inch rise in water level, however, triggers erosion of beaches and shorelines, and threatens marinas, docking facilities, and urban shoreline developments.

Clearly the approach required for long-range planning and management of such a highly interlocked complex of resources is a systems approach. Through the program that we are developing we hope, in collaboration with other institutions and agencies, to collect the new knowledge required, and in this collection of new knowledge we will emphasize collecting no more than the very minimum that is required in order to get the job done because of the staggering immensity of the problem and the great overall cost of developing this kind of predictive data for resource management. And secondly, we would use this new knowledge through synthesis into sets of predictive models which would be used to evaluate the consequences of the different developmental options open to mankind.

I might give an example: In this Great Lakes Basin, we might first develop an input-output model for the aquatic system that simply describes all the sources of water—input from tributaries and precipitation and outputs from outflow to other parts of the lakes and evaporation so that we would have a water balance on which we could predict on the basis of prescribed climatic regimes what lake levels would be. Similar procedures could be applied to transportation, shoreline erosion problems, and so forth.

The second model one would want to develop would be a comprehensive model of water circulation patterns. From this model one could predict shoreline erosion problems; the distribution of pollutants which may be dispersed in the water mass; migratory patterns, perhaps, of certain types of fishes; then one would superimpose on the circulation model still another model—one of the cycling of nutrients and biological components between the water mass and the sediments.

Injection of new substances, for example pollution effluents, into the system adds nutrients which enter and alter the cycling process, so that changes in water chemistry will be translated into changes in primary production and then into changes in the abundance and composition of the species; and these changes are passed on, in turn, up through a chain into fishes, and ultimately into situations which affect the economic and social welfare of man. A set of models of the natural ecosystem can be linked with the activities of man interfaced by some device such as the following: We might envision the natural resource complex as both stimulating and partially satisfying the needs of society; society's needs are translated into institutions; businesses, municipal, or social; and these, in turn generate new impacts on resources for the benefit of man; again changes in man's social, political, and economic status alter the the impact on resources. This type of cycling interlock between the natural system and the human system can be modeled with varying degrees of perfection, and our objective is to explore not just the functions of the natural systems but those of the interrelated human system as well.

One might think of using this body of data, and this synthesis of knowledge to explore the consequences of the different alternatives that are open to society; through some educational device provide society with an understanding of alternatives and consequences, so that society, in turn, through some acceptable political process, can make a choice, in fact, of their own destiny.

The process by which all this might be carried out is not understood at present, but there are varying types of model and game techniques which are applicable to the social sector as well as to the natural sector.

So I should say, in summarizing, the intent of this program, which I can describe only in broad outline here, is that what we are trying to do is to define the optimal interaction between man and nature. This definition is essentially an ecological one. We seek to work backwards and try to define the optimal social and political system through which man can establish the most enriching and enduring relationship between himself and the world upon which he is ultimately dependent. I think in pursuing this course we are, in a sense, defining a new culture; and the term that I propose for this is "eco culture." I suggest to you that ultimately man's best hope for achieving such an enriching and enduring existence on this planet is in the definition and the implemention of this global eco culture.

Thank you.

MASSACHUSETTS ESTUARINE RESEARCH AND PROTECTION PROGRAMS

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INTRODUCTION

During the 1950's and early 1960's, increased concern was expressed by state and federal resource agencies and local conservationists about the deterioration of our estuaries and coastal wetlands. These areas were rapidly being altered to fit the demands of an indifferent society—a society convinced that wetlands are wastelands. Ecologists have determined that wetlands are not wastelands but are, in fact, a major contributing biotope within the estuarine ecosystem. Odum (1961) estimated that tidemarsh ecosystems may produce ten tons of organic matter per acre, per year. Other sources indicate that saltmarshes rank above the most productive prairie lands of our Midwest.

Concerned with this environmental destruction, Massachusetts established programs for the evaluation, protection and enhancement of its estuaries and coastal wetlands in 1963. Hutton (1964a & 1964b) focused attention on these programs shortly after their inception. Subsequently, Clark (1967) summarized the contribution of these programs.

MARINE RESOURCE STUDIES

The Massachusetts estuarine research program was initiated as the result of a report of the Marine Fisheries Advisory Commission to the Governor of the Commonwealth in December, 1960. The Commission stated:

> The Commonwealth has only limited knowledge as to the physical conditions and basic productivity of its many harbors, bays, river mouths and other estuaries. As these serve as key areas of productivity for many species of marine organisms important to the commercial and recreation (sport fishing) industries, it would appear of paramount importance to initiate this basic survey as rapidly as possible.
>
> An additional factor lending further emphasis to the need for detailed studies is the rapid rate of change evident along much of the Massachusetts coastline involving the dredging of channels, construction of hurricane protection barriers, and filling of tidal marshland for commercial purposes. The Commission recognizes the urgent necessity of prompt investigation before such changes become irrevocable.

In their report the Commission recommended:

a. An analysis of the physical and geological characteristics of the coastal bays and estuaries, including surface area; depth and volume; tidal amplitude and tidal exchange ratio; bottom contour; and extent of fresh water inflow.
b. A study of the history of the marine fishery, both sport and commercial, in each area, with consideration of factors that may have altered the fishery, such as dredging and pollution.
c. An inventory of the commercial and sport finfish, shellfish and crustacean populations in each area.

The following objectives were established as guidelines for the Massachusetts estuarine research program:

1. to provide comprehensive information concerning the current condition of the fisheries in the inshore waters of the Commonwealth;
2. to determine the factors responsible for the decline of fishing industries in certain areas; and
3. to suggest methods of developing or improving local marine fishery production.

Since inception in March, 1963, 15 coastal bays and estuaries have been studied. Final reports have been published for the Merrimack

River Estuary, Quincy Bay, North River, Beverly-Salem Harbor, Parker River-Plum Island Sound Estuary, Pleasant Bay, Westport River, and Annisquam River-Gloucester Harbor (Fig. 1). These areas are representative of Massachusetts estuaries with regard to their physical and biological characteristics and their utilization by man.

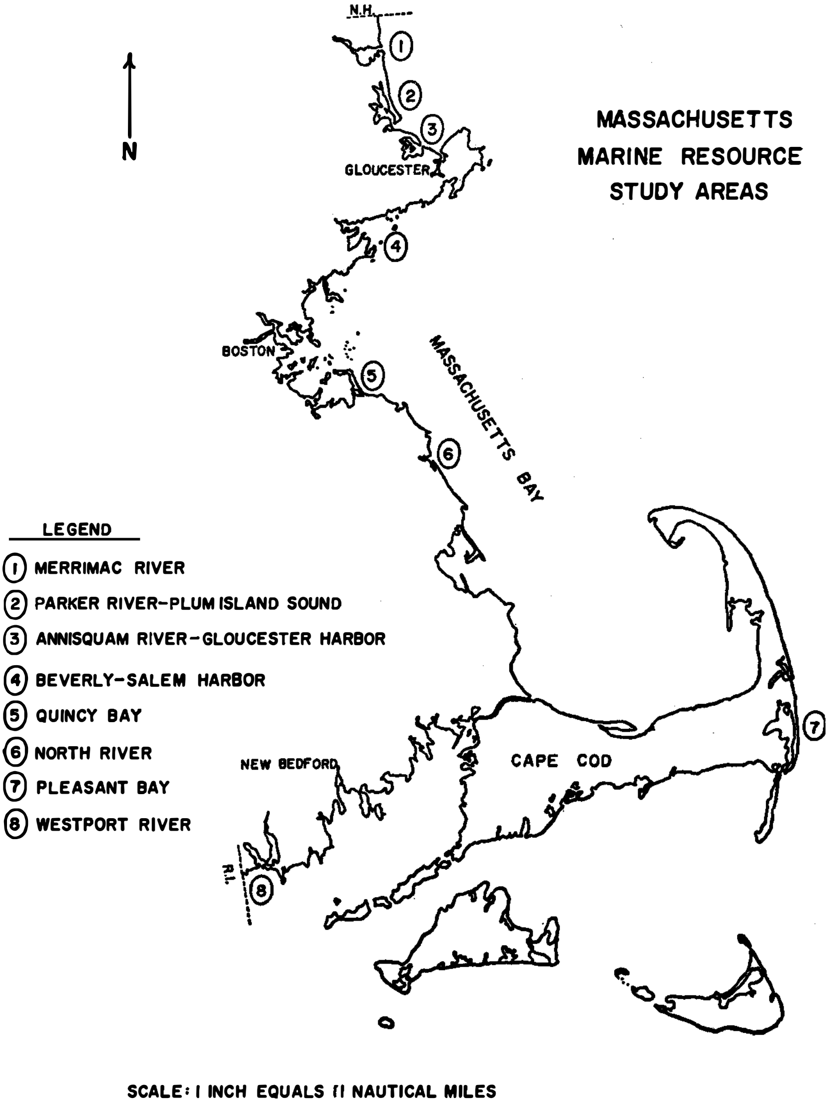

Figure 1

Historically, many of the Bay State's coastal communities were settled during the early 1600's. Settlers found the harbors and rivers teeming with many species of fish including cod, haddock, hake, mackerel, sturgeon, salmon, shad, alewives and smelt. Fishing, first pursued out of necessity, eventually became a profitable industry as trade with England and the West Indies increased.

With the passing of time these areas have become altered by man's increased activities, although the degree of change from one locale to another varies greatly. The most pronounced change is evident where population densities are highest. In Massachusetts, the third most densely populated state in the nation, approximately 20 percent of our total population lives within a 15 mile radius of Boston. Thus, the shorelines and basins in areas such as Quincy Bay and Beverly-Salem Harbor have undergone considerable alteration through dredging and filling operations.

Although some localized marine, urban and industrial development has taken place in the Merrimack River and Annisquam River-Gloucester Harbor areas, well to the north of Boston, these areas still contain large tracts of nutrient-producing saltmarsh.

To the south, the Westport River and Pleasant Bay still exhibit the flavor of an old New England fishing community. Despite considerable settlement adjacent to these areas, the estuaries have not been appreciably affected. Those changes that have occurred reflect the marine-oriented character of the area, such as marinas and small fishing facilities.

Development along the banks of Parker River-Plum Island Sound and the North River has been very limited. Both areas are unique in that they contain several hundred acres of high-value saltmarsh. Primary use of these areas includes waterfowling, clamming, fishing and recreational boating.

METHODS

Each area was studied for 12 months by a team of three biologists, with additional assistance provided seasonally. The Massachusetts estuarine program represents approximately 60 man-years of effort at an estimated total expenditure of $675,000.

Water analysis and finfish sampling was conducted monthly at preselected sites. Shellfish were inventoried during summer months. Sport and commercial fisheries statistics were compiled from catch reports and through personal interviews. General methods for calculating morphometric data were obtained from Welch (1948). Historical literature was reviewed by team personnel and geologic descriptions were furnished by personnel of the U. S. Geological Survey.

FINDINGS

The overall physical features of Massachusetts' estuaries vary greatly. Maximum length of the areas studied range from 3.6 statute miles in the Westport River to 11.7 statute miles in the North River, and maximum widths vary from 1.1 statute miles in the North River to 3.4 statute miles in Beverly-Salem Harbor. Total surface area at mean high water (MHW) varies from 533 acres in the North River to 9,051 acres in Beverly-Salem Harbor. The ratio of total surface area (MHW) to saltmarsh ranged from 1:3 in Beverly-Salem Harbor to 50:1 in the North River. The Merrimack River estuary exhibits a ratio of about 1:1.

Water analysis data collected during the investigations did not indicate any prolonged extreme conditions considered to be limiting factors for estuarine biota. Average annual surface water temperatures for all areas varied from 49° to 59°F (Table 1). The greatest fluctuation was recorded during the Westport River study, where surface water temperatures ranged from 34° to 83°F. Average annual surface salinities ranged from 18.8 to 30.9 0/00. The greatest fluctuation, 0.0 to 35.0 0/00, was noted during the Merrimack River study. Average annual pH values ranged from 7.4 to 8.0, dissolved oxygen from 7.6 to 11.3 ppm, and carbon dioxide from 3.9 to 8.0 ppm.

Eighty-four species of finfish representing 48 families were recorded during our investigations. In the Merrimack River alone, in 1964, 50 species were recorded. The 84 species of finfish taken in our study areas have been grouped according to McHugh's (1967) classification for estuarine nekton and include: 14 freshwater fishes that occasionally enter brackish water; 11 estuarine species which spend their entire lives in the estuary; 9 anadromous or catadromous species; 14 marine species which make regular seasonal visits to the estuary; 9 marine species which use the estuary primarily as a nursery ground; and 27 adventitious visitors which appear irregularly and have no apparent estuarine requirements.

Geographically, Cape Cod, Massachusetts forms a natural barrier for the range of many species of finfish and shellfish. The Cape is the dividing line between the waters of the Gulf of Maine and the Middle Atlantic Bight. For example, populations of oysters, *Crassostrea virginica*; quahogs, *Mercenaria mercenaria*; and scallops, *Aequipecten irradians* exist north of Cape Cod, but larger concentrations are found in the more favorable environment located to the south. On the other hand, soft shell clams, *Mya arenaria*, are more prominent north of the Cape. Southern-range finfish species, as defined by Bigelow and Schroeder (1953) captured only in Pleasant Bay and the Westport River were: the crevalle jack, *Caranx hippos*; flying gurnard, *Dacty-*

TABLE 1. TEMPERATURE AND WATER ANALYSIS MEASUREMENTS FOR EIGHT MASSACHUSETTS COASTAL BAYS AND ESTUARIES, 1964–1969

Estuary	Temperature (F) Water			Salinity (0/00)			pH			Dissolved Oxygen (ppm)			Carbon Dioxide (ppm)		
	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
Merrimack River	32	75	49	0.0	35.0	18.8	6.5	8.5	7.4	5.0	10.0	9.4	5.0	10.0	5.4
Parker River-Plum Island Sound	30	73	52	10.0	33.5	30.9	7.0	8.5	8.0	7.0	10.0	9.8	0.0	10.0	6.2
Annisquam River-Gloucester Harbor	32	78	52	13.0	34.0	30.5	7.0	8.5	8.0	8.0	10.0	9.9	0.0	10.0	4.8
Beverly-Salem Harbor	29	72	50	9.0	34.0	30.6	5.5	8.5	8.0	7.0	10.0	9.9	0.0	15.0	3.9
Quincy Bay	30	70	51	27.0	35.0	30.5	5.0	8.5	7.9	6.0	10.0	9.6	0.0	10.0	5.5
North River	31	76	59	1.0	31.5	23.0	6.5	8.0	7.4	3.0	11.0	7.6	5.0	15.0	8.0
Pleasant Bay	38	79	57	7.0	31.0	24.2	8.0	8.0	8.0	6.0	11.0	8.5	—	—	—
Westport River	34	83	54	0.0	33.0	25.4	6.0	8.4	7.8	5.5	13.0	11.3	—	—	—

lopterus volitans; hogchoker, *Trinectes maculatus*; northern kingfish, *Menticirrhus saxatilis*; northern puffer, *Sphaeroides maculatus*; orange filefish, *Alutera schoepfi;* oyster toadfish, *Opsanus tau;* sheepshead minnow, *Cyprinodon variegatus;* and striped mullet, *Mugil cephalus.*

Bluefish, *Pomatomus saltatrix*, normally considered a warm-water species, were collected during the summer of 1969 in Essex Bay. On July 11, 14, and August 28, a total of four juvenile specimens, ranging in size from 40 to 152 mm, were captured. Other fishes of more southerly distribution collected from the waters on the North Shore of Massachusetts include: a shortnose sturgeon, *Acipenser brevirostrum*, taken in 1966 while experimental otter trawling off Plum Island; a mackerel scad, *Decapterus macarellus*, and a banded rudder-fish, *Seriola zonata*, taken during seining operations in Essex Bay in August 1969; and a filefish, *Monacanthus hispidus*, found in a lobster pot in Ipswich Bay in September 1969.

Resource values for coastal Massachusetts areas vary greatly. Revenue derived from the 1964 marine sport fishery in the Merrimack River Estuary amounted to $326,670. The 1965 lobster fishery in Beverly-Salem Harbor yielded $244,303. Soft shell clam harvests from the Parker River-Plum Island Sound Estuary (1965) and the Annisquam River-Gloucester Harbor Coastal System (1966) amounted to $313,480 and $122,400, respectively. The most valuable resource in Pleasant Bay (1965) was quahogs, with a yield of $137,080, and in the Westport River (1966) the bay scallop, valued at $201,180, was the primary resource.

Salt hay, primarily highwater cord grass, *Spartina patens,* is still harvested on the North Shore of Massachusetts. During 1965, an estimated $10,975 was derived from the salt hay industry in the Parker River-Plum Island Sound area. Our investigations revealed that approximately one ton of salt hay was produced (harvested) per acre of salt marsh in this area. However, only a small portion of the hay produced is commercially harvested, and the bulk of this nutrient-rich organic material breaks down and is utilized by the lower trophic levels in the food chain.

Total minimum economic values for sport and commercial fisheries varied from $93,310 in Quincy Bay to $450,145 in the Merrimack River Estuary. The average minimum value, per surface acre (MHW) for five North Shore Massachusetts coastal bays and estuaries was $111.48.

After determining current status and potential for both sport and commercial fisheries in each area, and to fulfill the outlined objectives of the estuarine program, recommendations are made for public access, fishing piers, passage of anadromous fishes to and from their spawning grounds, improved methods of increasing shellfish productivity, obtaining additional revenue from local marine resources (license sales), sewage abatement, coastal saltmarsh protection and establishment of local Conservation Commissions.

POLLUTION

Tide waters have long been repositories of industrial and domestic sewage wastes. Gross pollution in coastal areas has been, and continues to be, a major factor affecting marine resource utilization in Massachusetts. Discharge of domestic sewage drastically curtails utilization of shellfish resources in many of our bays and estuaries. The Massachusetts Department of Public Health reported that in 1967, 30 percent of the areas in the state which produced, or had produced shellfish, were closed because of domestic sewage pollution. A 1963 legislative report by the Department of Natural Resources, relative to the coastal wetlands and certain shellfish grants in the Commonwealth, revealed that about 90 percent of the potential shellfish-producing areas from Boston north to the New Hampshire line were significantly contaminated by human sewage and industrial waste. A dramatic example of the effects of such closure occurs in the Merrimack River Estuary where, because of contamination from domestic sewage, adult clams in Newburyport Harbor die without being disturbed by a digger's hoe. The 1964 estuarine study in this area revealed that upwards of 20,000 bushels of soft shell clams could be harvested annually without endangering future stocks. We believe this annual production could be doubled under good management practices. Clam diggers in the town of Salisbury (Merrimack River Estuary) lost an estimated $1,500,000 in income between 1950 and 1965 by not being able to harvest available soft shell clams. In hindsight, $1,500,000 would have more than paid for the construction of a sewage treatment plant for the town over the same period.

WETLANDS PROTECTION

Data collected during our estuarine research program has provided much of the scientific basis for establishing effective legislation aimed toward protecting the estimated 60,000 acres of saltmarsh in Massachusetts. The 1963 coastal wetlands investigation revealed that 87 percent of our coastal wetlands are of high or moderate value to waterfowl, 80 percent are of high or moderate value for hunting, 66 percent are of high or moderate value to fur animals, 73 percent are of high or moderate historic and scenic value, 71 percent are of high or moderate value to soft shell clams, 69 percent are of high or moderate value to winter flounder and 82 percent are of high or moderate value to striped bass.

Approximately 1,010 acres of coastal wetlands in Massachusetts were lost between 1954 and 1964 due to indiscriminate alteration. In an effort to curtail such alteration of coastal saltmarshes, the 1963 Massachusetts Legislature enacted a law requiring that written notice of intent be filed before a person removes, fills or dredges any bank, flat or marsh bordering on coastal waters. If the area of proposed alteration contains shellfish, or is necessary to protect marine fisheries, the Director of our Division may impose such conditions as deemed necessary for the protection of marine fisheries resources. The intent of this law was upheld on March 9, 1964, when a Justice of the Superior Court ruled that "Broad Marsh is a 'saltmarsh' necessary to preserve and protect marine fisheries" (Hutton, 1964a). The intense use of our coastal areas is evidenced by the 101 applications received for coastal alteration during 1969. Of these, 51 were approved with no change, conditions were imposed on 35, three were denied and 12 were unresolved.

Although this Act has been successful in preventing total destruction of our coastal wetlands, its effectiveness is restricted because conditions may be imposed only if the proposed alteration is detrimental to marine fisheries. To provide further and more permanent protection of these vital areas, the 1965 Massachusetts Legislature enacted the Coastal Wetlands Protection Act. Under this Act, the Commissioner of the Department of Natural Resources may, for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife and marine fisheries, restrict or prohibit dredging, filling or polluting of coastal wetlands. By virtue of this law, the entire saltmarsh area within a community can be permanently protected. Hearings have been held in 11 Massachusetts communities and, with public support and approval, approximately one-fourth (13,487 acres) of our coastal wetlands are now permanently protected.

SUMMARY AND CONCLUSIONS

Concerned with rapid loss of its saltmarsh areas, Massachusetts established programs of marine resource study and coastal wetland protection. Since 1963, 15 coastal bays and estuaries have been studied, representing approximately 60 man-years of effort at an expenditure of approximately $675,000.

Eighty-four species of finfish representing 48 families were recorded during our investigations. Recent occurrences of southern range finfish species on the North Shore of Massachusetts include the bluefish, shortnose sturgeon, mackerel scad, banded rudderfish and filefish.

The average minimum economic yields from the utilization of the marine fisheries resources in five North Shore Massachusetts coastal bays and estuaries was $111.48 per surface acre.

Discharge of domestic sewage has drastically curtailed utilization of shellfish resources in many coastal areas.

More than one hundred applications for coastal alteration permits were received and processed by the Division of Marine Fisheries in 1969.

More than 13,000 acres of coastal wetlands in the Commonwealth are now permanently protected from indiscriminate use and alteration under the Coastal Wetlands Protection Act.

In conclusion, the estuarine research program in Massachusetts has:

. . . provided information relative to morphometry, water quality, and type and degree of pollution affecting the marine environment in the coastal bays and estuaries;

. . . served as a review of commercial fisheries;

. . . provided a means to determine relative abundance of various finfish and shellfish species, and the type, status and value of sport and commercial fisheries in each area;

. . . provided an inventory of the more common species of algae and vascular plants and a determination of the current status of saltmarsh;

. . . provided economic values that can readily be applied to an area under pressure for development;

. . . provided data to the Division of Marine Fisheries for assessing coastal alteration projects and;

. . . substantiated restrictions imposed under the coastal wetlands protection program.

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DISCUSSION

CHAIRMAN COOKINGHAM: Since approximately 1963, Massachusetts' marine biologists have been involved in an estuarine research project encompassing much of the coast of Massachusetts and much of the original credit for getting this work goes to Dr. Robert Hutton who is now the executive secretary of the American Fisheries Society, and who was at that time assistant director of the Massachusetts division of Marine Fisheries.

The effort that has been put forth has been successful in helping to protect a large section of the Massachusetts' coastal area from physical alterations due to protective acts which have been legislated.

The results of the estuarine research reported here today have played an important role in providing much of the "back up" of biological physical information to assure the passage and implementation of such legislation.

DISCUSSION LEADER LEACH: I had hoped that we would have some discussion on this very fine contribution because it is quite obvious that Massachusetts is very far along toward inventorying their estuary habitat, perhaps more so than some other states.

Are there people here from other states who can give us some statistics that are involved in this study of estuaries, or who want to ask some questions of our speaker?

MR. JOHN SMAIL (Point Reyes Bird Observatory, Bolinas, California): I would like to ask Mr. Chesmore if any kind of quantitative studies have been taken in the Massachusetts bird inventory?

MR. CHESMORE: Not directly in relation to marine fisheries, in our field of it. We do recognize the presence of the various waterfowl and the birds in these areas, but there are no available statistics.

MR. GLADWIN HILL (New York *Times*, New York City, New York): You indicated one-fourth of the total wetlands were permanently protected. What about the other three-quarters? I understand that the State of Massachusetts gave claims priority. Are there any questions on interfering with economic development? How many test claims have been registered over the years? Are your defense mechanisms working satisfactorily all around?

MR. CHESMORE: To answer the first question, our program for coastal protection began in 1965, but it took a couple of years to lay the groundwork, and we progressed on the basis of one community, and it takes about two months to do this. We have to go over the preliminary plans and then set up a public hearing, at which time if the order is placed it takes 90 days after the order is finally placed when the audit becomes effective. In the meantime, all of the landowners have to be notified by mail, and it is just a matter of time. We are going into another community for approximately 2800 acres, and we are progressing at the rate of approximately one every other month.

In answer to the second question, to date in my experience there is only one claim that has been filed before the courts, and there has been no decision on this to date.

The courts, however, have the final word on this, and anybody aggrieved can petition the courts in the state; but there has been no decision given by the court.

CHAIRMAN COOKINGHAM: I would like to make one comment with regard to Mr. Smail's question on wildlife.

In Massachusetts we have two separate divisions, one of those being the Marine Division, and the other the Inland Fisheries and Wildlife. The Inland Division has the responsibility for wildlife and does have programs particularly regarding waterfowl. There are no programs at the present time on shore birds.

MR. JOSEPH LARSON (University of Massachusetts): It might be well to read into the record at this point that the legislature has also passed two substantial acts regarding this, in one of which it makes provision for requiring a permit before alteration can be made on fresh water facilities; the second act requires a permit from the Department in advance of an attempt to classify a new inland setup for coastal application.

The only problem here is that in defining the limits to the satisfaction of the state, those concerned with the inland marshes, have more difficulty than those with coastal marshes.

MR. C. W. THREINEN (Department of Natural Resources, Wisconsin): I understand that the productivity of sewage waste is rather high. How does the productivity of that affect the marsh area production?

MR. CHESMORE: The example that I used was in the Merrimac River, and this is probably one of the most heavily polluted rivers in Massachusetts. It does naturally affect the utilization of these resources.

ESTUARIES AND THE ECOLOGY OF SHOREBIRDS

JOHN SMAIL

Point Reyes Bird Observatory, Bolinas, California

In the last few years the predicament of estuaries and other coastal wetlands has become a matter of increasing concern. In California this concern is particularly timely, not to say tardy, since by most estimates nearly 70 percent of the state's tideland habitat has already been destroyed by development.

The only two unspoiled estuaries on the west coast, Limantour Estero and Drake's Estero, are both located on the Point Reyes National Seashore and they disgorge through a common mouth into Drake's Bay about 25 miles northwest of San Francisco. In 1965, the master plan team for the newly established Seashore recommended a scheme to develop Limantour Estero as a recreation area by damming and dredging the main channel to make it into a boat marina and excavating the surrounding salt marsh and sandspit areas to provide a bathing beach and parking facilities for over 2,100 cars. Since opinion on the compatibility of this scheme with the estuary's natural resources was not uniformly favorable, it was felt that a quantitative wildlife study was indicated before any development took place. Point Reyes Bird Observatory was contracted by the Park Service to undertake a survey of the area to assess its value as bird habitat. More recently, the Limantour Estero study has received support from the Special Wildlife Investigations Division of the California Department of Fish and Game.

In this paper I shall sketch briefly some of the methods, results, and wider implications of this study with particular reference to shorebirds. Let me stress that research is continuing and that the data gathered offer very much more than I can present here.

STUDY AREA AND METHODS

Limantour Estero extends two and a half miles due east from its mouth on the north shore of Drake's Bay, with one large bay one and a quarter miles long and 2,000 feet wide adjoining the main channel to the north. At the east end there are two inlets to the north, both of which have been dammed in recent years. The estero is bounded on the south by a narrow sandspit with patches of dune grass at its western end (*i.e.,* toward the mouth) and denser vegetation at the east end consisting of salt marsh weed, coarse grass and low scrub. On the south bank there are large expanses of intertidal flat of varying sandy composition while at the west end there is a soft mudflat. The north bank slopes down more steeply to the water's edge, at the east end from rough pasture and at the west end from cliffs up to two hundred feet high. There is an extensive underwater vegetation consisting mainly of eelgrass (*Zostera marina*). The total area of the estuary including the flats and the marsh is about 600 acres.

Most of the data have been derived from detailed censuses of the whole area. For census purposes, different types of habitat within the estuary and the area immediately surrounding it were determined and boundaries defined (Figure 1). Divisions were made on the basis of substrate type, width of the channel, and more obvious geographical features. Twelve areas in all were established. On each census the observer would record, area by area, the numbers of all bird species using or influencing the estuary: loons, grebes, pelicans and cormorants, herons and egrets, all ducks and geese and swans, rails and coot, all shorebirds, gulls, terns, and alcids. Each observation specified further whether the birds observed were in the water, on the mudflat or at the water's edge, on the marsh, on sand, or flying, and also whether they were resting or feeding. More recently, Limantour Estero has been included in an aerial census program carried out in conjunction with the California Department of Fish and Game.

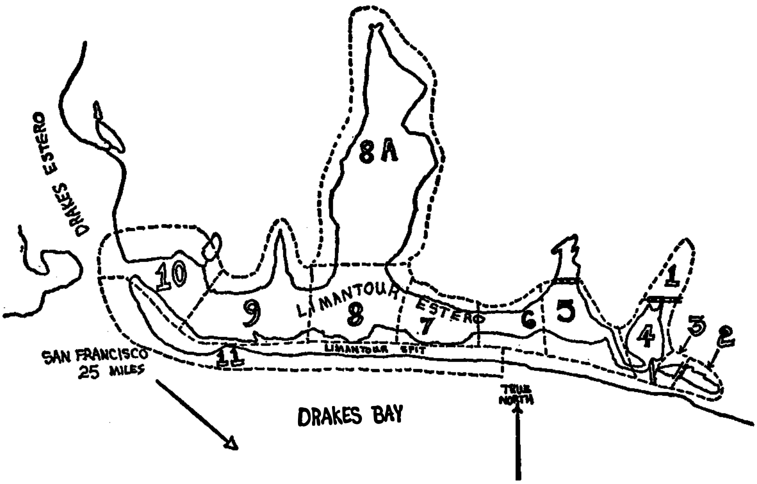

Figure 1.—Limantour Estero Census Areas.

It became clear from this study that the estuary provided, above all, outstandingly varied bird habitat. Its importance as a wintering area was obvious, and it was clearly a vital stopping-off point on the northward migration of many species, including such specialized feeders as the black brant (*Branta nigricans*). More than 100 water bird species have been recorded. But, while it was generally possible to predict how most groups would use the available resources, and where they could be found at any given time as the tide rose and fell, it was much more difficult to pin down the shorebirds. The tide affected them more obviously and drastically than any other group, since the prime feeding areas were flooded twice a day. One large species, the willet (*Catoptrophorus semipalmatus*), seemed well adapted to cope with this changing environment by virtue of its varied diet and feeding habits. It was able to make use of intertidal flat, salt marsh, and even the ocean beach, feeding by several methods: picking and probing on the flats or the beach, picking organisms from the surface of the salt marsh, and by probing upwards into the overhanging edge of the marsh to pull out small crabs. It gives the impression of being a careful feeder, scanning the substrate closely to find food rather than making rapid probes.

The small sandpipers (least sandpiper, *Calidris minutilla*; dunlin, *Calidris alpina;* and western sandpiper, *Calidris mauri*), on the other hand, appear to expend much more energy, feeding with many exploratory probes. Different feeding habits within this group are largely a function of bill length—the least sandpiper with its short bill spends most of its feeding time back from the water's edge picking as well as probing, while the dunlin, twice the size with much longer legs and bill, often feeds up to its belly in water and with its whole head immersed as it probes deeply. The "peeps" are much more restricted to the intertidal flats, although least sandpipers and dunlin make some use of the salt marsh.

It appeared that a quantitative analysis of the distribution of these species would reveal far more about the use of the various habitat areas than was possible from mere observation; and furthermore, that such an analysis would provide a sound basis for evaluating the relative worth of these areas. A computer program was set up for the Bird Observatory by courtesy of the U. S. Forest Service in Berkeley. Each census observation was punched with information on date, time, tide, and area, together with all other data taken.

Clearly, the tide was a critical factor. The long and narrow configuration of the estuary naturally causes a great deal of tidal drag, and low tide at the east end of the estuary, which is two miles east of the mouth, was found to occur over two and a half hours later than low tide at Point Reyes, which is two miles west of the mouth; the corresponding lag at high tide was approximately one hour. An appropriate correction factor was applied and tide values used in the following discussion are those at the east end of Limantour Estero.

The first computer run was used to obtain a tabulation of the number of small sandpipers and the number of willets observed in each area for a given tidal height. For the sake of simplicity, only three tidal stages were distinguished: "low tide," when the tide was less than 1.5 feet above the datum (mean lower low tide) and all available substrate was exposed; "mid tide," from 1.5 feet to 3.5 feet, at which height the elevated mudflat at the east end and the outer portions of the sandier flat adjacent to it were exposed; and "high tide," over 3.5 feet, when the only flat exposed at the east end of the estero was the elevated mudflat.

A selection of the results from representative areas is shown in Tables 1 and 2. The areas are shown in order from the west (mouth) end (area 10) to the east end (area 4).

The pattern of distribution for the willet illustrates some of the feeding characteristics of this species already alluded to. At high tide they are prominent in the east end of the estuary even though the intertidal flats are mostly covered. In this situation they readily take to the salt marsh, usually to feed on insects and small crabs (*Hemigrapsus* and *Pachygrapsus* spp.), but sometimes merely to rest. Area 5 is clearly the most favored area, even though the area of marsh (8

TABLE 1. AVERAGE NUMBER OF WILLETS (*CATOPTROPHORUS SEMIPALMATUS*) IN REPRESENTATIVE HABITAT AREAS

	AREA 10 Estuary Mouth	AREA 8 Coarse Sand	AREA 5 Sandy Mudflat	AREA 4 Soft Mudflat
Low Tide[1]	2	24	15	9
Mid Tide	4	20	41	30
High Tide	3	6	50	34

[1] Low tide is less than 1.5 ft. (above mean lower low water); mid tide is between 1.5 and 3.5 ft.; high tide is above 3.5 ft.

TABLE 2. AVERAGE NUMBER OF SMALL SANDPIPERS[2] IN REPRESENTATIVE HABITAT AREAS

	AREA 10 Estuary Mouth	AREA 8 Coarse Sand	AREA 5 Sandy Mudflat	AREA 4 Soft Mudflat
Low Tide	57	83	406	58
Mid Tide	74	110	174	378
High Tide	480	278	113	515

[2] Least Sandpiper (*Calidris minutilla*), Dunlin (*Calidris alpina*), and Western Sandpiper (*Calidris mauri*).

acres) is much less than that in area 4 (12 acres). It can be seen that at low tide the willets tend to spread out along the estuary; in fact as can be surmised from the low average figures, some of the birds leave Limantour Estero altogether, apparently going to neighboring Drake's Estero.

The distribution of the small sandpipers ("peeps") is more complex (Table 2) and in fact varies a great deal within the group itself. At high tide many birds can be seen feeding on the coarse sand in the areas toward the mouth (e.g., areas 8 and 10). But since the substrate does not retain water, the importance of these areas at lower stages of the tide is drastically reduced. In contrast, the elevated soft mudflat (area 4) two miles from the mouth, which is the most strongly preferred area at high tide, is also the most important in the middle tidal ranges. The interrelation of this mudflat and the adjacent sandy mudflat (area 5) is one of the most fascinating aspects of the ecology of the estero. Why does the lower-lying sandier flat feature so prominently at low tide? During the rest of the tidal cycle the limited amount of exposure makes it less favorable for feeding than the higher flat, but at low tide both these areas are fully exposed. A study (Johnson, 1967) on a flat of comparable silty consistency in Tomales Bay some 17 miles north of Limantour Estero indicates that polychaete worms do not actually burrow down as the tide recedes. However, they do become compacted into about 25 percent of their volume and assume a generally less accessible position in the substrate. This would naturally have a more pronounced effect on the higher flat. It also appears that for reasons we do not yet fully understand, the lower sandy mudflat is generally richer in food organisms. Substrate of this composition is known to be especially productive (Reid, 1961).

The first experience with the computer has been very valuable, but there is enormous scope for further investigation. San Francisco State College and the California Academy of Sciences have recently started work on the marine biology of the area, and I hope that cooperation with them will elucidate some of the many unsolved problems.

I believe that the importance of this study lies in its implications for the shorebird population as a whole. It is obvious that there are many variables to consider in accounting for the abundance or absence of a particular species in a given location, but the relative importance of the variables is often hard to assess. So little work has been done in this field, especially on wintering birds, that the literature offers little guidance. Since loss of wetland habitat on both coasts of the United States is already threatening shorebird wintering grounds, this lack is particularly unfortunate. With the kind of data gathered in this study (see also Lenna, 1969) embracing many variables in habitat and temporal distribution we have the basis for a detailed analysis of how various factors combine to produce favorable conditions for shorebirds, and thus we can accurately evaluate any given habitat. In this way it will be possible to make an informed case for preserving an area, wherever it may be, in the face of threatened development.

The future of Limantour Estero itself is uncertain. The horrendous original master plan, technically unsound as well as ecologically murderous, is now generally conceded to be a bad idea. But although the magic word "ecology" has reached the ears of National Park Service planners it still may not ring as sweetly as "recreation" and the old euphemism "multiple use." It is unfortunate that we cannot yet take for granted that the unique value of estuaries has been fully realized by all public agencies. In this case a number of people are waiting to examine with a critical eye the work of the new master plan team which is to examine the Point Reyes National Seashore during 1970. In California as a whole we face a long hard struggle to defend what remains of our tidelands.

ACKNOWLEDGMENT

During 1969 and 1970 the operation of the Point Reyes Bird Observatory was supported in part by a grant from the National Science Foundation.

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DISCUSSION

MRS. ROBERT ERICKSON (Racine, Wisconsin): I have heard other ornithologists very much concerned with the national seashore on the East Coast. There are many of those along the southern shores of our East Coast which have similar habitat and that need preservation as scientific areas in the same way.

I would like to say that many of these plans for having natural area within a recreational facility of the National Park Service might be made before plans are finalized; and I wondered if your group had thought of petitioning the coastal agencies before plans are finalized?

MR. SMAIL: That is a good question. In this respect the opinion of the rank and file of the Service, especially at the national seashore, is at variance with the attitude of the master planners.

Please do not go away with the opinion that Point Reyes is going down the drain. It is nothing of the sort. I think it is very important to get across that it is an ecological preserve.

I may say there is considerable support within the Point Reyes National Seashore for having it become an ecological preserve, and keeping the multitudes of people away from it. The original master plan called for parking for 2,100 cars.

As for petitioning vociferously, I am afraid that we, as a tax-exempt, independent body, are not really in a strong position to get into this politically. We are trying our best, but unfortunately we are very thinly spread to conduct our research program, and as for a full-time lobbyist, I am afraid that is out of the question.

MR. GLADWYN HILL: One of the problems of the California coastal area involves the sandy beaches, and, of course, the Point Reyes estuary areas must depend on the barrier beach there.

Is the future of this beach pretty well assured? I mean, are there adequate sources of regeneration of land? I understand the geologists have had a problem with erosion and lack of regeneration from upper areas, essentially because of damming. Is this a matter of concern?

MR. SMAIL: It is not a matter of concern at Limantour Estero.

I may say this beach is at present being used rather indiscriminately, but the beach, not the sandspit, is scheduled to become part of a recreation area.

Of course, as far as I am concerned, that is a perfectly compatible use; but as far as physical threat to this particular beach, I do not feel that is a problem.

DISCUSSION LEADER LEACH: I might answer the question on beach erosion in southern California, which is of some consequence. It has been attributed largely to the damming of many of our major rivers which no longer replenish the beaches.

MRS. ERICKSON: I would like to respond to what Dr. Smail has said in his remarks. Perhaps there is something we could do as people from all parts of the nation to suggest to the National Parks Commission that it set aside certain areas of its national recreation areas as natural areas for wildlife.

MR. SMAIL: Anything you can do would be greatly appreciated. I would very much like to see it. Thank you.

MR. O. L. WALLACE (National Parks Service): We certainly would welcome all of your interest. We operate three types of areas, as you know. We have historic areas; natural areas; and recreation areas.

In recreation areas we will have areas that are set aside for natural area preservation; but we also have a responsibility in these areas for vitally important recreational activities. Of course, these recreational activities also have to be somewhat compatible with the natural area of preservation, and we all agree that these areas need to be preserved at this point.

MR. SMAIL: The Point Reyes National Seashore Act calls for areas to be set aside for the "recreation, benefit, and inspiration" of the public. I realize that one of the difficulties the master planners faced, and I am afraid I may have represented it is a rather uncharitable light, was the pressures to provide recreation. I hope that they can be made to go along with the idea that inspiration and a superior type of recreation can be derived from an area such as Limantour Sstero, and that this can take precedence over the rather more obvious idea of recreation in the form of small boats in an area which, incidentally, is subject to 25 to 30-mile winds more or less constantly.

EVALUATION OF A LEVEED LOUISIANA MARSH

EDWARD RAY SMITH

Soil Conservation Service, U. S. Department of Agriculture, Alexandria, Louisiana

The agricultural use of marshland has been condemned many times because of deleterious effects on wildlife. Proper agricultural management of poorly drained land can, however, be beneficial to wetland wildlife. An example of this is the use of southern Louisiana rice fields by ducks, geese, and snipe. Dillon (1959) reported the species and poundages of plant foods available in rice fields of three Louisiana parishes. Many such fields are flooded after harvest to make the rice and weed seeds more available to ducks. Geese are attracted to these same areas by the sprouting stubble. Pastures in the prairie region of Louisiana also furnish much choice food for geese, and during wet periods, for snipe as well.

The grazing of cattle in marsh areas, if properly managed, also can be beneficial to wetland wildlife. Chabreck (1964) discusses the use of cattle in these areas and points out the beneficial as well as harmful features of this practice.

This paper reports on the vegetative changes on a tract of Louisiana marshland during five years of management directed at improving cattle grazing and food conditions for wildlife.

In the spring of 1961 Mr. Edgar B. Stern, Jr., president of the Mermentau Mineral and Land Company, requested that the Gulf Coast Soil and Water Conservation District assist in developing a soil and water conservation plan on the Company's 7,475-acre tract in Cameron Parish, Louisiana. The purpose of having such a plan was to improve the area for both cattle and wildlife.

This land lies west of the Mermentau River, south of Louisiana Highway 1143, and north of Louisiana Highway 82. It is typical of the slightly saline marsh in this area of the Gulf Coast. It includes low cheniers[1] running roughly NW-SE, and numerous scattered small shallow ponds. The major soil types are Harris clays, Palm Beach-Harris complex, and Palm Beach sandy loam. In 1950 this marsh was dominated by giant-cutgrass, *Zizaniopsis miliacea*. Because of

[1]Low sandy ridges, thought to be stranded barrier beaches of the past.

land subsidence and frequent flooding by hurricanes, the vegetative dominance shifted to the more salt-tolerant marshhay cordgrass, *Spartina patens*. By 1961 the giant-cutgrass was relegated to isolated clumps.

To provide the basic data necessary for the plan, a team of Soil Conservation Service scientists studied the soils, topography, and vegetation of the area. The team included a district conservationist, soil scientist, conservation engineer, range conservationist, and biologist. The information that was gathered was consolidated in a written report that the district conservationist used in developing several alternatives of land management. These were presented to the landowner for his consideration. After the alternatives were discussed and decisions made, a formal plan was drawn up.

The plan called for a stabilized water level over the entire area from a +2 to a —2 inches. This was to be accomplished by levees to exclude salt water from storm tides and by 14 water-control structures which would keep enough water in the ponds to preserve aquatic vegetation and at the same time allow germination and growth of desirable grasses, sedges, and forbs on pond margins and on other open ground. The control of tidal movement would also reduce turbidity of the water and allow better growth of aquatics (Chabreck, 1967).

To obtain better utilization of the range and provide drinking water for cattle and surface water for wildlife, two cattle walkways were planned. SCS specifications for walkways called for alternate excavations on each side to prevent drainage of the area, but the owner wanted continuous ditches for boat trails to reach his duck blinds. Drainage of the area did not occur because of the water-control structures.

The area was divided into fields and proper grazing (grazing no more than 50 percent of weight of key species of the vegetation) planned for each. To insure tender growth for grazing and to stimulate the growth of desired wildlife foods, controlled burning was also included in the plan. This burning was to be done only when the soil was shallowly covered by water. This would avoid burning organic deposits and injuring the root crowns of grasses.

Approximately 200 acres had been invaded by rattlebox, *Daubentonia punicea*. Aerial spray of this pest was planned so that these acres could return to producing cattle and wildlife food.

Construction was completed in 1962 and the grazing rights were leased to Mr. D. Y. Doland, who has carried out the grazing part of the plan. Between 800 and 1200 head of cattle are grazed on the marsh from September to April. At first, cattle were not grazed from

May to August on this marsh because of the mosquito problem. Cattle were taken off the marsh during the spring months and moved to central Louisiana where they remained until September. The dates of departure and return depended on the severity of the mosquitoes. Now only part of the cattle herd is removed during the summer months. Since control of water levels has been achieved, the mosquito problem has been reduced.

After the plan had been operating for five years, the Soil Conservation Service restudied the area in 1967 to determine:

1. Condition of the 14 water-control structures.
2. Changes in soil salinity after exclusion of tidal water.
3. Vegetation changes.
4. Methods used in operating structures.
5. Benefits to landowner from installing the water-control system.
6. Harmful effects from installation.

Another objective of the study was to locate a series of permanent transects for future vegetative evaluations.

Again a team of SCS scientists was assembled to evaluate the work. These are the highlights of their findings:

ENGINEERING

The engineers found the following failures in the structural measures. Chains for lifting flap gates were badly corroded or broken on six structures. Weir boards were not being used, or were missing, from five structures. There had been washing around the headwalls on four structures. Levees settled below predicted height in three areas. There was siltation around the inlet or outlet of two structures. Spacer rods supporting sides of the structure were badly corroded on two units. Operational platforms for flap gates were out of place on one structure. There was leaking around one structure.

SOILS

There was no significant change in the soils. The area of upland salt site had not increased nor had the area covered by ponds decreased. The indicator plant, Gulf cordgrass, *Spartina spartinae,* which demands a higher, drier site, had not expanded beyond the area it formerly had occupied.

The increase in millet, *Echinochloa sp.* and sprangletop, *Leptochloa sp.,* suggests that the marsh is becoming fresher. The dominant marsh vegetation is still salt-tolerant grasses. This indicates that the soils are still moderately saline.

VEGETATION

At the time of the original survey, a visual estimate of the vegetation composition was made. Change in vegetation was checked against this estimate.

Four line transects were established to evaluate vegetative composition. Another visual estimate of the whole area was also made.

This line transect was patterned after one described in *Range Research-Basic Problems and Techniques* (Cook 1962). It consisted of 300 feet of marked line extending into the marsh from an established point. The last 10 feet of each 100 feet were "read" and the vegetation measured at ground level in tenths of a foot. The transects were placed where they would cover as many different kinds of vegetation as possible. Existing water depths were also noted where the transects were established.

While the survey was taking place, notes were made of the species of wildlife observed and signs of wildlife use of various plants.

The results of the four transects are listed in Table 1 by species of plants and the percentage of area they occupied at each of the transects. An average of all these plants is shown in the last column.

TABLE 1.

	No. 1 Percent	No. 2 Percent	No. 3 Percent	No. 4 Percent	Average Percent
Marshhay cordgrass	62.9	57.0	41.2	—	40.3
Gulfcoast spikesedge	4.0	—	—	—	1.0
Millet	3.2	16.0	12.3	—	7.9
Purple pluchea	1.6	2.0	1.0	—	1.1
False-nutgrass	13.7	—	—	—	3.4
Knotroot bristlegras	8.1	—	—	—	2.0
Slim aster	6.4	—	—	—	1.6
Seashore paspalum	—	8.0	6.2	75.3	22.4
Bacopa	—	16.5	—	—	4.1
Knotgrass	—	—	39.2	—	9.8
Sprangletop	—	—	—	7.7	1.9
Seashore saltgrass	—	—	—	17.0	4.2

A visual estimate, using the same plants mentioned in the 1961 list, was made after all the transects were completed and the whole marsh inspected. The two are compared in Table 2. Only the species showing an important change in composition are listed in this table. The differences between the species are listed in the last column.

When comparing the transects (Table 1) with 1967 visual estimate (Table 2), one can see there is a close agreement between them.

RANGE CONDITION

Although there has been a major decrease in the percentage composition of basal density of marshhay cordgrass, common reed,

TABLE 2. VISUAL ESTIMATES 1961 AND 1967

	1961 Percent	1967 Percent	Difference Percent
Marshhay cordgrass	50	45	−5
Gulf cordgrass[1]	10	4	−6
Millet	3	10	+7
Sprangletop	—	3	+3
Seashore paspalum	4	4	
Rattlebox[2]	3	3	
Saltmarsh bulrush	Tr	3	+3
Big cordgrass	Tr	3	+3
Knotgrass	—	2	+2
Seashore saltgrass	4	3	−1
Common reed	3	Tr	−3
Longtom	4	Tr[1]	−4
Spikesedge	3	Tr	−3

[1] High percent on ridges (20 percent, plus).
[2] Operator has sprayed approximately 50 percent of rattlebox this year. Sprayed area not considered.

and Gulf cordgrass, the total grass production has increased considerably during the past six years. It is believed that this increase was caused by greater densities of millet, sprangletop, seashore paspalum, knotgrass, and others. Better production has resulted from a more stabilized water table, which allows for more plants, as well as allowing plants to make maximum forage.

With the increase of big cordgrass, millet, sprangletop, and knotgrass, the area would be more suitable for yearlong grazing if it were not for the mosquito problem.

As a result of installing the structures, Mr. Doland is now able to graze an additional 500 acres (6+ percent of the land). These areas were previously inaccessible to livestock grazing because of the high water table and soft bottom. Mr. Doland stated that acreage suitable for grazing is increasing each year. This is because more of the area is now growing a good stand of grass, making it capable of supporting the weight of cattle.

At the present time grazing management on the area is good. The degree of grazing was estimated to be approximately five percent of the better wildlife and cattle foods at this time. Distribution of grazing is still a problem on some areas, although most have been made accessible by the construction of cattle walkways, water facilities, and burning. Mr. Doland burns approximately one-third of the area each year.

BIOLOGY ASPECTS

Comparing the conditions of the marsh against the original conditions listed in the report, several things become evident:

1. There has been an increase in the amount of food available to wildlife.
2. The marsh has become fresher in the intervening years.

3. The present management program is beneficial to higher forms of wildlife, but not estuarine larval forms. Estuarine forms are dependent on marshes as nursery areas, and the water-control structures in this area prohibit access of these creatures.

After making visual estimates and running transects of the vegetation in the marsh, it becomes evident that the food plants have increased since the first evaluation was made. The original report showed a total of three percent to be millet and sprangletop combined, whereas the recent evaluation showed sprangletop three percent and millet ten percent respectively. The total production of millet in marshes varies from year to year, depending on water conditions. Perhaps this year is exceptional, but it is felt that it indicates a general trend towards improvement caused by the stabilized water level. This agrees with the statements by the lessee, which will be presented later in this discussion. The transects showed sprangletop to be three percent and millet eight percent of the total vegetation. The olney bulrush, *Scirpus olneyi*, is still present in the marsh, but still amounts to a trace (less than two percent). Saltmarsh bulrush, *Scirpus robustus*, has increased from trace to three percent.

A survey of the ponds revealed that dwarf spikerush, *Eleocharis parvula,* was present in varying amounts in most of them. Several beds of Gulfcoast spikerush, *Eleocharis cellulosa*, were also observed in the smaller ponds but these stands were not extensive.

The larger ponds south of Pumpkin Ridge, the largest chenier, were virtually bare of these plants when this evaluation study was made. However, on returning to these ponds on October 10 (the evaluation study was made on September 11-14) they were found to be choked with sago pondweed, *Potamogeton pectinatus;* widgeongrass, *Ruppia maritima;* and muskgrass, *Chara sp.* Apparently these ponds, being so shallow (8 to 12 inches average depth) and warming up so much during the summer months, did not produce these aquatics until the water cooled (Joanen and Glasgow, 1965).

Waterhyssop, *Bacopa monnieri*, was not mentioned in the original evaluation, but is now present over the marsh, especially in the shallow ponds. The ducks in the marsh at the time of this study, mottled ducks, *Anas fulvigula,* and blue-winged teal, *Anas discors,* were using this plant extensively.

The only other aquatics seen growing in the ponds were scattered stands of bulltongue, *Sagittaria lancifolia*; Delta duck potato *Satittaria platyphylla; Najas guadelupensis* (a small stand in a ditch on the north boundary of the property); water primrose, *Jussiaea repens*; sprangletop; and knotgrass, *Paspalum distichum.* These grasses were located at the edge of the ponds.

Indications that this marsh is becoming fresher are:

1. Smooth cordgrass, *Spartina alterniflora,* is all but eliminated except for a few relict stands at the northeast corner and the southern boundry of the property. The original report before construction states, "Immediately adjacent to all major water courses, a saline condition was noted. Here smooth cordgrass and saltmarsh bulrush were noted."
2. Millet (Walters and barnyardgrass) and bacopa have expanded over the marsh since the original survey was made.
3. When the aquatics did appear in the ponds, sago pondweed was the dominant species. Sago thrives at a salinity level lower than does widgeongrass (Baldwin, 1967).

Mr. Bill Doland, lessee of this area, stated that he has never opened the flap gates to let salt water into the area, therefore the only way salt water can enter is via flooding or fishermen opening the gates.

The reasons for stating that this marsh has been improved for wildlife are as follows:

1. Mr. Bill Doland stated that after construction was completed the number of ducks increased each fall. The lessees of duck hunting rights, before they were discontinued, told Mr. Doland the same thing.
2. Mr. Doland also reported that the marsh now has a good furbearer population. He let a trapper harvest furs in the winter of 1966-67 for a 20 percent share of the profits. Mr. Doland's return was between $900 and $1,000.00, which means that the trapper harvested between $4,000 and $5,000. Trapping was permitted only on about one-fourth of the total area.

Burning one-third of the marsh per year has produced excellent millet stands and goose food. The March burn has produced the best millet stands, and the June burn produces some millet and good early season goose food. The October burn will provide excellent goose food for mid- and late-season feeding, and it will clear the "rough" so ducks can get at seed on the ground (Hoffpauer, 1967).

The only detrimental effect of this water-control system is to estuarine forms, such as larvel shrimp, crabs, fish, etc. that no longer have access to the marsh for a nursery ground. In future projects this problem may be solved by modifying water-control structures (Idyel, Tabb, and Yokel, 1967).

Observations made during this study (September 11 to 14, 1967) showed a good population of the resident mottled duck, a scattering of blue-winged teal, and several king rails, *Rallus elegens*; and sora rails, *Porzana carolina*. Nutria, *Myocaster coypus*, signs were evident everywhere and eight muskrat houses were seen. The muskrat population is on the upswing and a much higher population can be expected.

On September 24-25, 1968, and September 2-3, 1969, these transects were inspected again. The results of the second and third readings were summarized, and compared to the 1967 data, in Table 3.

Table 3

Summary of transect reading	1967 Percent	1968 Percent	1969 Percent
Marshhay cordgrass	40.3	31.5	20.0
Gulfcoast spikesedge	1.0	2.1	5.8
Millet	7.9	16.0	13.3
Purple pluchea	1.1	—	—
False nutgrass	3.4	2.8	.6
Slim aster	1.6	1.5	—
Seashore paspalum	22.4	21.4	17.3
Bacopa	4.1	11.5	20.1
Knotgrass	9.8	1.5	—
Sprangletop	1.9	2.5	3.1
Seashore saltgrass	4.2	4.5	5.0
Delta duck potato	—	1.7	5.5
Longtom	—	1.0	4.8
Bristlegras	2.0	2.0	2.0

GENERAL

The general moisture conditions of Louisiana marshland in these years were poor. Most of the marshes were very dry during the summer months. The Mermentau marsh seemed to have fared better than most. The larger ponds on this area contained enough water throughout the dry period in 1968, but in 1969 some dried up.

After reading the transects it is evident that the food plants for wildlife are continuing to increase. There was a slight decrease in millet (16.0-13.3 percent), but it was still more abundant than in 1967; bacopa (11.5-20.1 percent), sprangletop (2.5-3.1 percent), spikesedge (2.1-5.8 percent), and longtom (1.0-4.8 percent). The percentage of bristlegrass was the same as in 1967.

The large decrease in marshhay cordgrass is probably the result of it being burned in early summer and of grazing.

The larger ponds were checked for submersed aquatics in 1968 and 1969 also. In both years these plants were sparingly present. A later check in 1968 revealed a moderate concentration of these plants, but not nearly as dense as in the 1967 season. A second check was not made in 1969, so no information is available for this season.

An increase of longtom from none to 4.8 percent and a decrease of seashore paspalum from 22.4 to 17.3 percent may be indicative of decreasing salinity.

DISCUSSION

The inprovement for cattle and wildlife of the Mermentau Mineral and Land Company marsh was brought about by many factors.

The stability of water levels had a prononunced effect. Chabreck (1967) pointed out merits of this is his excellent paper given at the Marsh and Esturine Management Symposium at Louisiana State University in 1967. Many of the influential factors he lists were active in this area. Removing tidal action maintained water in the marsh all year and prevented excessive drying. This retained water in the ponds to enable aquatics to survive. Preventing water exchange by tidal action also reduced turbidity (Chabreck, Joanen and Glasgow, idid). This gave the submersed aquatics more sunlight for better growth. The reduction of water level in these ponds, though not enough to destroy aquatics, did give the "semi-aquatic" grasses a chance to germinate and grow. Millet, sprangletop, and the paspalums, as well as *Bacopa*, benefited from this.

Finally, the average water level was higher than it was in the past. This allowed better growth of plants and provided more feed for the ducks and geese.

Controlled burning was also very influential in this change of vegetation. Hoffpauer (1967) in his paper on control burning in the Louisiana marsh accurately predicts the vegetative successions for this area. The "wet" type of burn used here would retard the present succession of plants, which, if undisturbed, would eventually terminate in a pure, or almost pure, *Spartina patens* marsh.

The controlled burn does several things which bring about a different group of plants. One thing it does is to remove the rough, which becomes extensive in three or four years. This allows the sunlight to reach the ground and lets the seeds of many of the annuals germinate and grow.

The burn immediately releases nutrients in the ash that can be used by these new plants. A blackened soil also warms up earlier and hastens germination of the seed in the soil. The ash deposits reduce acidity which may influence the growth of many plants (Hoffpauer, 1967).

The author feels that cattle grazing has been one of the important factors in the increasing amount of millet, sprangletop, paspalum, and waterhyssop in this marsh. If left alone, the marshhay cordgrass would rapidly reclaim the site, but the cattle grazing on this tender new grass holds back the rough (Neely, 1967). Since this growth is slowed down, growing conditions for the millet are better the next year. Pasture rotation and reducing the number of cattle in the summer allow the duck foods to grow and produce seed. By the time most of the cattle arrive in September or October, the plants have produced seed and the green seedheads the cattle eat are of little overall consequence. Then too, the cattle may transport these seeds over the marsh, to where a seed source is absent, via their droppings.

A final factor worthy of consideration is the unearthing of buried seed by the hoofs of the cattle. This churning of the soil is especially evident in soft areas where they have difficulty walking.

The cattle walkway, though not as important as the preceding items, brings about several changes in the marsh which favor wildlife. The borrow areas create surface water where it did not exist before. The walkway helps distribute cattle over the range and hence, as previously mentioned, retards the marshhay cordgrass growth. Nutria and muskrats use these walkways as denning areas. Frequently the mottled duck finds suitable nest sites next to the base of the walkway. Being higher than the surrounding marsh, the walkway may save the nest from "drowning out" in case of a heavy rain or light flooding.

Spraying the rattlebox benefits both cattle and wildlife because more room is available for desirable plants. This shrub has occupied thousands of acres in the Gulf Coast marsh and if it becomes dense enough it shades out all the desirable vegetation.

The only part of this plan which could be improved is perhaps the water level manipulation. If the flap gates were opened once or twice a month, for a day, the larvae estuarine forms such as shrimp, crabs, fish, and others could enter, use the marsh as a nursery area, and return to the outside waters.

A little salt water every so often would preserve the present vegetation of the marsh, which is more beneficial to wildlife than the pure stands of giant cutgrass or marshhay cordgrass.

At the present, conservation engineers are working on this problem and they may have a breakthrough in the near future.

SUMMARY

The marsh area owned by the Mermentau Mineral and Land Company in Cameron Parish was, in 1950, essentially a fresh marsh covered by a stand of giant-cutgrass. Deep flooding with salt water from several hurricanes, coupled with land subsidence, increased the salinity in the soil profile and the plant composition. Marshhay cordgrass and other halophytes became dominant and the marsh became less desirable for grazing.

At the request of the owners, improvements were planned for both cattle and wildlife in 1961. Water control, cattle walkways, and

controlled burning were begun to improve the area for cattle and wildlife. Construction was completed in 1962.

Five years later, in 1967, an evaluation study was undertaken by the Soil Conservation Service. The engineering, soils, range, and biology aspects were studied. Structural measures had stood up well with only minor damage to the appurtenances. Soils had not been changed to any degree during this period. There had been a marked improvement in the range and in the cattle using this range. Food and feeding conditions for wildlife were improved and, although no census was taken of waterfowl, persons having access to this area reported larger numbers of ducks and geese using the marsh. Furbearer populations were also said to be larger.

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OPERATIONS SINCE 1963 UNDER MONTANA'S STREAM PRESERVATION LAW

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A day seldom passes without some mention in newspapers, on the radio, in the weekly magazines, or over television of the destruction of the environment. The public is aware that serious environmental problems exist. Their attitude today is that they want to live in a high-quality environment, relatively free of any kind of pollution, even if it means paying higher taxes or a higher price for products. This attitude could only be held in an affluent society such as ours where the more basic needs of food and shelter are adequate for most people.

Protection of trout streams from the bulldozer and dragline is only one small part of the struggle for the maintenance of a quality environment. However, such protection is a milestone because the people of Montana have achieved some success in the preservation of this important part of the landscape. A law called the Stream Preservation Law is the reason for our success. Years of disappointing efforts showed that moral indignation or social alarm will not save a meandering stream from a bulldozer. Only the legal process with delegated responsibility will do the job.

Before Montana had its law, the road builders listened to alternate proposals, but the final plans included only incidental considerations for the preservation of the trout stream environment. The Instructional Memorandums of the Bureau of Public Roads were not adequate because there were no provisions to settle differences. Legally, the road builders had no responsibility to consider requests aimed at stream protection. Only after passage of the Stream Preservation Law were we able to work out compromises that allowed the building of roads without the needless destruction of streams and the surrounding valley floors. The compromises came relatively easy once the legal framework was provided by the Montana Legislature.

HISTORY

In 1960, there was major conflict with the road builders concerning the harmful effects of road construction on trout streams. After a history of attempting to get adequate consideration for preserving the stream environment, it became painfully clear that they would listen, but could not implement major proposals for minimizing damage. We had no recourse but to ask the legislature to give us the legal framework to protect our stream resources from the bulldozers. Faced with that task, it was obvious that facts were needed before we could adequately support our case.

So, in 1961, a pilot study was initiated on the Little Bighorn River to develop methods for measuring channel alterations and their impact on fish populations. Using the techniques developed on this pilot study, each of seven fisheries districts measured at least one stream in 1962. We completed inventories on 13 streams and rivers located throughout the state and the results showed that far more of the trout stream environment had been tampered with than we had suspected (Peters, 1964). Two other states, North Carolina (Bayless and Smith, 1964) and Idaho (Irizarri, 1969) have completed statewide channel inventories that show the same trend. All of these studies conclude that altered channels carry far fewer game fish than natural channels. Also, a study of channelization in the Little Sioux River in Iowa revealed that the channeled portions carried far fewer game fish than the natural channel (Welker, 1967).

As we presented the results of the stream channel inventory to various civic organizations, we gained the strong support of the Montana Junior Chamber of Commerce. Later, they received a National Conservation Award for their part in obtaining passage of Montana's first Stream Preservation Law. The Montana Wildlife Federation also pitched in with the Western Association of that Federation providing noteworthy leadership. Together these groups supported by the data convinced a rather reluctant legislature that Montana needed a Stream Preservation Law. One was passed which became effective on July 1, 1963, but only for a two-year trial period. Thus we had to repeat our efforts in 1965. Armed then with facts from channel inventories on 16 streams, and the record of not having stopped the entire road building program in Montana during the previous two years, we enlisted the support of several groups. These efforts were successful because a permanent law was passed in 1965.

The following facts based on the channel inventory were presented at the 1965 legislative committee hearings:

1. That 354 of 987 miles (36%) of channels surveyed had been altered from their natural condition.
2. There were 2,401 alterations counted, nearly three per stream mile.
3. Altered channels produced only one-fifth the number of game fish and one-seventh the weight of game fish as natural channels.

These facts played an important part in convincing the legislature that protective legislation was necessary to maintain a valuable natural resource, Montana's trout stream fishery.

Examining the voting record of the Montana legislature on this issue will give some insight into the desirable effects of a well-planned implementation of a good law. In 1963, the first law narrowly passed the legislature (with the House voting 53-33 and the Senate voting 32-21) and became law for a two-year trial period. The bill was killed twice in committee, only to be pulled out and passed after some interesting political maneuvering. In contrast, the 1965 legislature enacted a permanent law with only *one* dissenting vote from a possible 146, which was cast by a road contractor. I believe the change in the voting between 1963 and 1965 is excellent testimony in favor of exerting every effort to make a good law work.

The Stream Preservation Law covers only agencies of the state and subdivisions of state government, *i.e.,* cities and counties. The State Water Conservation Board is exempt. The law gave no jurisdiction over private landowners, corporations or federal government agencies.

There were two important changes made to the original law by the 1965 legislature. Most important the law became permanent in 1965 and no longer had to be renewed at each subsequent session of the legislature. The arbitration committee under the 1963 law was made up of a member designated by the Fish and Game Commission, a member designated by the agency involved, and a third member who had no connection with either agency, selected by these two members. Under the 1965 law the three-man committee is appointed by the district court.

THE LAW ITSELF AND HOW IT WORKS

Both the 1963 law (Chapter 258, Montana Laws of 1963) and the 1965 law (Chapter 10, Montana Laws of 1965) have identical preambles: "An act to establish the policy of the State of Montana on protection of fishing streams, providing for submission of plans for construction and hydraulic projects affecting such streams to the Montana Fish and Game Commission and for review of such plans; and providing for arbitration of disagreements between the Fish and Game Commission and the Agency proposing such acts." The following is a brief summary of the sections of the act itself and describes the mechanical operation under the current law:

1. The Fish and Game Commission is notified of a project affecting a stream on a special form accompanied by detailed plans and specifications. These documents must be provided not less than 60 days prior to the start of construction.

2. The Commission examines these plans. If they are inadequate, they so notify the applicant and may aid him in preparing better ones.
3. Within 30 days after the receipt of such plans, the Commission notifies the applicant whether or not the project affects any fish and game habitat. If the project is harmful to habitat, the Commission recommends alternatives which diminish or eliminate such effect.
4. If these alternatives or recommendations are unacceptable to the construction agency, they must notify the Commission within 15 days after receiving such alternatives and the disagreement is arbitrated. A special arbitration procedure is spelled out in the law which is binding on both parties.

However, we have learned that a much more practical operation exists with construction agencies than that formally spelled out by the law. Somewhere between 10 and 15 percent of the total cost of a highway construction project lies in its design. Once an alignment has been selected and the plans are completed, there is little opportunity for change without great cost to the construction agency. Considerable delay occurs while the project is being redesigned, too. Therefore, the conservation agency must be notified by a construction agency and be allowed to participate as a partner before such design plans are developed. In the jargon of the road-building agencies, this means notification to participate on the P-line (preliminary alignment) or L-line (location alignment) inspections. At this stage, changes are relatively easy to make. This allows the conservation agency sufficient time to make the necessary studies to collect data supporting a recommendation as may be required to justify changes by the construction agency. It is the practical way to carry out each agency's responsibility on a day-to-day, routine basis.

The Stream Preservation Law has been tested by legal decision three different times. One of the counties in the state did not believe the Fish and Game Commission had the jurisdiction to require them to abide by the law. The Attorney General ruled that the Commission did in fact have such authority and required the county to submit a notice of construction of their project influencing a stream.

As a mitigative measure in another case, we asked that a meander be built to replace one that was cut off. A landowner contested the necessity of selling his land for the new meander. After we provided testimony at a court hearing, the landowner amended his complaint, admitting the necessity for the taking of his land for the meander. He did not feel he was offered just compensation for his land from the road-building agency and continued the case in this regard. The meander has since been built, with the total cost, including right-of-way, estimated at $80,000.00.

In the third case the law was used to prevent the purchase of gravel from a site within the perimeter of a meander loop. We felt the river could erode its way into the borrow pit area and possibly upset the river's hydraulic regimen in the entire project area. The court ruled that the construction agency had the ministerial authority to make such a decision when requested to do so in accordance with the Stream Preservation Law.

WHAT HAS BEEN ACCOMPLISHED

Two reports (Whitney, 1964 and Peters, 1966) discuss specific accomplishments of the law during 1963 and 1965 respectively. From July 1, 1963 when the first law became effective, until June 30, 1969 we have reviewed legal notices for 259 projects. Of these, we asked for special considerations on 88 projects, roughly one of every three.

Following are the highlights of what has been accomplished during the first six years with the law. Proposed road alignments were moved to avoid encroaching upon the Madison, Big Hole, Missouri and Blackfoot Rivers. Meanders were designed and built in Prickly Pear Creek, the St. Regis River and the Clark Fork River so that the channel was as long after construction as before. Extra bridges to preserve natural meanders were built in the Beaverhead and Missouri Rivers and are planned for the Blackfoot River. Brushy floodplain vegetation, removed to facilitate construction, has been replaced. Channel excavation has been limited to those times of the the year when trout are not spawning and eggs are not in redds. An elevated and independent alignment has been proposed and been designed to preserve the St. Regis River and its scenic canyon. All of these fishery-saving accomplishments have been made by working with the State Highway Department with the concurrence of the Bureau of Public Roads, through the effective medium of a good law, which established the framework.

FRINGE BENEFITS

By asking them to follow the intent of the Stream Preservation Law, we now have written agreements with the following federal agencies: Forest Service, Bureau of Public Roads, Bureau of Reclamation, Fish and Wildlife Service, Soil Conservation Service, and the Bureau of Indian Affairs. The agreement with the Soil Conservation Service allows the Fish and Game Department to review each project under the Agricultural Conservation Program that involves work in a stream or river. No federal cost-sharing is allowed on channel work under ACP unless it meets with our written approval. Since channel stabilization work has increased in recent years to the fifth largest expenditure of funds under ACP, this has become an important part of our stream preservation program.

The Bureau of Public Roads has also followed the intent of the law. We have established liaison with the BPR that allows us to review all Forest Highway Projects from the preliminary alignment to the final construction phase.

Depending on individual forests in the region, we have established fair to excellent cooperation with the U. S. Forest Service. There are few problems with high-design forest roads as a rule. It is the smaller logging roads designed within the Forest Supervisors' offices that are often troublesome.

In 1969 the Montana Legislature appropriated $100,000.00 to the Department for the construction of recreation lakes. Involved in this program is the utilization of highway fills to impound water. The Fish and Game Department pays the difference in cost between a fill designed for a roadway and a fill designed for a dam embankment. The department has hired an engineering consulting firm to provide the design and right-of-way investigation work necessary for the development of plans and specifications. The State Highway Department provides us at cost with core log data necessary for material and foundation evaluation and with aerial photography necessary for site mapping. This is an example of an extremely efficient use of public money and illustrates what agencies can do when they are really willing to cooperate with each other.

Recently, we obtained a Memorandum of Understanding with the State Highway Department dealing with land isolated by road construction activities. It allows us to have the highway right-of-way personnel act in our behalf to purchase this isolated land for fish and game purposes. In this way, everyone can benefit, including the landowner with the isolated land. For example, some fairly large tracts of land will be isolated between the Clark Fork River and Interstate 90. It would be economically impractical to provide frontage road access to these lands, according to the highway department. Therefore, we are developing a plan to use these lands for a major waterfowl development. Since borrow will be needed to build the road, we will specify where it can come from and the size and shape of the borrow pits. These pits will become duck ponds rather than the traditional eye sores. This agreement will also be used to purchase land needed for fishing access, habitat protection for birds and fish, game checking stations, etc. It is not limited to interstate highways but can be used along new primary and secondary roads as well.

The Stream Preservation Law has been indirectly responsible for developing a more rational basis for our stream management program. Often we are asked by the construction agencies to justify our request for mitigative measures. This means measuring fish populations and providing reports describing the fishery for such justification. We have allocated time and manpower to do this in our fishery districts. Special jobs have been set up and work carried out over a long period of time to gather data for the stream preservation program. Because of this, the whole fisheries staff has increased its capabilities and practical know-how in accurately measuring stream and river fish populations.

WHAT IS LEFT TO BE DONE

Almost all of our effort in preserving the stream environment has been devoted to the preconstruction phase of road building. This phase allows us (1) to review and adjust alignments, and (2) to work out measures for fishery mitigation. However, this effort does not do the entire job for maximum protection of the environment. Our effort up to now only enables us to keep between two-thirds and three-fourths of the stream environmental problems in our management grasp. However, to improve our ability to preserve the entire stream environment, we must get involved on a day-to-day basis during the construction phase of road building. This will involve a great improvement in our understanding of just what can be done and what cannot be done when the contractor is building the road. We may have to change or refine certain measures for habitat mitigation once this knowledge gap is closed. Trained biologists must be hired to work with the construction engineer in this important problem area.

Under our D-J fisheries program, we have evaluated a few of the channel mitigative measures to determine their value for fish. But we do not have the money or manpower to begin to evaluate all the important measures that have been designed and constructed for aquatic life. We need more money and people to do this work. Until such a program is operating we are proceeding under the belief that channels that behave well hydraulically also provide the best environment for fish. With or without a more adequate evaluation program, we must work closely with the engineering community to better understand flow in natural channels as it relates to fish.

CONCLUSIONS

The Stream Preservation Law has provided protection for the trout stream environment in Montana. It has shown the public that a construction agency and a conservation agency can work together, given the necessary legal framework. One measure of the relative effectiveness of the program is the $100,000.00 appropriation for the Recreation Lakes Program granted to the Fish and Game Department by the 1969 legislature. This program would not be possible without the close cooperation of the State Highway Department, cooperation initiated by state law which detailed agency responsibilities.

We have achieved a measure of success by being able to work in the preconstruction phases of the road building program. We will have to begin working on a day-to-day basis at the construction phase of road building in order to achieve maximum success. The public does not compliment us on what we have accomplished; rather they criticize us on what they feel we should be doing to further preserve the trout stream environment. We must live up to their expectations and work even closer with the construction agencies in order to retain the public's confidence.

This law is a social document that applies a mixture of biological and engineering principles to protect a part of the environment. It illustrates that the public wants to maintain a quality environment and will pay for it. Yet this success as been achieved without economically penalizing the road building effort. Apparently the myth that this law would scuttle the road building program in Montana has vanished. The largest public works program ever conceived and funded by Congress continues in Montana and elsewhere. But there is a difference. We have a legal document which has helped us and the road builders minimize some of the destructive forces in that massive program.

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DISCUSSION

MR. CARL A. PERRIN (Arkansas Game and Fish Conservation Department): I did not hear you mention anything about putting into the design with the road-builders something to handle the runoff of highways and roads where oil and other pollutants get into good trout streams. Have you designed this there?

MR. PETERS: Yes, we have what we feel is a reasonably good set of special provisions that the contractors who build these roads have to follow.

These provisions, of course, are just like anything else. You have to enforce them to make sure the provisions are carried out. I think success depends entirely on the kind of resident engineer you have on the job. If he is interested in the environment you will probably get a good job, and, if he is not, it is hard telling what will show up.

I would say, however, that a person can do a good job, perhaps between two-thirds and three-quarters of the job he has to do, during pre-construction when the roads are being located and designs are being made.

But I think that is a very good point, that if we are not to have resource-oriented people out on the job when construction is going on, we are going to get criticized until we do, and I think rightly so.

MR. PERRIN: How about riparian rights? Does the landowner own those in your state?

MR. PETERS: The stream bed in most of our streams is owned by the property owner, and therefore if somebody wants to get on a stream there is legally no way he can do so, if the area is posted.

There are three rivers in our state that the Federal Government did, in fact, declare navigable, and of course, people have rights on navigable streams.

The field solicitor of the Department of the Interior has given us some hope that we may be able to redesignate navigability to include most of our streams and river beds so that legal rights can be had to these beds by the fishermen.

MR. PERRIN: Do they use your streams for road-building purposes?

MR. PETERS: Of course, there is always fill needed for road grades, and in the past, road fill was secured from the flood plain or directly from the channel itself.

We saw to it that this no longer occurred. We have asked that selected cuts be designated for material or special pits be so designated so that there is control over material sources.

In the eastern part of the state we try to make these borrow pits into lakes.

TECHNICAL SESSION

Wednesday Morning—March 25

Chairman: Carl R. Noren
Director, Missouri Conservation Department, Jefferson City

Discussion Leader: Frank C. Bellrose, Jr.
Wildlife Specialist, Illinois Natural History Survey, Havana, Illinois

WATERFOWL RESOURCES

REMARKS OF THE CHAIRMAN

Carl R. Noren

It has been a kind of shame that there have been so many uncertainties connected with this meeting. The people who have been responsible for the meeting, I know, have been plagued by problems connected with the postal workers walking out and the air traffic controller activities and now we are in a room that is a little hard to find for some people. I expect there will be more people joining the meeting as we go on through the morning.

These meetings, over the years, have stirred interest. The meetings of waterfowl people and the subject of waterfowl resources have stirred more interest, I believe, than any other one subject.

Now, you may wonder, as I have on occasion, how the powers that organize these meetings arrive at people who chair them and I might say it is somewhat of a mystery to me. Many years ago, my very first interest in the wildlife field, my first desire, was to work in the waterfowl field, and my first job application indicated I wanted to be a waterfowl biologist. However, I am afraid that wildlife agencies sometimes are a little bit like the military—they seem to have a way of assigning you to things of which you claim no special knowledge and ignore those fields in which you claim special interest. More than 35 years ago I showed this special interest in waterfowl. Someone must have held some compassion and now, after all of these years, I have my first specific assignment in relation to waterfowl.

Perhaps I have had more time to forget than most and that is my chief qualification.

Of course, we have with us today Frank C. Bellrose, as well as other distinguished people in the waterfowl field. Perhaps I should first tell you a little bit about him. I know I probably don't need to do this but, on the other hand, let me say that he has been a wildlife specialist with the Illinois Natural History Survey and has spent over thirty years in a study of waterfowl populations, migration and nesting. Further, he has written more then seventy technical papers on wildlife, most of which have involved waterfowl.

However, a detailing of facts about Frank does not tell the story.

I remember him first in the late thirties as a participant in the North American Midwest Wildlife Conferences and from the beginning I noted how his eyes sparkled and his whole being seemed to be vibrant and alert and attuned to the need of waterfowl. To this day I find that Frank maintains a disciplined and quite scientific kind of mind but he still is motivated primarily by his love of this wondrous waterfowl resource which we all cherish so much.

When Frank involves himself in a waterfowl conservation effort he feels that both his mind and spirit are taking wings just the way the waterfowl do and I really believe that Frank would lay down his life for conservation and for waterfowl.

It is a pleasure to share the platform with him. He will lead the discussion and I will not intercede in the proceedings further and have the program participants now take over, each in their turn.

Our first man on our program this morning is Doctor John S. Tener, as well as his colleague, A. G. Loughrey, who is in the audience. I do not have any biographical information on Mr. Loughrey but Doctor Tener will tell us something about him.

Doctor Tener joined the Canadian Wildlife Service as a Wildlife Management Officer in 1950.

He received an M. A. and Ph.D from the University of British Columbia and in 1962 was appointed staff mammalogist. In 1963 he went to Uganda as the Canadian Technical Advisor to the country's game department.

Now, whenever two or more people share something, problems can arise. The same can be said for countries when it comes to natural resources. The United States and Canada share the migratory birds that stream south each autumn. This could present monumental problems; however, the problems have been minimal, primarily because of the progressive leadership displayed by the governments of

Canada and the United States. The Canadian Wildlife Service has made very important gains in waterfowl management under the guidance of Doctor Tener and other Canadians. We welcome Doctor Tener.

THE MIGRATORY WATERFOWL PROGRAM IN CANADA

JOHN S. TENER AND ALAN G. LOUGHREY
Canadian Wildlife Service, Ottawa, Ontario

North American waterfowl are a major renewable resource very largely under the joint stewardship of three nations: Mexico, the United States of America, and Canada. Research on and management of this resource are the joint responsibility of these three nations. Formal consultation between Canada and the United States dates back to 1916 with the signing of the Migratory Birds Treaty and the subsequent enactment of the Canadian Migratory Birds Convention Act of 1917 and the American Migratory Bird Treaty Act of 1918.

In 1961, the International Migratory Bird Committee was established, with representation from the United States Departments of Interior and Agriculture and the Canadian Departments of Indian Affairs and Northern Development and of Agriculture. (In 1969 the latter was replaced by a representative from the newly formed Department of Regional Economic Expansion). This Committee provides a high-level but informal forum for the discussion of mutual problems and programs in the migratory bird field in general and for waterfowl programs specifically. We are very pleased that the Government of Mexico is now an official member of this Committee, and we look forward to its active participation in waterfowl management and research.

In Canada, as in the United States, the Federal Government has the overriding responsibility for the migratory bird resource because of the obligations of the international treaty. The Canadian Wildlife Service, a Branch of the Department of Indian Affairs and Northern Development, discharges the federal role of conservation and management of the resource by carrying out surveys and research, by preserving and maintaining habitat, through the enactment of legislation, by the co-ordination of enforcement and by co-ordination of and collaboration in provincial waterfowl programs.

Since Dr. David A. Munro (1965) presented to this Conference his review of waterfowl management in Canada five years ago we have made substantial progress in most of those activities. Inevitably, we have also suffered disappointments and delays and have come to a different view of the opportunities for the next few years. We want to say something of recent Canadian achievements and to outline what we believe needs to be done next.

In 1966 a statement of policy and program for wildlife was tabled in Parliament. That statement provided the impetus for an expansion of effort by the Canadian Wildlife Service, outlining for it a new role in waterfowl habitat preservation and protection as well as enlarging its existing programs. In 1969 the planned rapid expansion of the Service was checked, as part of a determined decision by Cabinet to restrain government expenditure. As in the United States, this anti-inflationary effort has been coupled with increasing scepticism about the merits and rising costs of all sorts of scientific endeavor, so that we will have to work harder to justify resumed growth in the future. There is, in fact, a very strong case for growth, but it rests on the recent (if belated) outburst of public concern about the deteriorating quality of the environment rather than on the more limited threats to waterfowl populations alone. Because of the graver nature of these enlarged responsibilities it would be helpful to have a correspondingly wider legislative basis for federal activities. Some progress has been made towards a new wildlife act, though its enactment may still be some way off. Meanwhile we have to do more, without much increase in manpower and funds.

The greatest recent gains in our management capabilities have undoubtedly resulted from the introduction in 1966 of the Canada Migratory Game Bird Hunting Permit. The Permit, which all hunters (except, for the present, residents of the Northwest Territories, Yukon Territory and Indians and Eskimos) of migratory game birds are required to purchase, in addition to provincial licences or permits, is in many ways similar to the duck stamp long used in the United States, though possessing some technical advantages for statistical purposes. It has at last made possible estimates of the numbers and distribution of hunters and, in conjunction with harvest and parts surveys analogous to those in the United States, estimates of the waterfowl harvest. It is estimated that in the 1968-69 hunting season 385,000 waterfowl hunters in Canada harvested and retrieved 2,800,000 ducks and 220,000 geese. A detailed listing of permit sales by province of residence for the 1968-69 hunting season is given in Table 1. Species composition of the estimated retrieved harvest of ducks (other than sea ducks) and geese for the 1968-69 hunting season is detailed in Table 2 and 3, respectively.

Combining the U. S. and Canadian harvest results, it appears that 22 percent of all the waterfowl hunters in both countries hunted in Canada and that 25 percent of the total retrieved kill was obtained in

TABLE 1. CANADA MIGRATORY BIRD HUNTING PERMIT SALES BY PLACE OF RESIDENCE FOR THE 1968-69 HUNTING SEASON

Province	Sales
Newfoundland	17,495
Prince Edward Island	3,611
Nova Scotia	8,936
New Brunswick	9,213
Quebec	36,342
Ontario	129,617
Manitoba	36,674
Saskatchewan	39,222
Alberta	51,875
British Columbia	33,557
Canadian resident total	366,542
Non-resident total	16,843
Residence unknown total	2,168
Total:	385,553

TABLE 2. SPECIES COMPOSITION OF DUCKS (OTHER THAN SEA DUCKS) TAKEN IN CANADA DURING THE 1968-69 HUNTING SEASON[1]

Species	Estimated harvest	
	Number	Per Cent
Mallard	1,030,000	37.92
Green-winged teal	287,000	10.56
Black duck	276,000	10.15
Pintail	194,000	7.14
American widgeon	178,000	6.56
Wood duck	115,000	4.22
Blue-winged teal	109,000	4.01
Ring-necked duck	84,000	3.08
Gadwall	77,000	2.84
Common goldeneye	70,000	2.57
Lesser scaup	68,000	2.51
Others	228,000	8.44
Total:	2,716,000	100.00

[1] Based on an analysis of parts received in response to a mailing to 28,000 hunters, or 7.25 per cent of permit holders.

TABLE 3. SPECIES COMPOSITION OF GEESE TAKEN IN CANADA DURING THE 1968-69 HUNTING SEASON[1]

Species	Estimated harvest	
	Number	Per cent
Canada	147,825	66.88
White-fronted	41,694	18.87
Lesser snow	24,728	11.19
Greater snow	2,717	1.23
Ross'	2,530	1.14
Other	1,514	0.69
Total:	221,008	100.00

[1] Based on an analysis of parts received in response to a mailing to 28,000 hunters or 7.25 percent of permit holders.

Canada. We are making determined efforts to improve the quality of our harvest surveys, before they become too set. We believe, for example, that hunters, like fishermen, tend to exaggerate their prowess, which may mean that estimates of kill based on their reports are inflated. Our surveys are also showing that Canadian hunters are not just American hunters writ large, or small.

There has been no corresponding great leap forward in our monitoring of waterfowl populations. We are still heavily dependent on the U. S. Bureau's aerial surveys in May for data on prairie breeding populations and on June pond counts for estimating duck production, though we have begun to contribute observers to the survey crews in the air and in the important air-ground comparisons. We are just now taking over the analysis of landing data for Canadians. This we believe will greatly increase our effective use of the data and permit more precise management strategies for waterfowl. As we grow increasingly impressed by the number of ducks not emanating from the prairies and by the number of waterfowl hunters in Ontario and farther east, we are renewing efforts to assess the duck populations in eastern Canada, with particular emphasis on the number present in the hunting season.

The provincial resource agencies in Canada are primarily interested in mammals and upland game birds, but they also contribute to the management of migratory birds, particularly waterfowl. They conduct important research and surveys, principally concerned with hunting opportunity. They provide advice to the Federal Government on provincial requirements for the use and protection of the waterfowl resource. Technical details of both research and management are frequently discussed at all levels. Major legislative amendments, including bag and possession limits and season lengths, as well as substantive management recommendations, are discussed at the annual Federal-Provincial Wildlife Conference in July. Since 1968 additional opportunities for detailed discussions have been provided by regional federal-provincial technical committees, which meet twice a year.

In Canada we also have several public and private agencies with a special interest in the waterfowl resource. These include the Canadian Wildlife Federation, the B.C. Waterfowl Trust and the Ontario Waterfowl Research Foundation, which carry out and support research and programs of habitat preservation and improvement. They also serve an important role as the collective voice of waterfowl hunters and other waterfowl enthusiasts. Other natural history and conservation societies across the country are playing an increasing part in habitat preservation and in arousing and articulating the ecological conscience of the nation. In the latter respect Canadian universities too are growing in strength, while at least 16 Canadian universities are currently supporting graduate training and research relating to waterfowl. Their programs not only provide substantial additions to knowledge but also serve as a source of trained personnel for the federal and provincial wildlife agencies and of ecologically-oriented teachers in the universities and schools.

In research training and in active habitat preservation we are still led, though not dominated, by two institutions domiciled in Canada but drawing much of their financial support from the United States. Delta Waterfowl Research Station has an outstanding record in training graduates over the last 30 years, and is producing more than ever, with an increasing population of Canadians. Ducks Unlimited (Canada) has an equally impressive record in habitat management in the Prairie Provinces and is now expanding its activities in other provinces, in close and cordial collaboration with the provincial and federal governments. Long may both these outstanding examples of international cooperation continue to flourish.

Many individuals and private clubs are active in the preservation of vital wetlands, either to provide hunting opportunities for club members or to establish sanctuaries for breeding and migrating waterfowl. With a few minor though important exceptions, industry has not yet entered actively into waterfowl conservation.

Undoubtedly the major role in the maintenance of vital nesting habitat, in both western and eastern Canada, is played by farmers. We believe it is essential that the contribution of the farmers receive increased recognition, encouragement and support.

Mapping of land capability for waterfowl production in agricultural areas of Canada started in 1965 and is now 90 percent completed. This promises to be of great value in assessing where, and on what scale, conservation measures should be intensified. In 1965 Munro described the pilot studies of habitat preservation through wetland basin easements in the Prairie Provinces. An easement program became operational in 1967 and has resulted in the preservation of 176,500 acre-years of habitat at a cumulative annual cost of $968,000. The original program called for expansion over 10 years, leading to a recurring annual expenditure of more than $5,000,000. It is now clear that a financial commitment of that magnitude is unattainable, given the likelihood of continuing scarcity of funds. Moreover it might well be unnecessary, because of the great change in the outlook for prairie farming during the last three years, due to the difficulty of selling wheat on the world market. This year special temporary government support is being given to encourage farmers to take their land out of wheat production. We shall watch with interest the short-term effects of that program on prairie waterfowl production and the long-term effects on agricultural land-use practices. The future of the easement program lies in a careful selection of areas of prime importance for the production of ducks that are genuinely threatened, so that the greatest effectiveness will be achieved with the least expenditure.

Preservation of migration habitat through a wetland acquisition program began in 1966. To date this has resulted in the establishment of 10 National Wildlife Areas, totalling 50,500 acres, at a cost of $2,600,000. The best-known areas acquired are in the vicinity of Last Mountain Lake, Saskatchewan and at Cap Tourmente, on the north shore of the St. Lawrence River near Quebec City, where most of the greater snow geese stop for several weeks in fall and spring. The acquisition program will continue, though the completion of purchases is frustratingly slow. We hope to collaborate even more closely with the provinces in the management of wildlife areas, which are not automatically sanctuaries but can be zoned to permit, or temporarily to prevent, hunting. They promise to be an increasingly useful management device. The plans for all the areas acquired provide for research on the effectiveness of the management practices that are introduced.

Enforcement of waterfowl regulations across the country has been intensified with the creation of a special migratory bird squad within the Royal Canadian Mounted Police and the appointment of enforcement co-ordinators on the staff of the Canadian Wildlife Service. We foresee further gains in this field as resulting from making the federal regulations simpler and more flexible, given the willingness of the provinces to assume greater responsibility for the introduction and enforcement of special local provisions. Much can also be achieved by intensifying educational efforts so that hunters become more knowledgeable and more willing to impose high standards of conduct upon themselves.

At present the Canadian Wildlife Service has a staff of 80 scientists, biologists and technicians assigned to migratory bird research and management, with much of their effort directed toward waterfowl projects. The annual budget provided in support of that work amounted to approximately $2,500,000 in 1968/69, $513,000 being devoted to research, $1,250,000 to operations and $725,000 to capital expenditure largely for habitat acquisition. Partly because our budget has been frozen at that level for 1969-70 and 1970-71, but at least as much because any active organization needs continually to reexamine its aims and proficiency, the Service has recently undertaken a complete review of the Migratory Bird Sub-Activity. A number of changes in emphasis have been proposed, all related to the aim of achieving the most effective deployment of our manpower and funds.

Our policy is to maintain and to use the migratory waterfowl resource wisely for maximum benefit to existing and future generations of Canadian and other peoples having access to the resource. We have identified eight objectives for our waterfowl programs:

(1) To assess the current social and economic needs, requirements and aspirations of Canadian society for the migratory waterfowl resource.
(2) To conserve rare and endangered species of migratory waterfowl.
(3) To encourage and to provide for the non-consumptive recreational use of all species of migratory waterfowl.
(4) To ensure that the legitimate and traditional needs for food of Canada's indigenous peoples and others in need of the waterfowl resource are met within the capability of the resource to support such a harvest.
(5) To ameliorate and to diminish effects of waterfowl which are detrimental to society.
(6) To establish major causes of waste of the migratory waterfowl resource, whether natural or artificial, and to seek and apply ways and means of preventing, reducing or eliminating that waste.
(7) To promote research and investigation on migratory waterfowl and on their environments which will contribute to man's understanding through the elucidation of biological and ecological phenomena and concepts.
(8) To ensure high production and optimum consumptive recreational use of the migratory waterfowl resource.

To move towards these objectives we have set ourselves a large number of goals, varying in specificity and in the time allowed for their achievement. Rather than elaborate upon them here, it may be more interesting to mention briefly some of the assumptions we have made in redefining our program.

Non-consumptive uses of migratory waterfowl, to satisfy aesthetic or social needs, could be supported by waterfowl populations smaller than those that now exist, but hunting for sport will require populations at least as numerous as those today, with levels of production no less than they now achieve. About 70 percent of the waterfowl production habitat in North America is in Canada, while 95 percent of their winter habitat is in the United States and Mexico. Thus, Canada has an international responsibility to provide breeding habitat for waterfowl for use by North American hunters, and a national responsibility to provide sufficient numbers of waterfowl for use by Canadian hunters.

Canadian regulations for waterfowl utilization and the Canadian habitat preservation program will be designed to provide optimum waterfowl populations within the constraints of economic feasibility, taking into account production and management costs, including disbenefits such as crop depredation. Those costs should be balanced or exceeded by the social benefits and values of the resource.

Where economically and biologically feasible, the waterfowl management program will be designed to:

(a) recognize the contribution of landowners to waterfowl production;

(b) assess and apply user fees to both consumptive and non-consumptive uses;

(c) increase opportunity for consumptive use by providing access to hunting areas by Canadian residents and tourists; and,

(d) increase opportunity for non-consumptive and educational use by providing access and educational or interpretive facilities at major waterfowl concentration areas across Canada.

Hunters place a premium on trophy and table species (such as the mallard; black duck, canvasback; redhead and wood duck; Canada, white-fronted, and snow geese) while naturalists place high priority on maximum variety of waterfowl species and preservation and maintenance of a dispersion of natural waterfowl habitat. A program to preserve rich and varied types of production habitat and especially staging and migration habitat for waterfowl and other migratory birds at locations accessible to centers of population, will meet the needs of society, naturalists and hunters.

The mallard provides approximately 34 percent of the North American duck harvest. It provides approximately 38 percent of the Canadian duck harvest, 46 percent of the western and 21 percent of the eastern Canadian duck harvest. The black duck provides approximately 21 percent of the eastern Canadian duck harvest. Therefore, a program to manage the mallard in the West and the mallard and black duck in the East will go a long way toward meeting the requirements of a large part of the North American and Canadian duck hunters now and in the future, while a program to conserve and manage less abundant or endangered species of waterfowl, such as the canvasback, will in part meet the requirements of North American and Canadian hunters, naturalists and society in general.

In setting quantitative management goals for the principal trophy species we envisage managing by identifiable sub-populations, using ecological zoning of breeding habitat in rather greater detail than has been previously attempted. The goals will be set in terms of fall population size, rather than of number of breeding birds. Emphasis on survivors to the spring is appropriate in the Bureau approach, since the bulk of the waterfowl kill is in the continental United States but, for the same reason, we in Canada are primarily concerned with the starting size of the fall flight. This presents us with a number of technical problems to solve before we can make major improvements in our annual decision-making on regulations, which has to be completed before many young ducks are on the wing.

We do not see the necessity, or indeed the opportunity, of attempting to retain existing patterns of distribution in Canada during the hunting season. In a rapidly changing environment, that would probably be futile and certainly be very expensive. If we have enabled enough birds to be raised and ensured that they have somewhere to live we shall have performed the major part of our commitment.

To sum up our approach to waterfowl management in Canada in the immediate future, we see this as involving an increasing number of people grouped in a variety of ways. We intend that the Canadian Wildlife Service should continue to play the leading role, as the responsible federal agency. Because of new demands resulting from the expanding public concern for all wildlife and the whole natural environment, it is likely that the share of public funds directly available for waterfowl management will increase only slowly. We do not believe this to be disastrous. It presents fresh challenges to the ingenuity, skills and determination of all Canadians concerned with waterfowl, that may well result in more substantial and more rapid progress towards safeguarding the future of the resource than we have yet seen.

DISCUSSION

FROM THE FLOOR: I believe Doctor Tener mentioned that the killing of waterfowl in Canada is based upon reports hinging on the duck stamp reports and that you apparently have no passion for the general tendency of waterfowl hunters to exaggerate. Is this correct?

DR. TENER: I recognize that there may be this tendency and we are looking at this from a statistical point of view. We are engaged in a program to sample hunters in Ontario, particularly to see if we can determine that particular kind of bias. There is presently a study of this under way.

REMARKS OF THE CHAIRMAN

CARL R. NOREN

As all of you know, the United States has partners in the migratory bird resource other than Canada. A third nation, Mexico, and to a lesser extent, a number of countries in the Caribbean area and Central and South America also are involved. The future of waterfowl lies with all our countries collectively and individually.

Doctor Rodolfo Corzo is head of the National Fish and Wildlife Program in Mexico and is a solid friend of the United States. He has many friends here in this country and is widely respected by American conservationists.

The hunting of wild game has been an important activity in Mexico and wildlife, if properly conserved and managed, will be further developed into a productive future resource.

Some misunderstanding on our part has arisen regarding waterfowl and white-winged dove hunting. It stems partly from a failure to appreciate the size of the winter grounds and the lack of hunting pressure on them. Allegations that great numbers of waterfowl are slaughtered in Mexico are baseless or exaggerated. Some hunters, chiefly from the United States, shoot too many birds, but the total kill is said to be negligible. Even this is being reduced through enforcement of regulation by Mexican authorities.

We trust that we will have reports on the migratory bird program in Mexico at future meetings.

In other words, Doctor Corzo was supposed to have been here with us today, but, due to unforeseen circumstances could not appear. Therefore, I leave this portion of our program with the introduction pertaining to him and his activities that I have presented and, as I said, I hope we will have reports on the migratory bird program in relation to Mexico at some future meetings.

Now, next on our program is Mr. John S. Gottschalk, Director, Bureau of Sport Fisheries and Wildlife, Washington, D.C.

Mr. Gottschalk started his career in Indiana in 1930 as a Park Ranger. He received a master's degree from the University of Indiana. His last job in Indiana before joining Federal Employment was as Superintendent of Fisheries for the Indiana Department of Conservation.

Waterfowl management for the North American continent is a complicated business. Major changes in population, industry and pollution, the use of land and public policy bear strongly on the numbers of waterfowl because man and waterfowl often have the same needs. The migratory bird resource of North America can be maintained and increased through proper management, but may be destroyed if neglected.

The Bureau of Sports Fisheries and Wildlife is charged with the mission of developing and implementing a national program for conserving and managing migratory birds so that waterfowl can be kept a vital part of the world of nature and a vital part of the American heritage for the hunter and non-consumptive user.

I am not attempting to take anything from the dignity of your position, Mr. Gottschalk. You know, of course, that I have high regard for you.

John is just an excellent person and he is occupying a position which is an extreme strain on anyone and he has responded with great skill to his responsibility. He has used intelligence and good judgment and, above all, applied a sense of humor in connection with his activities.

WATERFOWL MANAGEMENT IN THE SEVENTIES

JOHN S. GOTTSCHALK AND ALLAN T. STUDHOLME
Bureau of Sports Fisheries and Wildlife, Washington, D.C.

With any dynamic program there is a continuing need for updating and realigning objectives and policy.

For the past several months, we in the Bureau of Sport Fisheries and Wildlife have been reviewing our national waterfowl conservation policy. Our objective is to develop a statement that will adequately recognize the needs of today and build a philosophical platform for those of tomorrow. My remarks are taken from the preamble and portions of the draft of that policy. It is not finished. Indeed, we are not yet to the point of sending the document out for review. Nevertheless, the concepts set forth in this paper reflect the character of the policy as it now appears. We submit these concepts for your comment and consideration as a preview of a more refined document that will be available for further study and ultimate issuance later this year.

The American people have resolved to improve the quality of their environment. Natural resource managers are deeply involved in this "quest for quality," and waterfowl managers are in a position to play a key role. Waterfowl and their habitats are valuable parts of the ecosystem. Their health and well being are a measure of the quality of man's environment.

The Bureau's first concern as the nation's chief custodian of the waterfowl resource is to hold in trust all components of the resource and their required habitats. The waterfowl resource is rich in variety, both in terms of species and the wide array of experiences which they offer for human relaxation and enjoyment. There is more truth than fiction to the adage "variety is the spice of life," and we intend to foster this concept. This attribute of variety should be maintained and enhanced for people to enjoy in as many parts of this nation as possible. Variety, we believe, adds quality to the experience whether it is consumptive (hunting), non-consumptive (bird observation), or productive (aviculture).

Users of this resource, at times, have been exceedingly wasteful. Management agencies have fallen short in reducing many wasteful practices which are controllable. Since the demand far exceeds the supply, waste can no longer be tolerated. Since waterfowl are valuable and the odds against them are mounting, it follows that waste abatement becomes increasingly important. Waste includes the loss of eggs and death of the birds themselves. It also is related to human experiences in relation to the bird under such headings as poaching, lead poisoning, crippling losses, sportsmanship, selective shooting regulations, and hunter skills and attitudes. A human experience is wasted if it leads to guilt, frustration, anger, anti-social behavior, or tragedy. It is worthwhile if it brings satisfaction and pleasure to the individual without detracting from the fun of others.

The waterfowl resource is expensive to maintain; therefore, high positive benefits must be derived from it. Management must, therefore, strive for high qualitative standards, and wastage must be reduced as much as possible. This is the qualitative dimension of waterfowl management.

Quantity is involved too. The management of waterfowl for rewarding hunting recreation requires maintenance of larger populations of the favorite species than would otherwise be necessary. Most people would agree that it is a less satisfying experience to return from a hunt empty-handed than to have a limit. Less than a limit may not reduce the value of a trip afield, but complete failure usually causes dissatisfaction. An experience ending in frustration may be worse than no experience at all. Therefore, the management for consumptive uses of waterfowl, which has always been related to the surplus, should also be concerned with the problem of too many participants for the available supply.

Waterfowl managers deal with two different quantitative measures of supply. One is the theoretical surplus which would be available if it were possible to harvest exactly the number from each species which would still permit maintaining that species at some desired level. The other is the realistic surplus which can be taken under today's conditions of management skills, hunters' abilities, and ethical limitations. Since the theoretical limit is much higher than the realistic limit, a major goal of management is to work toward the theoretical limit, using species management techniques and training programs to upgrade hunter performance.

If hunting were of no concern to waterfowl managers and observation alone were the sole recreational use, the numerical requirements for waterfowl would be greatly reduced. This is not to say that bird watchers are not thrilled by the sight of waterfowl "darkening the skies." But most bird watchers enjoy a few hundred or thousand as much as many thousands. In fact, beyond a certain point, the extra thousands are "wasted" as far as the casual observer is concerned. It becomes more important in managing for non-consumptive uses to consider variety and accessibility above sheer numbers.

The foregoing considerations, as we plan a waterfowl management program for the next decade, relate to the certainty of expanding human populations and the mounting threat to the environment. A major area of concern is for breeding grounds for ducks which already have lost great segments to advancing civilization. These still are capable of producing enough ducks to provide good hunting, but will they retain this capacity a decade or two from now when the prime nesting area, the North American prairies, is called upon to double its output of foodstuffs? If serious food shortages develop, how tolerant of depredations by waterfowl can public opinion be? We cannot answer these questions, but we can streamline our waterfowl management program to attain a much higher degree of efficiency and public support.

It is our belief that man's need for a wide variety of wholesome outdoor experiences outranks some of his other needs and will increase along with urbanization and population increments. If reserved in adequate quantity, wetland habitats—complete with their full array of plants and animals, particularly waterfowl, can provide mankind with millions of man-days of enjoyable recreation and relaxation in the years ahead. It is in conformity with the national interest as expressed in formal policies that wetlands and waterfowl be managed in the best public interest and be given full consideration in all plans that might affect their welfare. Waterfowl management pointed at the 1970's and beyond must involve compromise as authentic human survival needs dictate, but will retreat only as all alternatives are exhausted. It will keep the public informed of the true state of affairs and the reasons behind the various courses of action. It will adjust to the changing disparity between supply and demand, recognizing that quality individual experiences for the most people are the ultimate goal.

THE PROBLEM

According to current projections, this is what the year 2000 has to offer:

—half again as many people in America, twice as many in the world.

—foreign demand for agricultural production more than doubled, domestic demand nearly doubled.

—75 percent of us living in cities.

—water needs for municipal use doubled, for irrigation trebled, for manufacturing quadrupled.

—land needs for homes, schools, and factories up 200 percent, for reservoirs 180 percent, for transportation 125 percent.

—outdoor recreation demand up 300 percent.

The future food and population problem is real, and it may be a desperate race for many people of the world. Under today's conditions of an exploding world population, there is real doubt that food production can match it. A paradox exists: In highly developed countries, food abundance, even surpluses, exist, while in the developing countries, scarcity and even starvation prevail. In North America, agricultural technology and capital have resulted in surpluses.

Looking ahead only a decade, the "home" market (Canada and the United States) is expected to increase by about 50 million people, while the foreign market for wheat may nearly double. Even then, there will be great deficiencies in the nutritional needs of many nations. At the same time, the per capita consumption of meat is expected to rise as North American affluence increases, and this will further increase the need for grain. But even so, the United States has more cropland now than it needs, and we may not need all of this cropland base for many years ahead. Studies indicate that cropland will be in "surplus" until 1980 at least.

The picture for the next 10 years seems to be that technological advances in crop production will offset the increase in food demand. But before the year 2000, the requirements for food and fiber may place a burden on the North American prairies beyond any demands ever experienced.

The problem will be one of too many people to:

—permit every pothole to remain undrained and fields to be reserved for wildlife when there are hungry mouths to feed without proper reimbursement or other incentives to meet competitive forces.

—universally share in the consumptive use of a resource already too small to satisfy the demand.
—have the elbow-room and solitude which produce highest quality outdoor experiences.

Our answer to this problem must be in the direction of making the best possible use of the opportunities at our command for establishment of practical management goals, high standards of problem-oriented research, and management efficiency beyond any exercised to date.

In order to fulfill this mission, the national objectives for the 1970's will, simply stated, be to safeguard all the values of migratory birds and their environments, to maintain maximum populations of migratory birds, and encourage the broadest possible beneficial utilization.

GOALS OF WATERFOWL MANAGEMENT

More specifically, this means those administrators and scientists carrying out the program must set themselves to:

1. Preserve and manage species, subspecies, and identified populations of migratory birds so that none will become either endangered or extinct through man's actions.
2. Provide opportunities to enhance public understanding, enjoyment, appreciation, and use of migratory birds, including hunting of game species within limits imposed to maintain or achieve desired population levels of designated species, subspecies, or identifiable populations.
3. Increase, where desirable and possible, the numbers of migratory birds, particularly ducks, geese, and swans, to the carrying capacity of their habitat.
4. Maintain a suitable, acceptable, and feasible distribution of migratory birds, especially waterfowl, with due consideration for the birds' behavior, welfare and habitat, and public recreational opportunities.
5. Control offending birds or bird populations to prevent harm to either man's health or society's welfare.
6. Preserve, develop, and manage habitat necessary for, and essential to, the well being of all migratory birds and needs of people utilizing this resource.

PROGRAM IMPLEMENTATION

We expect to prepare and fund Bureau activities which will:

1. Maintain close and continuing liaison with Canada and Mexico in fact-finding and regulatory fields, as stipulated under existing treaties, and develop similar liaison with other foreign governments supporting and sharing the migratory bird resource.

2. Conduct fact-finding programs to provide relevant information necessary for management of migratory bird populations and their habitats; coordinate these programs with those of other Federal, State and local agencies, and private conservation organizations actively cooperating with them for the attainment of common goals.
3. Provide leadership in preserving, restoring, and maintaining clean environments, reducing or eliminating pollutants, and maintaining high standards for preserving and enhancing the natural beauty of migratory bird habitats.
4. Encourage, develop, and support programs that will enhance public understanding and appreciation of the migratory bird resource, its environment, and its utilization.
5. Preserve and restore rare and endangered species of migratory birds.
6. Manage migratory birds by identified population units and strive to maintain continental populations at high levels.
7. Seek to maintain existing seasonal distribution patterns of migratory bird populations having satisfactory patterns. In those instances where changes in this seasonal distribution are in the best interest of proper management, and feasible and acceptable means of accomplishment are available, attempts will be made to effect changes after consultation with other responsible agencies or appropriate councils.
8. Continue to seek better methods for applying concepts of species management so as to provide maximum allowable recreational use of the migratory bird resource.
9. Promote programs of incentives, technical services and encouragement to users, including hunters, bird watchers, aviculturists, farmers, industrialists, resource planners, and developers, to retain and develop high-quality migratory bird habitat.
10. Evaluate the feasibility of introducing exotic migratory birds into the United States and control of their introduction and release.
11. Provide guidelines for propagation, rearing, and release programs for migratory birds.

DISCUSSION

VICE CHAIRMAN BELLROSE: Thank you, Mr. Gottschalk, for your realistic and dismal look ahead into the future. I cannot help but feel that your concluding remarks were most appropriate.

The fact that we are going to strive desperately to save these resources from the predicted 70 percent increase in human population in this country and the demands upon our wetlands for good, it seems to me, indicates that in the end we are going to have to have other reasons for having wetlands than producing waterfowl.

There must be other values to test wetlands that the public must be made aware of.

We must also look into the feasibility of making the wetlands more productive of waterfowl so that perhaps every acre in the future will be producing twice as much as it is today.

DR. CLARENCE COTTAM (Texas): John made the comment, if I followed him correctly, that in some of our hunting that we reached a point of frustration with regard to getting the limit that, in turn, we do more damage in this respect than not going hunting at all.

It seems to me that one of the needs we have is to develop our appreciation and our knowledge of wildlife better than we have.

I should like to say that within my short career, in the early days, there was no bag limit and then we had a bag limit of twenty and some people were peeved when they did not get that particular limit. Now we are down to about four, and we need to develop an appreciation which we will get out of not only getting the four birds that are there but, on the other hand, to see that we do not end up in frustration should we get only two or three.

I can think back to some hunting trips I have had where, by knowing the species and enjoying them and seeing something besides the bag limit, I was not frustrated, even if I got less than the full limit.

Therefore, I believe that one of the needs is to develop a broader appreciation of wildlife resources. You have to have some knowledge of what is out there before you can fully appreciate it. Therefore, I think a broader base would help.

MR. GOTTSCHALK: Well, Clarence, I could not agree with you more but really what I said was, and I quote, "Most people would agree it is a less satisfying experience to return from a hunt empty-handed than to have a limit."

These are the two extremes. Most people would rather come back with a limit than empty-handed. There is a long distance between. Less than a limit, I said, may not reduce the value of a trip into the field, but a complete failure usually causes dissatisfaction, and experience ending in frustration may be worse than no experience at all.

In other words, a person goes hunting and winds up with the idea in his mind that there are no birds and I think, as a result, there is a direct tendency on the part of the people to say "the heck with it," to come to the conclusion that there is no point in supporting the conservation program—that the individual has been led astray by the outdoor writers and the public by the State Game and Fish Department or the Bureau of Sports Fisheries and Wildlife. "There were a lot of birds this year and we did not see any." This is the sort of thing I had reference to. I think this can present a contrary reaction.

Of course, I am not suggesting actually that we think that it is necessary to get a bag limit. I know there is a great deal of philosophical controversy on this whole aspect of bag limits. We still think it is important and significant in certain areas as a management tool granted, of course, that in some situations the bag limit realistically is a figment of somebody's imagination because so very few people ever get up to the bag limit.

VICE CHAIRMAN BELLROSE: I certainly understand the point that Doctor Cottam is trying to make—that is, aesthetics are becoming increasingly important factors among all waterfowl specialists and that as we make knowledge more available to the hunting public, through books and through articles, that the interest in aesthetics will increase and the interest in a full bag will decline.

MR. ROLAND CLEMENT (Audubon Society): I would like to add a comment, especially in view of the fact I have done quite a bit of prodding in this area in the last few years.

I want to compliment John Gottschalk and his staff for bringing a much broader breadth of viewpoint to this statement than has existed in the past. I recognize, of course, that as an administrator he has to take many situations as given and accept a number of factors but, I think, for the rest of us who are in the field, we must view these projections and the adaptations to these situations as a sort of scenario. John and other administrators must work within certain constraints, but the rest of us have the responsibility of changing these constraints so that we will not end up with a minimum that is being projected at the present time.

I am glad that John gave us a preamble on the problem of analysis by citing his experiences, because we are really just beginning to wake up to human behavior. I think this is one of the exciting aspects of our day and the author of a new book called *The Human Group* has given us some clues that we might apply to our own investigations in human behavior and where, for example, it was demonstrated that sex is not a simple biological appetite—that there are many different kinds of sex. Of course, the standard one that we have all recognized has been the bonding aspect of sex. However, in addition, the author recognizes a number of others, including status sex, therapeutic sex and a number of others and, therefore, we need to pay some attention to this because we are going to have to learn to break down all human approaches in understanding what we are up against.

CHAIRMAN NOREN: You know, this has turned out to be about the sexiest waterfowl session we have ever had. (Laughter) I thought that the comments made by our last speaker were particularly appropriate. I certainly would like to echo them. I think it is fortunate, however, that there are those who continue to hammer on projections about population increases. I tend to believe they are going to be proven wrong because of certain changes in attitudes and technology.

It is true that this population problem, of course, is a fundamental factor here and I am certainly optimistic in that the people of this country are going to be intelligent enough to take the steps necessary to maintain some quality.

THE STATES' VIEWS ON WATERFOWL MANAGEMENT

JOHN R. WOODWORTH
Director, Idaho Fish and Game Department, Boise

As you might expect, the States' views on waterfowl management are quite varied. This is as it should be and, among other considerations, reflects differences in the waterfowl populations of the four Flyways involved, specific populations within the Flyways, and north-south Flyway differences. No attempt is being made to suggest that this may be a compendium of their views.

BROAD VIEW

A general picture of the States' views can be drawn, however, and the several States that responded to a request for their views felt that the waterfowl management program in the United States is generally being well administered. The fact that they are not always in agreement with present waterfowl management policies or viewpoints either at the federal level or that of neighboring states points out the complexity of this task. They agree that their criticisms on occasion have been politically motivated but feel that this has been necessary at times.

Biopolitics

The States do recognize that biopolitics has had an impact on waterfowl management which is considered at times to have bordered on biological irresponsibility. They further agree that there is a need for all groups to act responsibly and accept the reality that they all cannot have a completely equal opportunity in using the waterfowl resource.

In this respect it is important for us to remember that we do have the right to dissent to an existing condition or program. Indeed, it is our duty to do so if we believe that the need exists. Our system of government, in fact, is based on the adversary process (Ward, 1967). Although the term "politics" at times carries somewhat of a stigma with it, we must remember that politics can be defined as the promotion of a program or policy. Thus, whether a political action is good or bad depends on the program being promoted. We must recognize that even though programs that we disagree with will be brought up for consideration and possible adoption, in the long run the public interest will generally be served.

Land Use Planning

Greater overall long-range land-use planning is considered an urgent need affecting waterfowl management in view of the ever-increasing competition for the available space and resources. The need to educate the public to its responsibilities in preserving our waterfowl resource is also considered a great challenge and one which now may have been made somewhat easier in view of the present emphasis being placed on scrutinizing the overall environmental problems confronting us.

Many of the views of the States today can be found expressed in the transactions of this conference. This is as it should be and points out the relevancy of these meetings. (Bennett, 1969) in his remarks to this group stated that "the proper use of land is a disciplined procedure which requires an understanding of the needs, a knowledge of the adaptability of the land, an appreciation of the relative importance of the competing needs, and a reasonable plan for development."

Long-range planning includes educating the public to its responsibilities according to this author. He goes on to state that it is the responsibility of our leadership who have the ability to lead and influence others in their respective areas of discipline to accept that challenge and that "leaders often tend to lean too far in the direction of finding a consensus." This is a process which tends to lead to bureaucracy and inaction.

Greater long-range land-use planning then, which includes consideration of the waterfowl resource as an integral part of these plans, is considered as being urgently needed if this resource is going to continue to be a part of the American landscape in its present ecological form.

One State summed it up as follows: "The future of wildfowling in tomorrow's world is precarious at best. Only an outstanding effort on the part of all management agencies will assure its place in the future outdoor recreation picture." This effort must include effective policy making.

A North American Waterfowl Policy

In order to pursue an effective waterfowl management program, an updated North American Waterfowl Policy is needed. The creation of such a policy, of course, is now being actively pursued by the International Association of State Game and Fish Commissioners.

Waterfowl Population Goals.

In looking at the broad aspects of waterfowl management, a number of States pointed out that the goals for our waterfowl populations should be revised on the basis of present conditions as they exist in the field. This would be particularly important in view of the expressed need for managing specific populations more closely.

MANAGEMENT

There is a prevailing view that waterfowl management problems continentwide must be more specifically dealt with. As one example, the policy of setting nationwide goals for a species such as the mallard is questioned. This philosophy as viewed by a number of States can lead to overutilization of some populations while others may go underharvested. Management should be based on individual waterfowl populations themselves, while at the same time allowing a reasonably equitable take of the harvestable surplus by all users within the range of these birds. Inasmuch as two or more nations would be involved as well as various Provinces and States, it is recognized that this would necessitate a high degree of cooperation.

Cooperation

The view that waterfowl management is a cooperative task is widely held. A cooperative management program, which would include the States and Provinces to a greater degree, as well as the federal agencies involved as equal partners, is needed. The effort of all agencies including their manpower and financial resources should be coordinated and directed toward a common goal.

Regulations

The States want to become involved as more equal partners, particularly in the area of establishing regulations. This desire stems from the feeling that the views of the managing agency are too conservative and restrictive. There is recognition that a more liberal attitude is beginning to emerge. Although the States from time to time have requested very liberal seasons and bag limits in attempting to obtain less restricted ones, the feeling was expressed that regulations should be based on biological considerations alone. Crissey (1965) states that the manipulation of regulations is one of the most potent tools used in waterfowl management and vigorously defends the view that the size of spring waterfowl breeding populations returning north can be controlled by judicious use of regulations.

Differential Regulations

The need to establish differential regulations within Flyways as well as between Flyways is a view strongly held, particularly in the Mississippi and Central Flyways. Several States maintain that there is room in the broad scope of waterfowl management for differential consideration of season lengths and bag limits, based particularly on the behavioral patterns of the waterfowl themselves, and that this would tend to create a more equitable hunting opportunity. They point out that they are not asking for an attempt at an equal opportunity but simply that the scope of the regulatory process be broadened to include differential regulations which would tend to make that opportunity somewhat more equitable than it is today.

Complex Regulations

Concern is expressed that the complex regulations now being set may force hunters to look for other forms of sport, and that as a result there will be a decline in the awareness of this resource. This, in turn, could lead to increased removal of waterfowl habitat and decline in this resource.

Regulations Between the United States and Canada

There is also a feeling that an inequity exists in the regulations between the United States and Canada, and that the Canadian Provinces enjoy more liberal seasons than do the States to the south. The fact that this is a delicate area of consideration is recognized, and no desire was expressed that fixed percentage harvest figures be arrived at. On the contrary, the view was expressed that seasons and bag limits continentwide should be established on the basis of individual populations of waterfowl and on conditions as they exist during any specific year.

Sub-Flyways

The need for more intensive management within Flyways based on sub-Flyways, or zoning by specific management areas, is one of the most common views held by State waterfowl workers. This view is held in all Flyways. It is recognized that such units are in existence in some areas. The Columbia Basin mallard area in the Pacific Flyway was specifically mentioned. The desire for a more detailed breakdown by management areas again stems from the related need to recognize and manage more intensively on the basis of individual waterfowl populations and on differences in timing of waterfowl movements and vulnerability during the fall movement period.

Species Management

The view that the concept of species management is good is almost universally held by workers in this field. A dissenting view is that species management will increase the complexity of the sport of waterfowl hunting and tend to endanger its future due to a reduced interest in the sport.

The general view, however, is that species management will insure a more adequate harvest of each species and protect others as needed. Crissey (1965) points out that some form of species management has been in existence since 1904 and agrees that greater use can be made of this tool as our knowledge of the ecology of the various waterfowl species increases. The need to manage by individual species has been recognized for a number of years (Williams, *et al.,* 1938).

In addition to the need to manage on the basis of individual species, the more specific point system is viewed as an upcoming excellent tool. Many States across the country want to see a greater search for ideas in this area.

Wetlands Preservation

The continuing loss of waterfowl habitat and wetlands in general across our nation is a growing concern to the States. There is a need to save our estuarine areas as well as inland wetland areas. This need is recognized as being particularly urgent in areas where our human populations are growing fastest. Indeed, in some areas where habitat is limited, its loss is viewed as a threat to the opportunity to share in the resource. This concern is shared at the highest level of government.

The President's Council on Recreation and Natural Beauty (1968) stated that ultimately the nation will have to decide how much wetland should be preserved, but that in the meantime the States should go ahead and determine the value of and need for wetland preservation before special interest groups are allowed to encroach on them. It is fortunate that concerned waterfowl conservationists can draw on others for help. It wasn't too long ago that our marshlands were considered wastelands. Today, it is recognized that they add more to the diversity of our environment than any other landscape form (Aus, 1969). In addition to their immense value for plants and animals, wetlands serve as flood storage basins and ground water recharge areas, to say nothing of their aesthetic value.

As a means of preserving our wetlands, another State suggested that this be accomplished through the concept of a water bank. Harmon (1969) stated that the national agricultural philosophy is one of retirement of some lands to less intensive uses. Portions of these lands could serve as "water bank" lands for the good of the nation.

Refuges

A view was also expressed that some of our national refuges are being managed for people and not for the waterfowl resource. Specifically, the creation of small, metropolitan refuges was referred to. On the other hand, their value in bringing the waterfowl resource to the attention of the public was stated as being of real value. That more and more thought is being given to "appreciative versus consumptive" interests has been recently suggested by Hendee (1969). That this trend is going to increase is also suggested, and in fact, its furtherance was recommended by the recent Advisory Board on Wildlife Management for the National Wildlife Refuge System (Leopold, *et al.*, 1968).

Another view regarding management of refuges is that the 40 percent open area limitation for hunting is outmoded. This is considered particularly true in the case of newer refuges that were purchased largely in order to preserve the habitat rather than to provide protection. There is no argument with the need to keep some refuges completely closed.

Crop Depredation

The problem of crop depredation is of wide concern. The suggestion was made that inasmuch as the Federal Government is responsible for the management of migratory birds that they should assume a greater role in combatting these depredations.

RESEARCH NEEDS

In addition to the research needs that have already been alluded to, a number of States see the need for more research in a number of specific areas.

There is a need to experiment to a greater degree with waterfowl harvests to determine what effect various levels of harvest have on individual species. More specifically, in view of the available information suggesting that at least some species of wintering waterfowl populations are not subjected to the same restrictive security threshold as are resident upland game bird species, the need seems obvious to determine more specifically the spring breeding number that will result in greatest production. In this regard, effectively predicting spring habitat conditions on the production areas almost a year in advance will then become an increasingly important challenge. In line with the concept of the point system, there is a need for further research to find a way of obtaining additional harvests on some of the low mortality species while at the same time protecting to the extent needed, the high mortality species.

As was stated previously, there is a need to obtain more specific production data and analysis of these data, particularly from the Prairie Provinces. This would be in line with the need to manage more intensively on an individual population basis by species. More research into possible solutions to crop depredation problems is needed.

A number of States indicated that a need exists for research into effects of shortstopping waterfowl on these populations during their yearly movements.

The need for more research regarding species management was expressed over and over. Results to-date are highly encouraging and the view is strongly held that additional research should make this an even better tool. Problems that need to be solved include possible adverse effect on one species due to increased manipulation of another.

The need to inventory the available wetlands was mentioned as an important task in our northernmost State. Farther south the "water bank" concept was specifically singled out as an area that needs to be researched in greater detail. As the total value of our marshlands become more clearly understood, the possibility of their preservation and, in turn, the preservation of our waterfowl resource will continue to be a reality.

CONCLUSION

In conclusion, the states recognize that the present waterfowl management program is being generally well administered. They believe, however, that the time has arrived to initiate management programs on a more intensive basis which would include States' participation to a greater degree. More intensive management must be preceded by research in problem areas.

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DISCUSSION

VICE CHAIRMAN BELLROSE: Thank you, Mr. Woodworth. I think you have opened avenues for many points of discussion.

I do have a comment or two.

I think, for example, that the various states feel that the four flyway councils are not able to cooperate sufficiently with the Bureau at this time and they wish there would be a further mechanism of cooperation established with the Bureau over and above the Council system that has been developed in the last decade.

MR. WOODWORTH: I am now in the process of designing a new policy and new arrangement for the National Waterfowl Council on a more formal basis. I think those of you here Sunday found that we did have a considerably expanded program over the past years and that we hope to have by-laws and articles ready for the meeting a year from now. We hope that by formalizing the National Council that we can pool all of this together as we did in this paper.

I think this is the first time that all of these views have been put into focus at one time, at least to me. I found it very interesting to get all of these things, and I have tried to put them down into specific recommendations. I think we are on the track toward getting more consolidated and better working relationships with the federal agencies.

MR. ROBERT WEBB (Manitoba, Canada): My first comment here is to the effect that I see nothing on the program which would provide an opportunity for the viewpoint of the provinces of Canada. I would like to state that the provinces are very directly interested in waterfowl management, in the preservation and management of habitat as well as development of rational utilization programs and that we have demonstrated this and are demonstrating this interest and responsibility.

I think that Doctor Tener, if I may direct my remarks to him, may have given the impression, although I know he does not believe this or feel this way, that the provinces are primarily interested in management of big game animals and upland birds. This is not so. We realize this as our area of responsibility and, as stated, we actively pursue the interests of waterfowl resources.

I would like to ask Doctor Tener to explain the ways that now in Canada administrative avenues are open for communication and consultation between the provinces and the Canadian Wildlife Service on the matter of waterfowl management.

DOCTOR TENER: Thank you, Bob. In the process of reducing the length of my presentation, I eliminated a discussion of the provincial role and perhaps it might be useful just to read that particular paragraph over again. This has to do with the matter of provincial wildlife.

We place the greatest importance on constant and fruitful discussion between the federal and provincial agencies and, indeed, we are now expanding more rapidly into discussions and contact with private agencies. In Canada, as in many other jurisdictions, there are two levels of primary concern. One is the federal level, because of the existence of the international treaty but at the provincial level there is ownership and right of property and it is here, from the legal point of view, that provincial governments are involved and we recognize this through constant and close collaboration with provincial governments—in other words, that we in Canada and, indeed, internationally, are going to achieve the objectives we are all working towards.

I might add that the development that we are presently in has been discussed with the provincial government before it has and will be implemented.

VICE CHAIRMAN BELLROSE: It is good to know that the provinces are involved in various waterfowl resource management programs because the provinces encompass such a large area. They encompass an area greater than our states. Therefore, certainly, for the few provinces concerned, they carry a great impact upon the resource itself.

In regard to Mr. Woodworth's paper, I would also like to make a comment there.

I feel that the Bureau of Sport Fisheries and Wildlife has shown a great interest in experimentation in trying to assist the hunter in harvesting the resource to its greatest potential. I also know that the door has been opened for the public to enjoy a particular privilege and once this privilege is enjoyed, regardless of the facts following experimentation, it is hard to withdraw the privilege and so we get into politics. I would suggest that such experiments should be done with caution because of the human tendency to abuse privileges once extended to them.

CHAIRMAN NOREN: May I comment on the matter of the opportunities for the provinces of Canada to express themselves when these programs are being drawn?

We had included such an item on the program but some obscure program committee necessarily had to modify what could be handled in the time allowed and, consequently, this particular category was not included in this program today.

WILDFOWLING AND THE LAW

H. ALBERT HOCHBAUM
Delta Waterfowl Research Station, Delta, Manitoba

Free hunting is a popular illusion. It has never existed in our society; it is impossible to promote. In the beginning of our present North American culture, we intruded upon native peoples who were restricted in their hunting patterns by tribal rules and by inter-tribal strife. The white pioneer simply hunted beyond the realm of his own laws and called it "free." Wherever civilization caught up with the frontier, laws restricting shooting soon followed. Men who share their countryside with neighbors must live by law and order.

Although free hunting is an illusion, the freedom to hunt is a fact as firm and solid as Plymouth Rock. One definition of freedom is *government by law, not by man.* Our freedom to hunt hinges upon the laws of hunting.

Freedom to hunt and the right to hunt are not the same. Many have been led to believe they possess an inherited right to take game. This is not true at all. Hunting is always a privilege granted first by law, then by the landowner where the game resides. No citizen has a right to take game without the permission of both his government and the landlord. False ideas about hunting "rights" have led to a widespread practice in North America of intruding without permission to hunt upon the lands of others.

Our North American freedom to the privilege of hunting under law has its foundation in English legal tradition. In the beginning, each man hunted by agreement with his companions. As civilization advanced, bringing domestic culture of animals and crops, hunting became less important to human welfare, but was still followed by some for pleasure and sport. Eventually, leaders usurped the citizen's freedom to hunt, and in England the King claimed ownership of all game in his personal prerogative. Despite certain hunting privileges granted by the Forest Charters (Clarke, 1961), transgressors against royal ownership of game were punished, often severely—or, as Robin Hood, they lived as outlaws.

In 1215 the Magna Carta of King John changed this way of life. Game no longer was owned by the King. It became public property, held in sacred trust by the ruler in his sovereign capacity as the representative of the people. In short, game was held by the crown which protected public ownership. So the pattern of ownership and protection remains to this day in England and this principle forms part of the English common law. American colonists followed the common laws of England; and after the American Revolution, it was judicially decided that the common law of England constituted the common law of the United States. The common laws of Canada were inherited in simpler fashion from the same source.

In North America, of course, the State has replaced the sovereign, but the game is still owned by the people, while the State holds primary responsibility for its protection. No citizen can legally reduce game to personal possession except under laws declared by his government, hence the State not only protects game but regulates its harvest. The individual owner of real estate does not legally possess wild game on his land; it remains public property subject to the protective laws regulating hunting everywhere in his district. But a landowner controls his own domain and in this measure controls the abundance, the movements and the hunting (within the law) of the game thereon. In our crowded society, the owner of land becomes ever more important both to the welfare of game and to the survival of hunting.

Laws serve to protect each man from his neighbor who, despite all the artificial trappings of civilization, still is tempted to yield to primal instincts. Man loves, fights, plays and hunts according to inborn patterns he has inherited from his distant beginnings as a social being. The law, in large measure, seeks to establish an orderly relationship between men who live within the confines of society. The more our lawmakers learn of the basic instincts that lead men to behave as they do, the better the law will serve to establish controls that are effective and good for each man alike.

So it must be in the protection of waterfowl and other game. Man's urge to hunt may be instinctive (Fletcher, 1957: 311). Hunting behavior is a part of each man's inborn inheritance, an overpowering influence throughout his life. The pursuit of crawling, climbing, running things begins before the infant walks. Games involving searching, finding and escaping (for some game is dangerous) are part of childhood and adolescence. The grown man's pleasure in striking a mallard dead in the air is akin to the child's thrill in capturing a butterfly. The reward to both is derived not from the dead animal in hand, but from the completion of an instinctive act. And, as Ernest Hemingway exclaimed, "the last is as good as the first."

For primitive man, wildlife was the source of food and clothing, tools and housing. Man's survival depended upon patterns of behavior by which game could be harvested most efficiently. The story of our cultural growth is the history of the development of hunting skills. The first tools that lead us to blend hand and mind were patterned for the hunt.

Three sorts of hunting traditions developed: those dealing with techniques, those of regulation, and the traditions of use. Each youngster began to develop his hunting techniques when he set out to capture his first butterfly, his first cricket or frog, skills becoming refined as he grew older and sought prey higher in the life scale. When he finally joined his elders he learned their secrets that had been passed down through family and tribe from time beyond memory. Hunting from its very beginning has been a father-son affair.

Traditions of regulation became important when families joined tribes. Unless there were rules to be obeyed, young, hot-blooded men, keen to hunt but lacking experience, might easily spoil the chase. If a hunter of the Plains-Ojibawa spoiled the buffalo hunt by a move ahead of plan, or otherwise frightened the bison away, his belongings were seized, his tipi cover was cut to shreds and the man himself was severely flogged. For a second offense a man might be banished from the camp, and for a third he might be shot (Howard, 1965:21).

Enforcement of such tribal rules established the first legal restraints upon man's hunting activity. One did not break the rules because of the threat of penalty. As the hunter grew with his companions, he perceived as well the importance of moral restraints, self-discipline which considered the rights of others. Good sportsmanship became part of hunting because of a man's concern for his companion's welfare and pleasure. Our legends carry much evidence of the important role good sportsmanship played in the lives of our primitive ancestors. The ethics of hunting no doubt had their individual beginnings in childhood pursuits of small animals: the first to sight the quarry was allowed prior rights to its capture, and so on. "The development of a moral sense is not given irrevocably by heredity, but depends upon the infant's environment; and the so-called intuitions of right and wrong through which our moral sense operates are not intutions in the strict sense, but dependent and conditioned mental acts" (Huxley, 1947:1).

The product of the hunt was dead game in hand. Many and highly revered are the native traditions for its treatment. Thus the Eskimo hunter pours fresh water down the throat of the seal he has just slain, a token reward, a final offering of respect for a skillful and elusive prey. There are certain ways to clean and divide game, methods of preserving and using so that nothing goes to waste. Primitive people living in the wild still eat parts of the animal, such as the intestinal fat, that are quickly discarded by the modern white hunter, who often gets his vitamins from bottles.

Most important of all, dead game in hand had real value. Flesh and bones, skin and sinews were prized possessions as well as items for barter, measures of wealth, criteria of one's position in the social hierarchy.

Hence, in the preservation of something of value was the need for protective laws. In the beginning and, for some societies, even still, the hunter was not tied to the land by ownership. For all their freedom, the Eskimo's only property is his portable living and hunting equipment: clothes, tent, tools and implements. The white man, in his social development, added land to his private property. And as owners of land, some became skilled in the culture of game thereon. English game laws, largely by their simplicity, gave each landowner incentive to increase the numbers of game on his property. Game management thus developed its clever and effective techniques over the centuries, game thriving as a crop.

In North America, where the idea of free hunting was founded on the lawless frontier, each man felt he was breaking away from a shackled pattern. He could go where he wished, shoot what he liked and need ask permission of no man. But it soon developed that game vanished before such patterns. More than this, game unrelated to private property rights lost its real value despite the fact that some of it was taken for the market. It was only through government control, some of it heroic, that the complete extermination of several kinds was prevented. Nowadays we salve our conscience by saying that the passenger pigeon and the buffalo "had to go." If we speak the truth, however, some other species were saved by good laws strictly enforced. The closure of spring shooting of ducks is but one example of such a good law.

To this point I have spoken broadly of game, all the wild things man pursues, slays, and eats. Game as such has many properties governing its management and harvest, hence it is important to deal with the various kinds seperately. My concern here is for waterfowl; and I prefer to devote my main interest to ducks. While each of the many kinds of ducks inhabiting North America has its own distinct way of life, we tend to meet them on waters where two or more species gather together. Hence I'll discuss ducks broadly, coming to specific differences as these are important to my story.

Ducks as a whole have many characteristics allowing them to maintain relatively high populations. When the "Buffalo Winds" of April soften the prairie snow banks, natives have long since forgotten the bison or the call of Eskimo curlew. But the ducks continue to sweep back to their sloughs and potholes, their pairs spreading far and wide in the annual ritual of reproduction. Ducks are highly successful as game birds for several clear reasons:

1. *Most kinds breed as yearlings.* Notable exceptions are bufflehead, American goldeneye, Barrows goldeneye.

2. *Large clutches are the rule.* The average duck lays eight to twelve eggs. Shorebirds, outstandingly unsuccessful as game in our modern world, have four-egg clutches.

3. *A long nesting season is enjoyed by most ducks.* Most game ducks breed in middle latitudes, one side or the other of the international border. Their spring is long and usually temperate, the nesting season lasting at least two months for most species, most years.

4. *Persistent renesting is a common trait.* With two months available, ducks generally try a second time if their first nest is destroyed by predator or agriculture. If the second nest fails, some succeed with a third try. Most shorebirds nest in the Arctic where seasons are short and nesting is a one-shot affair. It is worth noting that the two shorebirds now qualifying as game, woodcock and jacksnipe, as well as the abundant killdeer, nest mainly in middle latitudes where they can and do succeed in renestings.

5. *Ducks do not concentrate during the breeding season.* Pairs disperse widely at the rate of 2 to 125 pairs per square mile. Thus major local catastrophes, such as fire or flood, destroy only small segments of the total population.

6. *Ducks are elastic in response to their environment.* When a nesting range becomes untenable, a pair of ducks does not vanish or die, as occurs in ruffed grouse and some other upland species. Ducks move elsewhere, usually to big lakes or marshes, ready and able to return another year when good nesting conditions are restored.

7. *Ducks are long-lived.* The potential life span of ducks is 12 years or more.[1] This is longer than the most extensive drought; hence if ducks are protected during dry years, they are ready and available to breed when the drought is broken. This is quite different than in most upland species which have shorter life spans, do not shift habitats successfully and which thus cannot be stockpiled.

8. *Ducks are highly adaptable to man's activities.* The major breeding ground of most game species is prairie farmland where one is seldom out of sight of ducks or farmsteads during the nesting season. Some of the highest breeding densities of prairie waterfowl are within the limits of metropolitan areas, as Minneapolis-St. Paul in Minnesota, and Regina, Saskatchewan.

9. *Young ducks tend to return to breed at or near their birthplace: adult hens come back to nest in the same place each year.* This

[1]Although the press now and again notes recovery of a banded duck attaining the age of 15 to 25 or more years, little has been published on the longevity of waterfowl. The Banding Office of the U.S. Fish & Wildlife Service could not provide me with information on this subject. Kortright (1942:40) has published some records, now long outdated, which suggest that the potential life span of many species of ducks may be longer than the extent of any drought: his extremes being a canvasback living to 19 years, a redhead 16½ years, American pintail 17 years, and a mallard 20 years.

homing of migrant game should be an incentive to local management of breeding grounds.

* * *

Until the early part of the 20th century these successful traits were dominant. There are certain other characteristics of ducks, however, which make them vulnerable to pressures of our present culture. Their heavy dependency upon marshland on rich, agricultural soils is a hazard. Their tendency to gregariousness in fall and winter masks real and sometimes drastic declines, leading to regional misunderstandings about total numbers. Their extensive migrations give few people along the way a feeling of responsibility toward nesting populations. The transient nature of their autumn lives does not instill the same respect for local responsibility as holds for most upland and big game. *"We demand our share"* is today a ruling principle in local waterfowl harvest policy. Many young ducks are not on the wing until late September or early October, many adult females are not recovered from the flightless season of the eclipse moult until then. Thus maternal hens and their young are most vulnerable on their home grounds at a time when they should not be considered fair game. Because of the tight bond between the female and her home breeding marsh, early shooting has already "burned out" local nesting populations of some species, as canvasback in Minnesota.

Just as ducks thrive or fail according to the natural laws governing their life histories, so man must heed these facts of life in establishing the regulations for hunting waterfowl, if wildfowling is to survive. Some of these facts, as the late maturing of diving duck young, the late moulting of adult hens, the strong tie of breeding hens to their home marsh have been known for many years, our knowledge and understanding repeatedly strengthened and multiplied by continuing studies. And yet these immutable laws of nature, our most useful and potentially effective tools for management, are seldom recognized in the formulation of waterfowl hunting regulations.

* * *

Each of us is aware of the perplexing, everlasting change in values of those goods we need to sustain life. The cost of food, clothing and housing spirals ever upward, to use a popular cliché. And yet in a careful analysis it becomes clear that such inflation does not represent a true increase in value. Our major problem is a steady devaluation of the dollar, which becomes worth less rather than the bread becoming more valuable.

By and large this inflation has its roots in excessive spending, much of it by Government. Government does not produce, nor does it earn.

Money comes from citizens. When taxes do not provide enough to meet the bill, the problem is solved by diluting money, so that without true earnings, without real production, there nevertheless is enough in hand to meet expenses.

Government is productive of but a small yield of game ducks. Most mallards, pintails, canvasback and other game species are produced on private land, usually at no expense either to the government or to the hunters. As waterfowl decline, as they did during the recent drought, there is no way our governments may "step-up" production to add more birds to the flyways to fill the deficits. Unlike the dollar, the waterfowl cannot be inflated. It is impossible to make two small ducks out of one big one, as is done with dollars. If the traditional pattern of government responsibility were followed, simple protective laws would be coined and enforced in years of low waterfowl production, such laws founded upon the known facts about ducks, and upon the observed behavior of man, the hunter.

But that has not been our choice. Unable to produce, impossible to divide and unwilling to protect by simple, natural laws, we have met the challenge of fewer birds by fielding a span of many new regulations aimed at greatly restricting the hunter's freedom afield. In effect, the present idea is to divide what is left of ducks as far as they will go. Special teal seasons, one-bird mallard bags, bonus scaup and goldeneye, and now the "point" system are nothing more than legal means of devaluating a resource that cannot be physically divided.

There are important features detrimental to both men and bird in these many recent regulations aimed at dividing the harvest of a dwindling resource. First of all, some of the new laws are impossible to follow. Some are virtually impossible to enforce. The result, as in the tragic experience of the "Experimental Teal Season" in the United States and in the special mallard season in Manitoba, is a serious breakdown in respect for law and a heavy waste of birds killed by mistake. The new pattern of wildfowl laws discourages the honest law-abiding citizen, places a premium on irresponsibility. "This erosion of self-responsibility and self-respect surely contributes to the general decline of morality in our time" (Curtiss, 1968:774).

The one-mallard bag, the special teal season, the bonus scaup require that a hunter identify in a flash more than half the species of waterfowl on the marsh—know them against the light, in all their plumages, indeed in dress some trained ornithologists cannot always identify at once with bird in hand. These impossible regulations are placed on hunters to promote recreation—"free" public recreation in good times and bad. Waterfowl hunting policy in the United States during the lean years of the drought has followed this precept: We, the U.S. Fish and Wildlife Service, "are in the business of supplying recreation to people. Our stock in trade to accomplish this is the migratory bird resource" (Crissey, 1966:5). As the drought progressed and waterfowl production declined we were further advised that the U.S. Fish and Wildlife Service would continue to seek out "underharvested" populations of waterfowl and try to find ways of devising more recreation through regulations that promote greater pressure on these populations (Gottschalk, 1967).

Ladies and gentlemen, it is impossible for any individual, or any business, or any government agency to provide something it does not produce. A careful review of all available population data reveals that considerably less than 5 percent of ducks produced in the United States are hatched and reared on public lands. The rest come from private property. Moreover, more than 85 per cent of the "stock in trade" shot in the United States is produced in Canada. The pattern of providing ducks from private and foreign sources as free public recreation cannot last. To follow this course will lead only to a dreary, lawbreaking era of one- or two-bird bags.

Along with this idea of a government providing ducks for general fun, there has generated the impossible dream that waterfowl can be divided equally among the citizens of a country. "Since government agencies are charged with managing waterfowl," we are told, "there is the obligation to provide the best possible distribution of the opportunity to enjoy the sport of waterfowl hunting" (Geis, 1960:5). There is no way we can equate any other wildlife resource. Only because waterfowl are migrants, at the mercy of human beings along all the long way of their travels, does this pipe dream seem feasible. Equality has been attempted by short-stopping birds in massive numbers on public shooting grounds where false refuge and food are used as bait. Equality has been attempted by dividing the declining species, one or two birds to a hunter, as far as they will go.

There are not enough ducks in the land, even in the best of times, to provide equality for all. Moreover, in this drive for equality, duck hunters are being led by the hand away from the very traditions of freedom that have made Canada and the United States strong countries. The regimentation, the institutionalization, the impossible restrictions tend to create a new class of people who are equal only in their willingness to forfeit personal initiative. If one reads the rules of some public hunting grounds he will understand what I mean. Such forced equality removes choice, leaves each man to behave exactly as his neighbor, a person he has never seen before. He is a number on a list who has been directed to his loss of liberty. Just as some playground dogooders are erasing age-old traditions of childhood games, just as the handicraft officers modify the ancient skills of Indians and Eskimos, so the regimentation of hunters and, indeed, the regimentation of ducks and geese leads to breakdowns in wildfowl traditions. Respect for one's neighbor, sportsmanship, is the first to go. Respect for the land is next. The idea of game being something of value is lost. And, finally, respect for the law vanishes. "When men take the law into their own hands—when men, acting as individuals, decide for themselves which laws they will obey and which they will disobey, then we don't have freedom—we have a direct and aggravated assault on *all* freedoms" (Carpenter, 1968:617).

I suspect the pattern of bad laws and regimented hunting cannot long continue. Some in charge apparently feel the same way. The "in" thing now is plannng for bird-watchers. Let me quote from recent U.S. Fish and Wildlife Service reports: "As a result of very restrictive regulations in the Central and Mississippi Flyways, beginning in 1962, people in these two flyways have been conditioned to accept lesser opportunity for harvest and still participate in the recreation provided by waterfowl hunting. Looking into the future, it seems inevitable that duck hunting populations of North America will decrease. Hunting, which is consumptive use of the resource, will suffer a corresponding decrease, but there is no reason why bird-watching, a non-consumptive use, could not increase manyfold" (Anon. 1955:182). "In the not too distant future . . . managing for bird-watching will become the primary objective of the Bureau program and hunting may come in a poor second" (Crissey, 1966:5).

It seems to me that if there are not enough ducks for hunting there surely are not enough for people to enjoy in other ways. During the past decade a vast population of mallards all but vanished from the Delta Marsh. Their morning and evening flights to and from the fields were a vital part of the prairie scene for watchers as well as for shooters. But when their flights ended, no longer serving the wildfowler, they were missed by the watcher as well. I suspect that before the waterfowl decline much further, both wildfowlers and birdwatchers will learn that there are ways and means which they can follow to maintain waterfowl at high levels. Indeed, some birdwatchers are leading the way. Thus the late Mr. W. A. Murphy, of East Meadows Ranch, Manitoba, established the prairies' most vigorous breeding population of Canada Geese on a range where nesting geese had been absent for many years. Simply watching the comings and goings of these geese, some 300 pairs nesting on his ranch, (many more breeders spreading far and wide over once-gooseless country) was Mr. Murphy's only reward. Beyond the realm of the managed ranch, many hunters enjoyed these geese as well. So it was, too, in Regina, Saskatchewan, where Mr. Fred Bard, another watcher, established a strong breeding clan of Canada geese. And on both ranges, the goose management techniques benefited ducks and other marsh wildlife. Scattered over the prairies are many other nuclei of strong duck and goose breeding populations established by people who were interested only in having wildfowl at ease, close by. Waterfowl breeding numbers within and nearby prairie cities and towns are often greater than in the surrounding countryside where habitat is just as good or better. Surely there must be a lesson here that can be broadly applied to the management of ducks and geese as a continuing harvestable resource.

Somewhere along the road there must be a turning point, an end to this federal defeatism, a beginning of public and private interest in productive management of this hardy resource, a just and legal way of protecting and enjoying waterfowl under the simple pattern of freedom established by the Magna Carta in 1215.

First of all, I think we must understand why ducks are considered a "stock in trade" for free public recreation. A large part of the answer may be found in current interpretations of U.S. Public Law 1024, the so called "Fish and Wildlife Act of 1956," which some leaders in the U.S. Fish and Wildlife Service consider to be a mandate to provide wildlife as a form of public recreation.[2]

An important step toward management of waterfowl as a harvestable resource hinges upon government returning to its major function as protector rather than provider of waterfowl. When this vital move is accomplished there must develop a trend toward simplification of wildfowling laws. More laws have not brought more ducks. There is much evidence that fewer laws, easily understood and obeyed by all, readily enforceable and founded upon the biology of waterfowl, should play an important role in the management of a harvestable waterfowl resource. Laws governing the time and the length of season will be paramount in protecting a huntable supply of ducks. The legal hunting season acknowledges mans' ability to turn himself on or off, to confine his hunting activities within a time set by law. When the season is closed, the firing of a gun draws attention to a violation. No matter how clever a man may be or how urgently he wishes to hunt, he is deterred by a crisp, fair law easily enforced. Present-day seasons have everywhere favored the hunter, often as these laws encouraged pressure on "underharvested" birds. By such favors, in the name of recreation, some species are being overshot to the point that, even with drought and drainage, breeders rather than

[2]Public Law 1024—84th Congress, Chapter 1036—2nd Session S. 3275.

marshes are in short supply. Bellrose has pointed out (and long ago) that waterfowl hunting seasons "should depend upon what species of ducks need the greatest protection and whether the hunter or the waterfowl population should be favored" (Bellrose, 1944:371).

There is a tendency to consider delayed openings important only in northern regions where, by such delays, moulting adult hens and youngsters just on the wing are not harvested before dispersal from natal marshes. In Illinois, more than halfway down the Mississippi, it has been found that "ducks of many species are most easily killed during the early part of the season . . ." (Bellrose, Loc. cit.). The overshooting of local breeders on duck marshes in the United States has been going on for a long time, has advanced severely during the past twenty years when we have seen nesting canvasback disappear from fine canvasback marshes in Minnesota and North Dakota. Now this decrease is advancing rapidly into Canada. Should it not be much easier to hold breeders by stopping overkilling than to restore these to their marshes after they have vanished?

Within the same framework of seasonal control, the protection of some kinds, as canvasback and redhead, could be much more effective by protecting zones of time and place used most frequently by the species needing protection. Such has been deemed too "complicated" to enforce. Zonal control was not too complicated, however, when it favored the hunter, as in the experimental teal season.

The daily bag limit is another major form of legal control. Above all things, this limit must not have complications that make it impossible to obey, difficult to enforce. Roland Clement pointed out last year that "hunters should not be expected to behave ethically if they are encouraged to seek satisfaction afield and are then frustrated by circumstances the lawmaker knew all too well could not lead to satisfaction. One mallard or one canvasback in the bag is ridiculous . . ." (Clement, 1969:349).

No doubt the shooting refuges, with their sad morning line-ups and their skybusting, will always be with us. But there must be far more encouragement to private initiative in waterfowl management; let's get on with the job of encouraging private management. Extension work on how to maintain a good duck marsh should be far more effective than the vastly more expensive task of teaching every man behind the gun how to tell all ducks in all plumages under all hunting conditions.

I suspect there must be international discussions of waterfowl at treaty level. It looks as though some of the "underharvested" populations the U.S. Fish and Wildlife Service wants to provide for public recreation are ducks Canada would like to save as breeders.

Certainly there are many aspects of our international use and misuse of waterfowl that need reconsideration after 54 years on the long downhill run for ducks.

We must place a real value on ducks, indeed on all waterfowl, a valid measure of worth by which something of value is exchanged for the privilege of taking a bag of ducks. If the government is the landowner, so-called quality shooting on public property occurs only where guests pay in fair measure for their hunt. If the landowner is a private citizen, the investment in his duck marsh and its upkeep is his cash contribution toward wildfowling. An important incentive to private management is a no-nonsense bag.[3] If one does not have shooting property, cash paid to the landowner is right and proper. How to reward the prairie farmer of northern pothole ranges, whose product of ducks departs before he can take any harvest, is a hard nut to crack. This must be soluble, but hardly by public purchase or by public management.

And finally there must develop a stronger respect for private property. Such respect does not simply honor the owner's right on his own land, but acknowledges the contributions of private lands to the community at large.

We have been so dependent for so long on Ottawa and Washington that know-how is often lacking. But is it not more appropriate for government to provide information on private marsh management rather than toward this fruitless and expensive educational program concerned with picayune laws? Is it not more appropriate to provide incentives for private marsh management than to give recreation to men who seldom fully appreciate that the massive cost of their so-called "free" shooting places them on public welfare? No natural resource in this land is free for the taking. To attempt equal division of waterfowl means the end of wildfowling for all. But good laws, crisply enforced, encourage an equality of the privilege of enjoying waterfowl to the measure of each man's personal investment in such enjoyment.

All of this, to some, may sound like "Ivory Tower" thinking. Yet whenever the government has relaxed to encourage private initiative, as in Manitoba, Ontario and in several midwestern states (notably in southern Minnesota), new ideas and new management techniques bringing local increases in wildfowl have resulted as if by magic.

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DISCUSSION

VICE CHAIRMAN BELLROSE: This excellent paper gives us much food for thought. Certainly here we can see why Doctor Gottschalk is always caught in a cross-fire of state conservation agencies. They would like more liberal waterfowl regulations so that their hunters can shoot ducks. He is caught in a crossfire with the bird watcher, who would like to see no ducks shot and here we see the great diversion of views which are certainly difficult to reconcile among a resource that stretches over three continents and one that so many people have an interest in.

MR. JOHN GOTTSCHALK: I am sure there are other questions and so I am not going to take much time. However, I do have two questions.

I have been sitting here trying to think of one broad basic question I could ask Al that might put this whole thing into a nutshell, you know, but it is sort of like managing waterfowl—it is hard to find one big, broad regulation that covers the whole situation. Also, I cannot find a broad question that would give Al the answer. Therefore, I am going to confine myself to two questions.

First of all, I don't really understand what you mean by the misinterpretation of the 1956 fish and wildlife reorganization act and then I would also like to have you say a little bit more about what you consider to be a "no-nonsense bag."

DOCTOR HOCHBAUM: First of all, may I ask you one question? What is the interpretation of your agency with regard to this act?

MR. GOTTSCHALK: Well, I think that is going against the rules. (Laughter) I am supposed to be asking you questions but I will tell you that we interpret this act as a broad mandate on the part of Congress to provide the greatest opportunity for recreation from the resources that the Federal Government has any responsibility for managing and that can be obtained without sacrifice of the long-term utilization or potential of the resource.

DOCTOR HOCHBAUM: Well, all I can say is that the reason this was raised was because so many times in so many parts of the Fish and Wildlife Service, when this question comes up, whether you feel it proper to provide free shooting to the public when you are not producing the ducks, the answer is in this act which you cite to us. I am one man trying to find the answer.

Now, although I am not a lawyer, I have talked with the legal profession about this and I have found that the general appraisal of this law simply does not agree with the things I have heard from my colleagues in the Fish and Wildlife Service.

I suggest that this is so important that some outsiders should study and examine this law and make sure whether or not they agree with Mr. Gottschalk and his department about it. You do not object to the questioning of this, do you?

MR. GOTTSCHALK: Not at all.

I would like to say, while you are here, that the Federal Government does not interpret the reorganization act of 1956 as anything more than a broad statement of congressional intent. We have tried to do this on occasion but our solicitor and some others challenged this, particularly the Bureau of the Budget, especially when we are trying to use this act as a means of justifying budget. They are the ones who challenge the use of it in that aspect.

We consider it a broad statement in governmental policy on the part of Congress as to the way the thing should be done. However, when we come to this point of public versus private management of resources, then I do not think there are any of us who feel that the idea that we can continue to have free public hunting in a traditional sense. I don't think there are any of us who are realistic enough to believe that this is a wise course for the long-term future.

I have said many times myself, especially in relation to obscure papers and writings of one kind or another, that people do not read too much; but I think we have an obligation among ourselves as partial stewards of this resource to promote the idea of some kind of incentive to land owners to get them to do more to protect the resource and habitat on which it depends. And if we do not move in this direction, then we are going to wind up with most of the habitat disappearing because the average landowner feels that free public hunting as practiced in the United States over the years is a price that he must pay for having wildlife. Therefore, he sees very little incentive in having wildlife on his farm.

Therefore, I am not quite sure about your objection to our utilization of the Fish and Wildlife Reorganization Act, but I say that we do not think that whatever authority this gives us is any substitute for trying to encourage private protection of marshes.

Now, I believe the other question had to do with a bag limit.

DOCTOR HOCHBAUM: The no-nonsense bag limit is a bag any wise hunter can follow easily and which can be enforced easily. This does not presently hold to our bag limit in many parts of the United States and Canada. That is it.

MR. ROBERT WEBB (Canada): I think that such an excellent statement deserves much discussion and careful scrutiny.

I don't want to detract in any way from what has been said by way of trying to promote certain factors mentioned by Al, but I would like to make reference to one of his assumptions—and this was that the mallard in some parts of Manitoba is being reduced to the detriment of the various hunting seasons. I would suggest that this is far from a proven assumption, although there are indicative data on hand but, at the same time, there are data which indicate that one of the main problems in Manitoba, as elsewhere, has been associated with the failure of those breeding units to reproduce sufficiently to sustain populations in relationship to all types of mortality.

I think we must be careful to check these assumptions in order to make sure they are correct. On the other hand, I think this was a very stimulating talk and I think we should well pursue this avenue and I am sure we all will.

WETLANDS PRESERVATION-MANAGEMENT IN NORTH AMERICA

DALE E. WHITESELL
Executive Vice President, Ducks Unlimited, Inc., Chicago, Illinois

The continued decimation of our wetlands environment is more serious today than it has ever been before in history.

The total acreage adversely affected today by various forms of exploitation is no doubt less than the millions of acres affected over the past forty years; however, we are now debilitating that critically needed and reduced remnant of our once plentiful wetland habitat.

I won't waste a lot of time recounting our losses and restating the problem. However, many of these problems that were *supposedly* corrected by law and policy years ago are still around, still plaguing us in various forms. I want to first cite a few examples and then I want to describe what Ducks Unlimited intends to do and how it might be possible to correct some of these other pressing problems facing today's wetlands environment.

Let's begin by looking north of the U.S. border, where a majority of our waterfowl are produced. Based upon the U.S. Bureau of Sport Fisheries and Wildlife estimates in its 1961 waterfowl status report, the number of potholes across the southern part of Canada's Prairie Provinces, and extending as far north as the forest transition, would provide for an average of between 4 and 8 million acres during the average period '52 to '60, but only about ⅓ that amount during the driest year then on record, which was 1961. This is assuming that the average size of a pothole is between 1 and 2 acres. We might also assume that if all the prairies were wet in the same year there would be almost 8 million potholes, representing between 8 and 16 million acres. These figures may indicate that the pothole situation is not as bad as it might seem; however, we have only to look at the "average" figure and the "driest year" figure to observe the potential drainage and elimination factor that faces us, since we all know that when the prairies are dry the plows can move in.

Although drainage data are hard to come by in the north country, we can look at some figures that are both significant and interesting, keeping in mind that the exact acreage drained is never as important as the total area affected. In the Prairie Provinces almost 3 million acres have reportedly been drained. Since half of this amount was reportedly drained before 1930, we should realize that these are barely minimum figures. Granted, we must look at drainage as a tool of development and that it has certainly not proceeded in Canada at the same rate that it has in the United States. Even so, future justification supporting any drainage projects must be practical and protected from programs that are unharnessed and uncoordinated, especially as practiced by various branches of the same government. Such can be most detrimental to our total wetland environment, as evidenced by the rate of drainage in the United States. When we recognize that during dry years we are seeing only about 10 percent of the potential potholes for duck production on the prairies, it becomes all too evident that the loss of additional potholes will tend to become more critical during future dry periods.

Where and when do we stop draining? I think we have to stop it *now*, unless it can be demonstrated that such drainage can be turned into an enhancement for waterfowl by diverting such water into equally productive and better protected areas of waterfowl production.

How do some of the Canadian citizens look at this drainage situation? Let's look at a report of the Migratory Bird Committee for 1968 by R. M. Ferrie, presented to the Canadian Wildlife Federation:—"It is not possible to report on waterfowl without bringing agricultural development into the picture. The most persistent adversary to threaten our waterfowl population is agriculture and the trend to bring more land under cultivation." He also pointed out that, "all however is not lost. Some habitat is being recreated, some improved and some just retained." In his summary he further stressed that habitat reduction in Canada was a national problem. On the plus side is the current Canadian government policy to encourage the reduction of wheat acreage by at least 20 percent—a policy brought about by the recent glutting of the wheat market. This policy must *not* allow us to feel that we have a breathing spell within which to relax our efforts. It simply means that we now have an opportunity to more rapidly and precisely guarantee, wherever possible, the preservation of many of these key wetlands.

We in the U.S. *must* be concerned *now* with the total water situation in Canada, not only because of its importance to the environment of wildlife, but as it very realistically applies to the environment of men. For example, I am told that some Chicago area water supplies come from Lake Superior aquifers. It is sufficient to say that there are points much farther south than Chicago that are dependent upon one or more of the Great Lakes. We now hear that future plans call for the use of Canadian water in the U.S. For example, most of us have heard of the North American Water and Power Alliance, operating principally on the West Coast. This group is vitally interested in obtaining Canadian water to be used by the millions of Americans in the Pacific Coast area. The Toronto *Tele-*

gram, dated Tuesday, February 10, 1970, tells of a plan to sell Canadian water to the U.S. A company has reportedly been created for the purpose of getting permission from various Canadian authorities involved to sell water to the United States for the following stated reasons: "The company also makes possible the profitable sale of water to the U.S. to aid in flushing the lower Great Lakes clear of pollution with fresh water once a joint U.S.-Canadian ban on phosphate detergents comes into effect". Canada is having its pollution problems also, even in the West where the key waterfowl production grounds are concerned.

Although these are only remote instances, we all sincerely hope that our Canadian friends will be able to apply wisdom and understanding to the knowledge derived from the mistakes made in the U.S. as a result of industrial, agricultural and municipal expansion, and provide for their correction before they occur.

Let us now look at the siutation in the United States. I will not belabor the issue by referring to the millions of acres of wetlands already destroyed as a result of pollution, needless drainage, misplaced or unplanned economic development *and* destruction of the incentive of the private marsh owner to maintain and manage his lands in a manner and at an expense beyond that, that would be endurable by government. I will point out several recent examples.

The Roseau River area in the extreme northwestern part of Minnesota is an area comprising roughly 100 thousand acres. It was drained back in the late 20's and early 30's; however as a result of action by various government agencies the region has reverted back to a wildlife situation. You might be relieved at this. However, it now appears that another Corps of Engineers drainage project is again scheduled for this area. Authorization has apparently been in hand for several years and most everyone agrees that their drainage efforts cannot be stopped. However, most of the concern being expressed by conservationists is centered on the role that will probably be played by the United States Soil Conservation Service. This role will consist of digging lateral ditches throughout the entire countryside, leading into the "big ditch."

There appear to be several factors involved with the failure to retain this area for wildlife purposes. Although it is reportedly desired by the Federal Government as a refuge, their representatives tell us there are no funds available for purchase. The county jurisdictions involved are having a difficult time economically and do not want to lose the taxes generated by the lands. There is also a vague but effective deterrent present called the "Minnesota Consent Line," as it is sometimes referred to, which reportedly involves a

17-county area in which public agencies may not purchase lands. It is apparent that many of the concerned government agencies desiring to retain this area for wildlife purposes are faced with problems they cannot solve of their own accord.

Now let us move on farther south, where we read in the *Birmingham News* of Thursday, January 29, 1970, of a fabulous multimillion dollar family recreation complex, covering over 700 acres and featuring an 18-hole P.G.A. championship golf course, an Olympic pool and even a wave-making pool. This sprawling leisure time "utopia", which will open this Spring in Decatur, is to be called "Point Mallard Park," and I quote from the article in part,—"it is rapidly becoming a reality as bulldozers churn up the Tennessee Valley soil in an area east of Decatur on the Tennessee River at Flint Creek." I would like to now quote from a letter written to the newspaper in reference to this article by Dr. Walter B. Jones, a former director of conservation for the State of Alabama. "It is a pity that you did not shed at least one tear for the Canada Goose which is not likely to put up with a fun park in the exact middle of his traditional rest area—and it could be that he will leave the Wheeeler Refuge altogether. It is not believed that there is another area in the refuge that would be suitable for his occupation. There was a day when great numbers of Canadian Geese wintered on Big Muscle Shoals and Little Muscle Shoals. Wilson and Wheeler dams took care of that—if he (the goose) is driven out of the Wheeler Refuge—there will be a lot of unhappy people in all walks of life. A fun park is a frightful price to pay for such a tragedy." A similar situation is described in the July, 1969 issue of Georgia's *Game and Fish Magazine*, by George Bagby, director of the State Game and Fish Commission, writing about *Georgia's Ruined Rivers*. He points out the destruction of miles of trout streams and other wildlife environment, as a result of the "improvement" programs under the U.S. Soil Conservation Service's Public Law 566 Program and programs of the Corps of Engineers and other related development groups. Mr. Bagby describes how they are making it possible for private land owners to drain over 4 thousand acres of swamp lands in the Alcovy flood plain and place the acreage into row crop production, even though such a move is in direct conflict with other federal agricultural policy designed to reduce the amount of crop land in production. It is apparent that the days of many of the southern wetlands are going to be short circuited.

A similar situation exists in Tennessee on the Obion River, where a quarter of a million acres of wildlife habitat have been destroyed. Another example of how wetlands can be lost in the United States can be seen on the Carolina Coast, where recently a 2400-acre marsh changed hands. It had been acquired in 1935 by the present owner, at a cost of about $25,000.00, because the sellers could not see opening the marsh to shooting in 1935 for only a 30-day duck season. The present owner has just decided to sell this marsh for a reported price of several million dollars. It happens that a key piece of the property is ideally located for resort development. It is hoped that the new owner will continue to manage the marsh as a refuge, which had been established by the prior land owner himself. This marsh along with neighboring marshes has provided solitude to many waterfowl, including swans, each winter for many years. I could name several other large marsh areas that have recently "died" as a result of a lack of incentive to maintain some of the most ideal wetland habitat on this continent.

In Mexico we have heard many stories, some exaggerated and some fact, concerning the harvest of waterfowl, but these facts we are sure of—numerous of the inner-mountain water areas are being diverted to irrigation programs and many of the coastal marshes are being polluted. Mexican officials report that they winter between 10 and 40 million waterfowl, depending upon the year and the conditions that prevail. As we continue here in the United States to act as does the bird that dirties its own nest, it follows that more of our Canadian and U.S.-produced waterfowl will be forced to winter farther south in Mexico and points beyond—*if* suitable wetland habitat will continue to be found there.

Well, I could continue describing other instances of wetland deterioration, but let us look now at what can be done concerning the future of those remaining.

It has been estimated by Canadian biologists that at least 6½ million acres of prairie potholes must be protected and managed to maintain waterfowl numbers at the average level of 1956-62. These acres will have to be strategically located so that additional acres will inure to the program, thereby affecting even more acreage.

Ducks Unlimited, recognizing its responsibilities to not only preserve and manage wetlands in the Pairies and key Delta areas is undertaking a ten-year program during the '70's of adding more than 4 million acres to our currently managed and reserved 2 million acres. We feel strongly that with DU's 6 million acres under development by 1980, along with the additonal acreages developed by other agencies and organizations in Canada during the same period, a most formidable barrier can be provided against irrevocable wetland exploitation. To start the '70's off in grand style DU plans to call for the construction of 63 new projects this year. This is the greatest number of projects undertaken in any one year of Ducks Unlimited's 33-year history. This will add almost 18,000 acres and 400 miles of duck-producing shoreline to our total construction figures to date of more than 900 projects built, 1.6 million acres developed and 8,200 miles of shoreline.

This year DU will also be initiating pilot programs to establish methods and procedures for reserving additional selected marsh areas.

This brief outline of what DU intends to do in Canada is only a part of the critically needed effort to be expended over the next 10 years. Considering the magnitude of the job to be done and the costs involved, we want to invite the participation of all interested individuals, private organizations and public agencies.

I want to make it abundantly clear at this time that Ducks Unlimited's currently reserved 2.0 million acres (of which 1.6 is developed) were made possible *only* as a result of the steadfast support of the farmers, ranchers, Provincial and Dominion governments of Canada and the monetary support provided by thousands of U.S. citizens.

In the United States those people who support Ducks Unlimited will be most interested in every program, both public and private, that could adversely affect or benefit the dangerously depleted wetland habitat remaining in this great nation.

A definite approach to pollution appears to be in the offing, but we have yet to make the emphatic motions of removing politics that bestow favor upon some at the expense of many. We further must establish criteria of environmental quality and administer them without delay. We must, in addition, consider that one of the greatest pollutants destroying our estuarine coastal marshes and inland marsh areas is yet a more subtle form called siltation. We can by law prohibit all other forms of pollution from entering our environment or at least limit their involvement, but until we solve the siltation problem our marshes, lakes and streams will continue to "die." It makes little difference whether we choke on a rank poison or on too great an amount of a normally harmless substance.

These conservationists will also be alert to the need for a philosophy that will extol the virtues of creating and maintaining incentives that will provide for the encouragement of private marsh owners to maintain and develop their wetlands which local, state and federal governments cannot afford to acquire, let alone manage in a manner that would be unrestricted by politics and politicians.

The protection of the public's interest on and off public lands must also be guaranteed. The practice of involving a private organization as a third party to the management of public lands has, in specific instances, afforded a method of short-stopping or delaying the misuse of such lands, when a politician has found it to be expedient to pressure a public agency into what could have resulted in the exploitation of certain public lands. Such a method can also be used to better guarantee the use of improved conservation practices on these lands, when additional use of specific resources on and under the land is deemed practical.

Action resulting in the prohibiting of land purchase by a public agency might be surmounted by providing for a reasonable "school tax" or other specifically ear-marked reimbursement to the local taxing authority. Such has been done in the past to pave the way for land acquisition in parts of the U.S.

It is also a sure bet that the public cannot help its favorite public agency, *if* the public does not understand the problems facing that agency. More efficient and more "off the cuff" communication is required to solve many of our environmental problems in the U.S., especially where the agency is handcuffed by pressure on up the line.

And now back to Mexico. In February of this year, only weeks ago, Ducks Unlimited stood on the threshold of a new era by being able and privileged to again encourage cooperation between a government and its people, for the purposes of preserving our wetland environment. During last February, while in Mexico City, the officers and Executive Committee of Ducks Unlimited paved the way for the establishing of Ducks Unlimited of Mexico, and that organization has now become a reality. Funds will be provided by interested conservationists in Mexico for the purpose of underwriting the costs of waterfowl conservation in that nation. We firmly believe that such an international effort will provide for a much closer cooperation between the people and their governmental officials, as well as greater understanding and liaison between them and the governements and citizens of the U.S. and Canada.

In closing, I would like to quote from the 1969 report on Wetlands and Waterfowl presented to the Saskatchewan Wildlife Federation by A. J. Rankin and R. M. Ferrie. "Unfortunately any plan to preserve wetlands fell on deaf ears and those in authority or able to direct policy were bound to their own course of action. The farmers were hearing sounds with appeal and ones that would draw action towards the one thing they could do well—grow wheat. Land was cleared, wetlands drained, pastures plowed in a mad scramble to get fields into wheat from which prosperity was to flow in abundance. Within a short span of two or three years a reverse was all of a sudden urged upon the same grain farmers to reduce their wheat acreages and some appeals did warn that farmers should not plant wheat at all in 1970. Two or three years of prosperity has led to about ten years of austerity. The long term benefits have been negated by short term gains. Prosperity is a wonderful thing but we may be paying too high a price for it."

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DISCUSSION

DISCUSSION LEADER BELLROSE: Thank you, Dale. It is certainly disheartening to learn about the wetlands in the United States that continue to be drained by government agencies. We might suspect, of course, that the Corps of Engineers would be forever busily engaged in this practice but now when we add the U.S. Soil Conservation Service as a government agency perpetuating this program on a tributary level of streams of large rivers, we have another avenue that is leading to destruction of wetlands and that we must explore and fight with great effort. It is heartening, however, to learn that the people of Mexico are interested in preserving this waterfowl resource and, certainly, it is an important area and one that we have been able to do little to in relation to habitat development and management heretofore.

DOCTOR CLARENCE COTTAM: I have lived through much of the drainage of the Dakotas. I want to give you a little history of what occurred there.

The engineers of USDA encouraged the draining in many countries of the two Dakotas and western Minnesota. It was an interesting thing to note that when we got the map out and checked those counties, some ten years later, when the worst drought came, it struck those particular counties that were drained. As a result, these counties were declared disaster counties and the government had to move in again to save the people. Therefore, we got skinned in relation to the drainage and skinned again whene those same people were hard-pressed economically and the had to move in to take care of them. This is what we are headed for again in connection with what has been said here.

MR. JOHN ANDERSON (Connecticut): Speaking only as a duck hunter and long-time member of Ducks Unlimited, I appreciate the good work they have done so far in Canada. I think, however, we must guard against oversimplifying the job that still lies ahead of us.

I don't believe that it is wise for us to assume that just because we have completed some five thousand restoration projects in Canada, where there are some six million potential sites, that we have really made much of a contribution so far.

Let's not kid ourselves. If we had been able to restore twice that many marshes, we would still be losing ground. I think that if we are really serious about maintaining a shootable surplus of ducks, then we have to attack the enemies of duck hunting on a much broader front than has been the case with Ducks Unlimited in the past.

I am very encouraged by Dale's paper because it indicates that Ducks Unlimited may be thinking in broader terms than they have so far to date, because I think we realize that nesting habitat is not the only factor in this equation In fact, much of the range involved has not been a limiting factor because we have had more nesting habitat than we have had breeding ducks to occupy it.

If we want to attack the real enemies of ducks and duck hunting, then I think we must look at the limiting factors, such as human overpopulation.

Ducks Unlimited members, as private citizens, could stand up and be counted when birth control measures are being debated on the floors of the legislatures. Now, under those circumstances, they have usually been absent thus far, insofar as I can tell, in really being effective in fighting the subsidized drainage carried on by the U.S. Department of Agriculture and the U.S. Corps of Engineers. It seems to me that Ducks Unlimited has not been as successful as it could have been in encouraging its own members to obey those laws which are set simply to keep us duck hunters from killing ducks faster than they are being raised.

In one of the Atlantic States during the past season I think there were about 700 violations brought to court—such things as overshooting bag limits, shooting with live decoys and all of this. I think that if you will check the records you will find that the majority of these violations were committed by members of Ducks Unlimited.

Now, I do not know what this does to a resource, but I sure know that the public image of the hunter in general is suffering and, therefore, I say, let's not give comfort to our enemies, such as Senator Dodd and his anti-gun legislation. Ducks Unlimited thus far has done little to break the barrier between the duck hunter and the professional waterfowl biologist, the guy who could be and should be his most important ally. Quite the contrary, it seems to me that for some 35 years Ducks Unlimited has effectively and deliberately widened the credibility gap between the average duck hunter and the professional waterfowl biologist, who has been trying his damnedest to do what he could do to squeeze the very last duck out of the resource. We have rather effectively widened this credibility gap by a rather simple approach.

In years of above average rainfall, Ducks Unlimited has taken all of the credit for the extra good crop of ducks and in years of drought, they claim they just do not know how to counsel. This approach, I will admit, in one case, at least, had been very effective in raising money but from the standpoint of maintaining a shootable surplus of ducks, I think the approach is indeed open to question.

Again, I am very happy to say that I was delighted to hear Dale's paper because it indicates that Ducks Unlimited may be doing an about face. All I can say is that it's about time.

VICE CHAIRMAN BELLROSE: It is gong on twelve o'clock noon and we have to limit discussion here. There are divergent views and they can be reconciled by talks in the hallways. We must proceed to the next paper.

CHAIRMAN NOREN: Dale, I am sorry that you do not have a chance to respond but we are running out of time

MR. WHITESELL: I would like to thank him. I think he is going to help me collect more money.

EVALUATION OF THE 1968-1969 EXPERIMENTAL MALLARD DRAKE SEASON IN MONTANA, WYOMING AND COLORADO[1]

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The future of wildfowling depends upon the ability of management agencies to provide a sport acceptable to its users. During the duck drouth of the 1950's and 1960's, hunter numbers dwindled as low bag limits and short seasons removed some of the satisfactions associated with the sport. This development brought about the present stage of the waterfowl dilemma.

These years of attrition, however, were beneficial in many ways, particularly in focusing attention to critical waterfowl needs and identifying the resource's role in the overall recreation picture. In keeping with circumstances, game and fish administrators have called, or are calling, for critical examination of old or current waterfowl management concepts; formulation of new techniques; and, in continuing efforts, development of plans and policies to insure the best possible future for ducks, geese and swans.

One such measure, now under test, is more efficient usage of waterfowl population surpluses. Accordingly, a series of experimental seasons designed to test new duck hunting regulations in terms of hunter performance and harvest results have been conducted in Colorado and certain parts of the Central Flyway. One such experiment, a mallard drake-only season, was held in Montana, Wyoming and Colorado during the season of 1968-69. Results are the subject of this report.

This experimental hunting season on mallard drakes, approved by the Central Flyway Waterfowl Council, was proposed by the states of Montana, Wyoming and Colorado. It was predicated on an intensive data-gathering and analysis program directed toward establishment of a specific mallard management unit in the Central Flyway, generally west of the 100th Meridian. Subsequently, this area came to be known as the "High Plains Mallard Management Unit."

Information obtained by the three participating states indicated that wintering mallards of the High Plains Unit had a strong

[1]A contribution of Federal Aid Projects: Montana, W-74/77-R; Wyoming, W-50-R; and Coloradio, W-88-R.

tendency to return to this area after their initial wintering period. Further, harvest, as measured by annual mortality rates, was light compared to other areas, particularly during the 1960's; and the ratio of wintering birds per active hunter during these years was very high, exceeded only by the ratio in the Columbia Basin of the Pacific Flyway. Kill data revealed that very few birds banded in other flyways were taken within the boundaries of the High Plains Unit.

On the basis of these data, proposals for the establishment of a High Plains Mallard Management Unit, recommending more liberal hunting regulations, were submitted in 1966 and 1967 to the Bureau of Sport Fisheries and Wildlife but not approved by this agency (Grieb *et al.* 1966; Funk *et al.* 1967).

As the three-state mallard population came under more intensive study, and as results of a coordinated banding effort covering all wintering segments of the population became available, additional factors were recognized. Sex-ratio counts conducted in conjunction with post-season banding indicated a strong preponderance of mallard drakes (estimated at 65 percent) in the population. At the same time, annual examinations of mortality by the Relative Recovery Rate Method of birds banded in Colorado, 1963-64 through 1966-67, indicated that hen survival ranged from 51 to 64 percent, and drake survival, 76 to 86 percent (Funk 1969).

It seemed clear that drakes in the population could sustain greater harvest. It appeared certain, too, that a specific drake season after December 1, when migration of species other than mallards was over, would increase hunting opportunity without jeopardizing the mallard resource. Admittedly, this assumption tends to ignore the hypothesis that excess drakes are needed to serve as a breeding reservoir for re-nesting females. But, in the absence of satisfactory proof of such need, it appeared that additional harvest would not alter the sex ratio sufficiently in one year to influence breeding in the nesting population.

The experimental mallard-drake season proposal, documented by the findings described above, was submitted to the Bureau in the summer of 1968 and, after careful consideration, was approved for the hunting season of 1968-69 (Funk *et al.* 1968). Objectives were: (1) determine the ability and willingness of hunters to selectively harvest mallard drakes, and (2) obtain information on hunter participation and harvest, and on mallard movements, age and sex ratios.

The experiment consisted of a special season in addition to the regular season in the Central Flyway portions of Montana, Wyoming and Colorado. Season length was 23 days, with a bag limit of 4 mallard drakes, possession limit of 8 drakes, and specified shooting hours of sunrise to sunset on all days. A penalty of seven days was extracted from the regular duck season in order to cover possible loss of ducks other than mallard drakes. A special permit was required for all participating hunters.

The writers are indebted to many persons for successful execution of the experiment. Success would not have been possible without the whole-hearted support of game and fish personnel in the three states, who conducted hunter performance checks, intensive information programs, and issuance of special permits. We also acknowledge cooperation of the Bureau for the assistance of refuge personnel and game management agents in collecting hunter performance data, comments and suggestions concerning the season. In addition, Walter F. Crissey, Aelred D. Geis, and staff of the Migratory Bird Populations Station, provided helpful suggestions in the design of permits, wing envelopes, questionnaires, and many other phases of the study. Lee E. Yeager edited the report.

METHODS

Data-gathering procedures consisted of: (1) four periodic inventories of waterfowl before, during and after the experimental season; (2) hunter performance checks, a minimum of 100 in each state; (3) sex-ratio counts, a minimum of 500 birds in each waterfowl region in each state, periodically covered in conjunction with inventory flights; (4) random hunter surveys varying from a 20 percent sample in Colorado (the state with the most hunters) to 100 percent samples in Montana and Wyoming; and (5) a sample of wings collected by hunters in each state. Materials were supplied and surveys conducted at the expense of the states involved.

RESULTS

Experimental season dates selected by the three states were: Colorado and Montana, December 14, 1968-January 5, 1969; Wyoming, December 21, 1968-January 12, 1969. Later dates were selected by Wyoming in an effort to alleviate waterfowl crop depredations in several critical areas.

Preliminary analysis of season results have been presented to the Central Flyway Technical Committee (Grieb *et al.* 1969). It was intended that this report include an analysis of band recoveries for the 1968 hunting season, evaluating harvest rates and distribution between the regular and experimental season. Such information, however, was not available at the time of writing from the Bird Banding Office and therefore cannot be included here.

Duck Population Information

Despite a strong effort on the part of all states to make necessary inventories, weather problems precluded flights in some areas. This was particularly true of the count during the interval of December 19 in Montana, and two counts, December 5 and January 16, on the Bighorn River in Wyoming. In the first instance the entire census for the period was discarded; in the latter, the nearest counts were used to estimate populations in specific areas so that totals could be compared. Counts were not taken by species, although it was estimated that mallards made up about 95 percent of the total population in the three-state area.

About 70 percent of the population in the experimental area was in Colorado. The general population pattern was one of decreasing numbers of birds from the first survey to the last (Table 1). The decrease amounted to about 80,000 ducks, reasonably close to the total estimated kill (including crippling loss) of 72,000 ducks. Additional decreases were undoubtedly due to birds moving out of the area, particularly mallards wintering on the Platte River in Wyoming and northeast Colorado. Since Nebraska was closed to hunting during the drake season, and since these two areas are adjacent to wintering areas in that state, it is believed that the decrease in counts noted January 2 and 16 were the results of birds moving to adjacent wintering habitat.

A slight but progressive decrease in the percentage of drakes was noted from the first to the last count, probably due to the selective drake harvest. However, it should be indicated that these counts were often spotty and at best represented unweighted estimates of the true sex ratio. Counts were reasonably close between areas and states and support original findings based on more limited data, namely, that drakes make up about 65 percent of the wintering mallard population.

Hunter Activity and Harvest

Table 2 summarizes hunter activity and harvest information in Montana, Wyoming and Colorado. The number of permits issued by these states was reasonably close to pre-season estimates, Colorado granting by far the greatest number. Response to random survey questionnaires, with one follow-up, was excellent as indicated by the 83 to 84 percent return. Furthermore, 33 to 35 percent of the permit holders in Montana and Colorado, but only 20 percent in Wyoming, did not hunt. This circumstance considerably reduced the total number of active hunters in comparison to the gross number indicated by permits allowed.

TABLE 1. DUCK CENSUS AND MALLARD SEX RATIO INFORMATION BY AREA AND INTERVAL[1]

Area	December 5, 1968			January 2, 1969			January 16, 1969		
	Ducks Censused	Percent Drakes	Sex Ratio Samp. Size	Ducks Censused	Percent Drakes	Sex Ratio Samp. Size	Ducks Censused	Percent Drakes	Sex Ratio Samp. Size
Montana									
Hi-Line	16,500	67.8	1,123	15,900	77.9	815	15,900	72.5	247
Central	2,717	66.4	992	1,812	58.3	772	2,050	—	—
Yellowstone River	27,431	73.6	1,456	9,465	66.2	142	10,258	62.0	142
Bighorn River	24,296	71.0	1,267	24,968	—	—	21,563	—	—
Totals	70,944	69.7[2]	4,838	52,145	67.5	1,729	49,771	67.3	389
Wyoming									
Platte River	24,975	—	—	8,775	70.3	516	8,880	—	—
Fremont River	31,350	59.4	880	19,040	64.7	616	15,925	63.2	524
Bighorn River	22,565[3]	61.3	2,447	18,718	63.4	1,659	18,718[4]	67.0	1,204
Totals	78,890	60.4	3,357	46,533	66.1	2,791	43,443	65.1	1,728
Colorado									
Northeast	114,190	71.8	2,828	69,678	63.6	826	69,620	57.8	767
North-Central	114,510	—	—	129,273	66.5	841	124,345	69.7	1,020
Southeast	18,293	—	—	34,930	—	—	29,397	58.5	1,836
Totals	246,993	71.8	2,828	233,881	65.1	1,667	223,362	62.0	3,623
Grand Totals	396,827	67.3	11,023	322,559	66.2	6,187	316,576	64.8	5,740

[1] December 19 census not complete for all areas due to poor counting weather.
[2] All percent drake totals are unweighted averages.
[3] December 19 count used to estimate this count.
[4] January 2 count used to estimate this count.

TABLE 2. MALLARD-DRAKE SEASON HUNTER ACTIVITY AND HARVEST, BY STATES—1968–69

Category	Montana		Wyoming		Colorado	
	Per Active Hunter	Total	Per Active Hunter	Total	Per Active Hunter	Total
Permits issued		3,196		2,553		17,161
Questionnaires mailed		3,196		2,512		3,436
Questionnaires returned, %		83.00		84.00		84.00
Estimated total hunters		2,140		2,050		11,081
Days hunted	3.89	8,325	4.02	8,241	3.87	42,883
Estimated retrieved harvest	6.34	13,568	5.24	10,742	3.41	37,786
Ducks per day hunted	1.63		1.30		0.88	
Ducks not retrieved[1]	1.52	3,253	0.44	902	0.46	5,097
Total estimated kill[2]		16,821		11,644		42,883
Crippling loss, %		19.30		7.75		11.90

[1] Adjusted by results of hunter performance surveys.
[2] Includes birds retrieved and cripples lost.

The average number of days hunted was similar among the three states. Success, however, was obviously highest in Montana and lowest in Colorado, and was reflected in both the average seasonal bag per hunter and ducks bagged per day hunted.

Harvest by time of day indicated that 73 percent of the ducks harvested in Colorado were taken in morning hours, and forenoon kills made up, respectively 51 and 58 percent of the total in Wyoming and Montana. The difference between Colorado and the two other states was probably the result of below-zero weather in Wyoming and Montana, which discouraged hunting early in the day. However, severe temperatures appeared to contribute substantially to the higher hunter success in these states.

The level of morning harvest in Colorado followed a pattern normally expected under conditions of the milder weather experienced during the special season. Here, hunters usually had good duck flights only in early morning hours, after which the birds settled down on large reservoirs where they were unavailable.

The total retrieved harvest for the three states was estimated to be slightly over 62,000 ducks. It is believed that, since the questionnaire was deliberately worded so as to request the number of birds (not drakes) bagged, this number includes mallard drakes and all other illegal birds. Likewise, crippling loss, adjusted for each state by hunter performance results, included both legal and illegal birds. The estimated total duck kill, including retrieved harvest and crippling loss, was 71,348 in the three states.

Composition of the kill in terms of legal and illegal birds can be examined through use of hunter performance survey results. Comparison of the number and species of illegal birds shot to total legal birds bagged, permits an estimate that can be expanded to the total kill. These data indicated that illegal birds made up 10.8 percent in Colorado, 5.9 percent in Montana, and 3.5 percent in Wyoming. Thus, of 71,348 birds killed in the experimental area, an estimated 6,030 (8.4 percent) were species or sexes other than mallard drakes. It should be noted that this 8.4 percent is a weighted average and is, therefore, higher than the illegal kill percentage mentioned later in this report. By far the most common illegal bird was the mallard female, accounting for slightly more than 4,000 of the 6,000 illegal birds taken. The remainder were mergansers, widgeons, gadwalls, green-winged teals, and goldeneyes.

Distribution of harvest by season dates followed a normal pattern for the three states, the greatest amount occurring early and tapering off toward the end of the season, according to wing-survey data. Opening weekend harvest varied from 21 to 27 percent, and the four weekends of the season accounted for 60 to 62 percent of the total kill.

Comparison of hunting pressure and harvest during the experimental season, with that of the regular season for the same area, indicates that only about 48 percent of Colorado and Wyoming, and 35 percent of Montana, duck hunters were active during the drake season. Likewise, the special season accounted for 24 to 27 percent of the total duck harvest in the Central Flyway portion of the three states.

Hunter Performance

Hunter performance surveys for Montana, Wyoming and Colorado have been combined into one analysis to conserve table space, yet permit the best possible display of the data. The major drawback in this procedure is that certain information, such as crippling loss and illegal kill, are not weighted in relation to differences in hunter numbers and harvest existing among the three states. Where these items were used to project total estimates in the "Hunter Activity and Harvest" section, weighted state information was employed. The data, therefore, are offered as an overall appraisal of hunter performance in the entire experimental area.

Observations of hunter performance include 61 surveys in Montana, 118 in Wyoming and 138 in Colorado, totaling 317. Surveys were conducted on both private and public lands and for all types of hunting (decoy, jump and pass shooting), but no attempt is made to present this information by these categories.

Hunter performance relating to 1,507 flocks judged by observers to be within range is listed in Table 3. Information is categorized by "legal" and "illegal" flocks, a legal flock being any that contained at least one drake mallard.

Opportunity for hunters to fire at legal flocks during the season was high, since 80.3 percent of all flocks within range were in this category. Almost 90 percent were fired upon in contrast to 17 percent of the illegal flocks. The shooting pattern, therefore, showed a marked degree of restraint by participating hunters and indicates they awaited mallard drakes before firing. Restraint is further demonstrated by 447 of 482 (93 percent) mallard drake-only flocks fired upon, while mallard pairs were fired upon 76 percent of the time. Reluctance to fire at pairs is understandable since the two birds usually fly close together, increasing hunters' chances of inadvertently taking a hen while firing at a drake. However, such reluctance seems to break down somewhat with mixed flocks (drakes plus females or other species), since 89 percent of such groups were fired upon.

Even though hunters demonstrated a desire to shoot at legal flocks, they obviously made some mistakes since 24 of 623 birds (4 percent)

TABLE 3. SURVEY OF HUNTER PERFORMANCE, SPECIAL MALLARD-DRAKE SEASON, MONTANA, WYOMING AND COLORADO, 1968–69[1]

Species	Opportunity to Fire Upon		Flocks Fired Upon		Number Birds Killed[2]	Birds Lost		Illegal Birds Killed
	Number Flocks	Percent of Total	Number	Percent		Number	Percent	
Legal flocks								
Mallard males only	482	31.9	447	92.7	218	32	14.7	0
Mallard pairs	99	6.6	75	75.8	37	11	29.7	3[3]
Mixed or unknown	581	38.6	522	89.8	341	51	15.0	17[3]
Mixed spp. (mallard males present)	48	3.2	39	81.2	27	3	11.1	4[4]
Total (legal flocks)	1,210	80.3	1,083	89.5	623	97	15.6	24
Illegal flocks								
Mallard female	63	4.2	17	27.0	12	2	16.7	12
Merganser (Common hooded)	42	2.8	10	23.8	5	1	20.00	5
Teals (green-winged and blue-winged)	41	2.7	1	2.4	0	0	0.0	0
Other dabblers (mostly widgeon and pintail)	58	3.8	8	13.8	3	0	0.0	3
Divers (mostly goldeneye)	71	4.7	9	12.7	1	0	0.0	1
Canada goose	1	0.1	0	0.0	0	0	0.0	0
Mixed species	8	0.5	0	0.0	0	0	0.0	0
Unknown (not mallard)	13	0.9	6	46.2	1	1	100.0	1
Total (illegal flocks)	297	19.7	51	17.2	22	4	18.2	22
Grand total	1,507	100.0	1,134	75.2	645	101	15.6	46

[1] Tabulation based on 317 performance surveys.
[2] Includes birds lost.
[3] Female mallards.
[4] Three Green-winged teals and one widgeon.

bagged from such flocks were illegal. Of these, 20 were mallard females and 4 were green-winged teals. This number, however, may have been much higher if hunters had been shooting indiscriminately at legal flocks.

Of much greater concern is that hunters did intentionally shoot at illegal flocks. Some such shooting was undoubtedly due to identification problems but some was deliberate. There is no way to separate the two, but it should be recognized that mis-identification can be corrected in appreciable degree through training and experience while little can be done to alleviate deliberate violations except through vigorous law enforcement. Despite this pattern in hunter performance, and for whatever reason, the number of illegal birds taken was low, being only 46 of the 645 ducks (7 percent) observed bagged in all states. Observed crippling loss was substantially higher than the illegal kill—15.6 percent.

Some understanding of the relationship of hunter performance as influenced by experience and presence of species other than mallards can be gained from information collected in Colorado. Legal flocks constituted 94, 87, and 63 percent, respectively, of all flocks observed by hunters in the San Luis, South Platte and Arkansas valleys of Colorado. In a similar comparison, illegal bags of birds observed taken during performance checks in these three areas were, respectively, 0, 14.9 and 16.3 percent. The outstanding performance of hunters in the San Luis Valley may well be the result of two previous experimental seasons which required specific sex and/or species target identification. The other two areas had never been subjected to such regulations prior to the current experiment. In addition, hunters took a larger percentage of illegal birds in the Arkansas Valley than in the South Platte Valley, possibly because they observed a greater number of illegal flocks. This information is intriguing, but not conclusive, and bears further study.

Comparisons may be made of illegal activity between the mallard-drake and the three experimental teal seasons, although validity may be questionable because of differences in season structure. Thus, illegal flocks were fired at by 25 percent of all hunting parties having the opportunity to fire upon illegal flocks during the drake season, as compared to 41.4, 43.3 and 47.5 percent during the teal seasons, 1965-1967 (Martin and Kaczynski, 1968). Also, 17.2 percent of the illegal flocks were fired at during the drake experiment, as compared to 25.3 percent during the teal seasons. These differences indicate that hunters performed better during the mallard-drake season than during the three experimental seasons on teals.

Hunter Comments

A question in the random survey questionnaire permitted an expression of hunter opinion on the experimental season. Surprisingly, 60 to 65 percent of those responding in the three states took time to offer comments. Of these, 69 to 74 percent commented favorably, expressing satisfaction with the season. Many indicated that it should be continued if at all possible.

Unfavorable comments (26 to 31 percent) related to a variety of the usual complaints. Colorado hunters felt that the weather was too good (it was), while Montana hunters felt that it was too cold (also true). Season dates were judged too early or too late, access problems were reported, and some hunters felt there were too few ducks while other complained of too many shooters. Illness, especially Hong Kong flu, kept 2 to 4 percent of the hunters from participating. Flu reached epidemic proportions in the experimental area during the drake-only season.

Of particular importance, however, were complaints that related specifically to special season regulations. Five to 6 percent of those commenting in the three states indicated some disfavor, including such things as a general dislike of the idea, identification problems, and recommendations that other species, as well as female mallards, be allowed. Less than one percent of the hunters indicated dissatisfaction with the fact that special permits had to be obtained.

The preponderance of favorable comments definitely indicated that hunters approved the season, an impression substantiated by an unusually large number of unsolicited letters praising the season and commending the states and the Bureau on this new approach to waterfowl management. The response was both surprising and pleasing, since the general theme of letters normally received regarding hunting seasons are most often derogatory, offering a complaint of one type or another.

Enforcement Aspects

In general, enforcement personnel, state and federal, involved with the experimental drake season were favorably impressed with hunters' behavior. Most officers questioned expressed a belief that the season produced additional recreational benefits without harming the resource. Enforcement effort during the special season was increased in Colorado and remained similar to that of previous years in Montana and Wyoming.

Law violations handled by state and federal agents amounted to 122 in Colorado, 14 in Montana and 5 in Wyoming. Examination on the basis of violations attributable to drake-season regulations (mallard hens, other species, no permit, etc.), and those that may occur in any type of waterfowl season (early and late shooting, no duck stamp, unplugged gun, no license, etc.) showed the following: Montana, 9 of 14 violations (64 percent) related to drake-season regulations; Wyoming, 4 of 5 (80 percent), and Colorado, 35 of 122 (29 percent).

It is difficult to relate these figures specifically to an evaluation of drake-season regulations, but it is interesting and significant that in Colorado, where an added enforcement effort was made, most of the violations were for other than those relating specifically to the season. Indeed, 70 of the 122 violations (57.4 percent) related to early and late shooting and no hunting license.

DISCUSSION AND RECOMMENDATIONS

Results of analyses and surveys relating to the mallard-drake season in Montana, Wyoming and Colorado indicated clearly that the experiment was successfully conducted. Personnel involved would have welcomed more data on hunter performance and related factors. Also, the weather was not particularly favorable during periodic population surveys. It should, however, be understood that participating agencies gave maximum effort in effecting success of the season, minimizing shortcomings attributable to sparse data and imperfect weather conditions.

Valuable information accrued from the study. Population data indicated that harvest was not excessive, sex ratios were not greatly altered, and the end result was increased recreational use of the mallard resource. In addition, hunters indicated a strong willingness to abide by restrictive regulations as indicated by hunter performance surveys. While it is true that performance was not perfect, for violations did occur, it is suspected that some, and maybe all, infractions may have been of normal occurrence since some hunters willfully violate game laws. It is thus difficult to say how "clean" the drake-only season actually was because there are no comparable performance standards. Of interest is the evidence that hunters improve their performance with experience, in this instance indicated by data gathered in the San Luis Valley where previous sex- and species-specific seasons had been held, but where violations of the regulation were not observed during the drake season. Violations did occur in two eastern Colorado areas lacking similar prior experience.

From the hunter's viewpoint, the special season was gratifying recreationally, as stated. Many hunters who had not previously attempted selective shooting reported that being forced to do so made the drake-only season a more challenging and enjoyable hunt.

Careful consideration of all factors indicate that the drake hunting regulation provides a good mallard management tool, applicable to definite harvest goals in specific locations under certain population conditions. Its most serious drawback is that it cannot allow for honest mistakes even by the most careful hunter, placing him in the position of rationalizing his mistake as unavoidable and thus acceptable. Conceivably, he might become conditioned to violations, and his performance, under restrictive regulations, might become progressively worse. Another alternative is that he may become disenchanted with the regulation to the point of losing interest in participation.

After due consideration, it would seem that management's search for a better, more flexible, hunting regulation has not been ended by this experiment. Rather, it has pointed the direction toward which additional effort should be given. Specifically, a regulation must be sought that will: (1) apply to a variety of situations characteristic of different areas at different times of the year; (2) provide managers with the ability to harvest sexes or species of ducks selectively when these specific groups exhibit low mortality rates or when surpluses exist; and (3) provide hunters with strong incentive to identify and harvest species or sexes managers find to be surplus, but which provides mistake birds which, when taken, penalize him by reducing the allowable kill. He should not be forced unwittingly to violate the law. Such a regulation, which might well be the "point system bag", was tested extensively in the High Plains Management Unit of the Central Flyway during the 1969-70 hunting season. Final results are not available at this writing (3/15/70).

The following recommendations suggest guidelines for conducting hunting seasons based on mallard-drake regulations:

1. The hunt should be conducted in areas with a minimum of other species present. A wintering population of about 90 percent mallards would offer a rough rule of thumb.

2. Before such a sex-selective hunt is considered, population information should indicate a preponderance of drakes with a high survival rate.

3. The hunt should be for populations on terminal wintering grounds, restricting hunting effects to a definite population segment rather than a series of populations moving through the area. Mallard-drake hunts should be scheduled after December 1.

4. Intensive information-education efforts should always precede mallard-drake seasons.

5. Strict law enforcement should be conducted during the season, leading hunters to realize that mistakes will not be tolerated.

The participating state game and fish agencies of Montana, Wyoming and Colorado are pleased to have conducted this experimental season, and feel that investigations of this sort are needed to examine alternatives leading to improved management of the waterfowl resource.

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Wednesday Morning—March 25

Chairman: MAX SCHNEPF

Editor, Journal of Soil and Water Conservation, Soil Conservation Society of America, Ankeny, Iowa

Discussion Leader: JAMES T. FLOYD

Chief of Information and Education, Florida Game and Fresh Water Fish Commission, Tallahassee

CONSERVATION COMMUNICATIONS

REMARKS OF THE CHAIRMAN

MAX SCHNEPF

Good morning, and welcome to this technical session on Conservation Communications.

If our program this morning has any single theme or purpose, it is perhaps to emphasize the basics of Conservation Communications, and to put Conservation Communications in a contemporary context.

Today, as never before, conservation communicators have an opportunity to address millions of people in this country, people who were heretofore unconcerned about what use we made of our natural resources, or who were totally indifferent to our conservation message.

Now, however, they suddenly have hanged their emotions on the peg *Conservation* and they want very much to hear what we in the natural resource business have to say.

Our challenge, I think, is not only to capitalize on this current tidal wave of public concern for conservation, but to sell conservation in a highly palatable manner, and thereby win and sustain the loyalty and support of the public for conservation.

THE ECOLOGY OF THE NEW CONSERVATION

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When the very first settlers came to the region around the tip of Lake Michigan in the early 1800's, they found much of the land

[1]Professor and Chairman.

covered with "oak openings," or savanna—a striking combination of scattered, mature trees amid prairie patches, the whole array appearing, in the eyes of one early observer, "like so many old orchards" (Hoyt, 1960).

The trees were principally bur oaks, their characteristic thick bark protecting them uniquely from the fires that raged over the prairies each year. When the fires were stopped by the settlers, a rapid change took place in the oak openings: they became filled with dense stands of oak saplings. But surprisingly, the new oaks were not burs; they were largely blacks. Frequently a pure stand of black oak would spring up amid widely spaced bur oaks even though there might not be any mature blacks for miles around. Some early observers attributed this black oak irruption to a mass seeding of the openings by flocks of passenger pigeons. Each bird was presumed to have carried a single black oak acorn across the prairies to the bur oak grove and dropped it, in concert with his fellows. We now understand that no such charming an explanation is necessary. The black oaks had been there all the time, growing as brush or grubs among the prairie grasses, suppressed by annual fires. When the fires stopped, the black oak developed swiftly into tall, mature trees, gradually shading out many of the open-grown bur oak veterans (Curtis, 1959). Today a prairie grove with an intact ground layer is the rarest plant community in the Midwest, yet there are more oak forests than there were in 1800.

I cite this bit of ecological history because it may help us to understand, I believe, what is happening, and what may happen, in the area of what has been called conservation information and education (I & E).

Since the 1900's the American conservation landscape has resembled a savanna. Here and there on a broad prairie of indifference you could identify scattered bur oak individuals, organizations, and agencies, their tough hides protecting them from annual fires of covert carelessness and overt retribution. Now, with breathtaking scope and velocity, the scene has changed. The oak openings of conservation today are thick with saplings. And these saplings are a different species, springing from submerged roots, displaying a distinctive foliage. This much we can see. What lies ahead is problematic. Will the black oak environmentalists grow straight and tall to form a dominant forest, shading out the bur oak veterans? It may indeed be that the militant ecology movement is leading squarely to a broad rearrangement of basic social and economic institutions, as Pekkanen writes (Pekkanen, 1970). Clark, on the other hand, says environmentalism offers nothing really new, and that we had better get back to fundamentals (Clark, 1969). So, will the new cohorts succumb to renewed fires of convention, leaving only the old, gnarled sentinels of concern? Or could we see emerge a unique community of symbiotic relationships between old and new, exhibiting heterosis—hybrid vigor.

If those of us in environmental communications and education are to continue to contribute effectively to the emergence of a broad ecological conscience, it will be helpful if we speculate sensibly about possible answers to such questions as I have posed. But before we can do so, we must ask several more. What characterizes the "new conservation"? Who is the "new conservationist"? What was responsible for his irruption? And then, finally, where are we all going?

THE NEW CONSERVATION

In another paper (Schoenfeld, 1969) I have gone to some lengths to delineate the differences between the old "conservation" and the new "environmentalism." While some differences may be more apparent than real, others are quite distinctive. They may be summarized as follows:

In terms of its *scope*, the new environmentalism attempts to be all-encompassing. Whereas yesterday we tended to treat soil conservation, water conservation, forest conservation, wildlife conservation, and so on, as separate units, today we try to understand and explain the ecological unity of all man-land relationships. In terms of its *focus*, then, the new environmentalism is man-centered. That is, our primary concern has shifted from the survival of remnant redwoods and raptors to the survival of nothing less than the human species itself. At the same time we are not so much concerned about quantities of natural resources as we are about the quality of the human experience. "Conservation used to be merely a hobby practiced above the 10,000-foot level by a few eccentrics," Bylin (1969) has said. "Today it has become a universal synonym for human survival."

In terms of its *locus*, while the old conservation conjured up images of open country, the new environmentalism incorporates the pressing problems of the city. In terms of its *emotional underpinnings*, the new environmentalism is based more on fear for man's tomorrow than on a love for nature's yesterday. Thus today's "preservationist" is not a lover of wilderness; he is one who fears the four horsemen of "conquest, slaughter, famine, and death." In terms of its *political alliances*, the old conservation was linked to such orthodox causes as depression pump-priming, national defense, and outdoor recreation; the new environmentalism, on the other hand, encompasses the hitherto unmentionable demands of the neo-Malthusians for populaton control.

It is in its *basic cultural orientation,* however, that the new environmentalism differs most strikingly from its antecedent, conservation. The latter, in the words of one patron saint, stood clearly for economic development, for the infinite goodness of American "progress" (Pinchot, 1910). But environmentalism reflects a growing suspicion that bigger is not necessarily better, slower can be faster and less can be more. As Pett has written recently, "More and more people actively seek to conserve a tree, a lake, a view. More people question the Biblical injunction to be fruitful and multiply. More people question the old American faith in growth and expansion, and suggest that maybe what we don't need is another factory in town. More middle-aged people have begun to sense the validity in the young who scorn the plastic life" (Pett, 1970). Upon viewing a new smokestack, millions of Americans used to see a sign of progress; now they see a sign of pollution. The mammoth motor car used to be a symbol of affluence; now it is a symbol of effluent.

If anything surely marks this revolutionary nature of both the rise and rationale of the new environmentalism, it would be the recent words of a Republican President of the United States, telling us that "wealth and happiness are not the same thing," that now is the time to "make our peace with nature," and that we must "measure success or failure by new criteria" (Nixon, 1970). Not even F.D.R. would have said that!

If it all sounds suspiciously like echoes of Thoreau and Leopold, it only suggests that the black oaks were indeed here all the time, waiting only for a favorable concatenation of events to vault the philosophies of a Walden or Sand County muse into a State of the Union address.

THE NEW CONSERVATIONIST

Now, who is the "new conservationist"? He comes, of course, in pellage of many colors, and it will take years of sociological research before we can arrange him by phylum and genus. But on the basis of subjective analysis it seems to me we can take note of at least three types.

First, there is the old conservationist who has acquired an awareness of the global nature of what once seemed a parochial problem, an understanding of some new points of entre toward constructive action, and a vastly heightened sense of urgency. He is the erstwhile County Conservation League member who has shifted his emphasis from prairie chickens to air pollution. He is the Sierra

Clubber who has added "human survival" to his agenda. He is the Park Service specialist who is trying to take his parks to the people instead of vice versa. Witness the words of the National Wildlife Federation: "Conservation is no longer just the story of vanishing wildlife and vanishing wilderness areas. There is a new urgency in the word today. Suddenly, as we stop and look at our total environment, it has taken on the meaning of human survival" (Zinn). Yet by no means have all old conservationists boarded wholeheartedly the ecological express. After all, like bur oaks, they have survived by resisting the fires of their surroundings, and they see the present situation as but another momentary diversion. We can expect to see them dotting the landscape indefinitely, lending perspective if not punch.

The second distinct type of new conservationist is a "she." But she is not the proverbial "little old lady in tennis shoes" who has graced the ranks of the bird watchers. She is the sharp young housewife whose automated kitchen has rendered her underemployed and who, in looking around for new worlds to conquer, has discovered the environment and its problems. Through such local fire brigades as a Capital Community Citizens and such national organizations as the League of Women Voters she is lying down in front of bulldozers, accosting legislators in their lairs, baiting conservation bureaus, plumping for bond issues, and in general raising polite hell in the best traditions of American populism. She may even propagandize her Rotarian husband.

Perhaps the truest type of new conservationist is the committed college student who is making his presence felt through such activities as a national campus environmental teach-in. He is indeed a new breed in several respects. As a matter of fact, he is several breeds. At the far left is the true radical who sees environmental degradation as the Achilles heel of capitalism, and hence is riding conservation as his current hobby-horse toward revolution. For this "Mao-now" clique, the mouthy revolutionaries who profess to see some social Nirvana beckoning at the end of a trial of brutal confrontation, real conservation is the least of their concerns (Milwaukee *Journal,* Oct. 6, 1969). At the opposite end of the spectrum is the professional student in one of the resource management fields who is doing what comes naturally to him, in orthodox ways yet with early verve and elan. They are saying to their elders, in effect: "It is you and your system that have brought about the environmental mess which is making much of the world unlivable. Now, before it is too late, let us have a say about the profession and the planet that we are to inherit" (Cahn, 1969). It is the students occupying the great middle ground of the movement who are unique. They represent everything from art to zoology. They come from Boswash and Grover's Corners. They have long and short hair, full pocketbooks and lean. Their folk heroes may be George Wallace or Bertrand Russell. They may know everything or nothing about the hydrologic cycle. Yet they have certain attributes in common: a neo-Transcendental feeling for the man-land community, a revulsion for the excesses of a technological society, a suspicion of the establishment, a sense of so little time, and a consuming desire to act, now, and the devil take anybody who doesn't. As a Washington observer reports: "No group is more concerned, or more disgusted, about the growing destruction of the American environment than the young. First, they haven't been around long enough to become accomplices in the pollution violence, assuming they might want to. Second, the young are more concerned about saving the environment because they will be the worst casualties if it is not saved. Although many student environmental activists are using little more than the scream method, others are digging in for a long siege by finding out about the economics, the technology, and the politics of environmental problems" (McCarthy, 1970). The young eco-activist, in sum, is the same disenchanted American who came over in steerage, who pushed into the West. He is the same American who took off with a song for Bull Run, Belleau Woods, and Buna. Now the environment is his only frontier left, and the eco-war the only one he wants to fight. He insists on doing his own thing. He is willing to cooperate with the old-line conservation organizations, but he lives in fear of being coopted by them—that and the fear that a fatal public paralysis will render his cause impotent. He may call his mission impossible, but he still has an innate faith in the future, if only we act in time.

In essence, the practitioners of the old conservation have been exponents of the art of the possible. The new recruits see environmentalism as the science of the impossible.

THE NEW ENVIRONMENT

Now, what has triggered today's mass irruption of the new conservationist? Historians, with the perspective of 50 years, have never been able to agree on the factors responsible for the so-called "first wave" of conservation at the turn of the century. Hays (1959) says conservation had its origin in a concern for scientific management and efficiency among a relatively small group of planners and technicians. Bates (XLIV), on the other hand, argues that the movement was a grass-roots upswelling of many passionate people versus the special interests of the day. From current experience, perhaps we can see that both of these explanations have their points.

Unquestionably today's environmentalism has its roots in the labors of a handful of leaders: particularly ecologists turned writers like Leopold, Carson, Darling, Commoner, Allen, Dasmann, and Ehrlich; and politicians turned ecologists like Udall, Nelson, Muskie, and Jackson. Unquestionably, too, the movement is taking on all the dimensions of a somewhat spontaneous general revolution in thinking, if not in action. In this transmutation of environmentalism from a learned cult to everybody's cause, many factors have surely been significant.

Gaus (1947) once pinpointed the critical elements in the ecology of any institution or movement as "people, place, physical technology, social technology, wishes and ideas, catastrophe, and personality." A brief examination of these factors at work in the America of the latter 1960's may illuminate the origins and development of our new ecological conscience.

The American *people* in 1970 are simply ready for the conservation message in a way they have never been before (Schoenfeld, 1968). They have been on a decade-long emotional binge that has left them both frustrated and pent up: multiple assassinations, civil rights confrontations, campus unrest, Vietnam, cost of living, crime in the streets—as F. Scott Fitzgerald once described a somewhat similar era, "all gods are dead, all wars fought, all faiths in man shaken." Little wonder that Americans are turning to their original font of solace, inspiration, and challenge; to nature, its ways and wise use. Countless individual leanings toward environmental concerns have been reinforced by the sense of community growing out of a timely Gallup poll, which indicated that conservation now is everybody's "thing" (Chaney, 1970). Another key social force is that ever-growing army of the young: "Modern technological society postpones the age of work and responsibility. Many of the young must be trained through high school, university, graduate school, and apprenticeship. In the meantime, the student can afford the luxury of a strictly ethical view of the world—uncluttered by those compromises and deals that are the glue of any society" (Knebel, 1970). And in this long meantime, the student moralist is having a profound impact on politics—and on pollution abatement.

Yesterday's environmental degradation was usually over the hill and far away—in somebody else's dust bowl, somebody else's Echo Canyon, somebody else's boundary water canoe area, somebody else's forest. But the place of today's environmental degradation is where we live—in the foul air, rancid water, and clogged arteries of our cities. Millions can see, smell, taste, and hear the problem now: "The environment may well be the gut issue that can unify a polarized nation in the 1970's. It may also divide people who are appalled by the mess from those who have adapted to it. No one knows how many Americans have lost all feeling for nature and the quality of life. Even so, the issue now attracts young and old, farmers, city dwellers, and suburban housewives, scientists, industrialists, and blue-collar workers. They know pollution well. It is as close as the water tap, the car-clogged streets and junk-filled landscape—their country's visible decay" (*Time,* Feb. 2, 1970).

Continuing along the Gaus outline, the *physical technology* of the 60's has been responsible for our current state of mind in a striking way. It has vaulted us to the moon, and thus has given us renewed faith in our capacity to conquer, but from our new vantage point in the cosmos we have also been struck as never before by the fragile, finite character of Spaceship Earth. By invading one frontier we have rediscovered another, the state of harmony between man and land. So we are appalled that the combined governmental expenditure at all levels on natural resources, including agriculture, amounted to less than $7 billion dollars last year, while we spent $9.7 billion for tobacco, $15.5 billion for liquor, and $5 billion for cosmetics (Hartzog, 1969). We are particularly appalled because the technological eye of the decade—the TV camera—has brought environmental degradation right into our livingrooms with stark realism. Along with scenes from Selma and Saigon, we have squirmed at scenes from Santa Barbara and Sanguine.

Developments in the *social technology* of the 60's have likewise played a part in the rise of eco-awareness and eco-action. The voice of the mass media has become increasingly dominated by a coterie of magazine editors and TV commentators, so when these gatekeepers of communications have seized on pollution as the big story, the snowball effect has been dramatic. Not in our wildest dreams as conservation I & E people have we thought that *Time, Life, Newsweek, Look, Fortune,* and *Sports Illustrated* would ever devote simultaneous issues to ecology; yet that is exactly what happened earlier this year, accompanied by electronic voices like those of Walter Cronkite, Eric Sevareid, John Chancellor, David Brinkley, and Ed Newman, not to mention Arthur Godfrey, Eddie Albert, Johnny Carson, and Pete Seeger.

(What got the media onto the population-pollution story so compellingly? It is probably not without significance that the big media messages in this country originate from our two most populated and polluted places—New York and Los Angeles.)

The media calls to reveille might still have met with no response were there not throughout the land a spirit of rank-and-file activism, particularly on the part of the young. Whether you call this spirit a new "participatory democracy" or a throw-back to the Boston Tea Party, the result is the same—a confidence in the tactics of confrontation. Americans have witnessed the subtle yet sure effects of civil rights marches and peace moratoria, they have seen the results of brass-knuckles conservation as practiced by the Environmental Defense Fund, they have watched a David like Ralph Nader take on the Goliath auto industry; and now they are ready to practice the same guerrilla warfare on a broad scale for a cause that is easily identified with all the better angels.

In their *wishes and ideas*, all the great ecological philosophers have always expressed frankly the belief that true conservation would require a profound change in American values. But nobody really listened. We went right on basing our practices on economics at the expense of the esthetic and the ethical. Now, however, the youth of America are beginning to get the real message that was there all the time. It fits right in with their basic anti-materialism, anyway. Probably nothing so accounts for the current popularity of conservation on our campuses as this marriage of orthodox ecological doctrine with the innate iconoclasm of the young. In environmentalism there is no generation gap: "It is possible that ecologists can eventually stir enough people to an emotion as old as man—exaltation. Ecology, the subversive science, enriches man's perceptions, his vision, his concept of reality. In nature, many may find the model they need to cherish" (*Time,* 1970).

Social scientists are saying that only once before in recent American history has there been so profound and rapid a change in American public opinion as the rise of eco-understanding. That was the flip-flop from isolationism to interventionism occasioned by Pearl Harbor. So it is all the more striking that the emergence of ecology as everybody's "bag" has not been triggered by a single *catastrophe.* We have had, in recent months, our Everglades, our Storm Kings, and our Alaskas, but these have not been continental disasters. Yet this is just the point. Today's catastrophe is not a single clap of thunder, it is a pervasive drizzle, and thus all the more far-reaching. There is literally no dry spot. Millions can sense that swelling population, rampant technology, and fragile biosphere are on a collision course, threatening the quality of the human experience if not the very survival of man.

No single *personality* dominates the ecology of environmentalism as T. R. and F. D. R. dominated the first two waves of conservation. President Nixon has tried to preempt the movement, but it is doubtful that he will be able to make his image stick. Nor will any one scientist or interpreter likely run away with the show. Rather, the new conservation is characterized by the diversity of its exponents and troopers. It is, in itself, a complex ecosystem, and this speaks well for its stability and longevity. "Few of the (conservationist) troops know who their generals are, or even their sergeants" (Margolis, 1970). Perhaps one day a Bill Mauldin will capture in cartoons the personality of this new-style World War III, and it will not be a Patton, but the peace-time equivalent of G. I. Joe.

Out of the changing people, places, technology, aspirations, conflicts, and personages of America at the turn of the decade has come a new spirit and a new agenda. The spirit is an embryo ecological conscience. The agenda is clean air, clean water, open space, zero population increase—an illusive yet essential entente between modern man and the only home he has. In short, we sense that "we have mortgaged the old homestead and nature is liable to foreclose" (Ritchie-Calder, 1970). Or we may sense that "the real specter that pollution casts over man's future is not, perhaps, the extinction of *Homo sapiens* but his mutation into some human equivalent of the carp now lurking in Lake Erie's fetid depths, living off poison" (*Newsweek,* Jan. 26, 1970). Dubos speculates that man can indeed adapt to almost anything, even the dirt, pollution, and noise of the city. And *that,* he says, would be the real tragedy, worse than extinction—a progressive degradation of the quality of the human animal (Dubos, 1970).

TURMOIL AND TRENDS

Will we make it? What will our prairie grove look like 30 years from now? Will the black oaks of the new environmentalism be the dominant species, the old burs rotting and fracturing in the shade? It could happen. After all, the veteran resource management agencies and organizations are not particularly ecological in their orientations. On the contrary, they tend to espouse unilateral programs and cultivate special-interest clientele. For example, the Soil Conservation Service supports the drainage of the same wetlands the Bureau of Sport Fisheries and Wildlife seeks to preserve, the Corps of Engineers would innundate a national park without batting an eye, the Forest Service has never been much of a custodian of wilderness, the Bureau of Outdoor Recreation already represents yesterday's patrician focus, and "the farm-subsidy program encourages the misuse of toxic chemicals, one-crop farming that destroys ecological diversity, and mechanization that drives jobless rural laborers into packed cities" (*Time,* Feb. 2, 1970). If these agencies and their publics are so inflexible as to resist coordination, they may well wither. Indeed, the white light of publicity we have all caused to fall on conservation can hasten the demise of the organization that temporizes in adjusting to changing times, changing priorities, and changing audiences. As Pitzer says, "We can make no greater mistake than to shrug off the ideas of the young as foolish and impractical. It will be at our peril that we encourage them to point the way to a better world, only to tell them later that nothing can be done about it. Conversely, youthful idealism and energy represent a potent force for good if only we can give it productive and creative outlets. We must be willing to change" (Pitzer, 1970).

On the other hand, our prairie grove of the year 2000 may be punctuated only by the old bur oaks. It could happen. The new environmentalism could turn out to be only a passing fad, like hula-hoops. Americans are given to switching issues in mid-stream. Whatever happened to United Nations Day? Some are already saying that while "the conservation and proper use of natural resources may be a fundamental problem, that should not divert the nation's attention from the problems of social justice and racial equality" (*Time,* Feb. 2, 1970). Writes Beyers, "I particularly note a growing resentment among blacks that environmental interests may represent a white 'cop out' from pressing issues of race and poverty" (Beyers, 1970).

Or perhaps the sonorous voices of gloom and doom will render us absolutely insensitive to any possibilities for progress. The fallout scare of the 50's produced precious few underground shelters. You already hear the complaint: "We have read the statistics of degradation, and heard them, and flinched at them, and even wearied of them; statistics that boggle the mind, and that are repeated like clockwork every year, inching higher and higher. It takes something really different—like a river so filthy it actually catches fire—to engage our jaded attention" (Allen, 1970). The Jeremiahs of the movement could indeed have such a narcotic effect on public opinion that masses of Americans will "tune out." Taffler has already written of the danger of "future shock" which forces us to crawl into our shells in utter despair (Toffler, 1970).

The new recruits may also just plain run out of gas "when the bandwagon stops coasting and has to be dragged up the hills" (Chaney, 1970). Or they may climb off "when the limits of present ecological expertise become apparent" (Houseman, 1970).

There is another danger: If the eco-activists on college campuses become dominated by neo-Fascist hooligans, irreparable damage will be done to the new environmentalism. Riots will repel, not attract, support. The single thing more dangerous to man than environmental pollution could be the growing clamor over the issue, according to Theobald. Intense efforts to change the established social order could produce a reactionary backlash that would pit man against man in a most unecological fashion (Theobald, 1970).

Hopefully there can be a third broad possibility—a welding of old and new. In many cases today, what was once a natural prairie grove is dominated neither by bur oaks or blacks but by thrifty white oaks. These white oaks exhibit some resistance to fire as well as a tolerance of shade. Perhaps we will likewise see emerge a lay ecologist with all the lore and savvy of the old-line conservationist and all the heightened idealism and sense of mission of the new environmentalist. We need both, as Margolis has pointed out. If the traditional conservation organizations had just spent all their time worrying about ecology, fewer woods and waters would have been saved in recent years. If the new conservation is to succeed it will be through the mainstream of going groups, he says, yet groups that grasp the technical and radical rules of the new ballgame (Margolis, 1970). We must seek a conservation movement old enough to have traditions and young enough to transcend them.

In this regard it is particularly intriguing to see the hesitant yet healthy emergence of an eco-industry. We are beginning to hear of "ecological stocks" pacing the New York exchange. If Americans can learn to make as much money out of environmental husbandry as we have out of environmental exploitation, the problem will be solved with some dispatch. It will be particularly important that the private sector lend a massive hand, because environmental reclamation is not a nice, neat governmental package like a Manhattan project or a lunar landing. It is more like the Depression or World War II in its breadth and diversity. True, "attacking environmental ailments has a special appeal for Americans; in large part they are technical and mechanistic problems that involve processes, flows, things, and the American genius seems to run that way" (*Time*, Feb. 2, 1970). So a typical American response to a series of crises in a given field has been to smother it with money and expect solutions to appear promptly. "But environmental-quality problems do not lend themselves to this kind of approach. There is no single goal toward which technology, economics, and management can marshal their forces. Environmental pollution and degradation appear in many forms and many places, and successful programs of prevention and amelioration will be difficult and many-sided. The complex scientific-engineering-economic-political-management-educational programs for cleaning up the air, the water, and the landscape will have to be tailored to meet different situations in various regions of the country, in various industries, and in various social conditions" (Fisher, 1969). Furthermore, "practical ways to resolve the obvious conflict of economy and environment are far from clear for a free society. There is real danger that the current emphasis on the importance of ecological balance will obscure the importance of economic balance." Certainly we cannot go back to some Medieval womb. We must start with what we have and work forward.

One way to make the economic system accountable for the damage it does to the environment is to work the costs of avoiding environmental damage right into the pricing system. As higher prices then begin to show up for goods whose manufacture damages the environment, the mass re-examination of values necessary to the beginnings of broad environmentalism may begin to take hold. (Anderson, 1970). In a real sense the revolution in the way we view things may already be happening. That is, we may already be seeing a mutation of bur and black oaks, so to speak. For a particularly perceptive analysis of this new "counter-culture," I quote from Edward Kern in a recent issue of *Life*:

> Gradually but imperceptibly, the ties that held people to the old ways of thinking are loosening and new ties are being formed to a new outlook. It is often said that we are in the midst of a social revolution. The truth, probably, is both something less and something considerably more. There is a social revolution, which seems only to have begun; but there is also something more profound—a revolution of consciousness. Conceivably it could alter the whole aspect of America and produce a new species of American. If it does, this would not necessarily doom the existing structure of institutions or the present forms of political life. The impersonal pressures of advancing technology are certain to have a great effect on these, and trends point to larger and more complex organizations in the future rather than to the simplicities of the countercultural commune. But organizations, from one standpoint, are social vessels which are designed to contain humanity. What matters most is the quality of human consciousness that is poured into them, and time may prove that it is possible, after all, to pour new wine into old bottles (Kern, 1969).

THE BIG TEST

In summary, what is really on trial in the tension zone of the '70's is not a movement. It is the processes of American education, American democracy, and American culture.

Can education go beyond a mere imparting of ecological facts to *inculcate a will and a way for the individual and collective solution of environmental problems?*

One difficulty in changing attitudes toward environmental exploitation is that attitudes toward the environment are tied to over-riding values which are highly resistant to change. There are many basic values in Western culture that support environmental destruction—the Abrahamic concept of land, for example. But there are also basic values which support environmental conservation—the survival instinct, for instance (Pyron, 1970). We need not be discouraged. When threatened, man is capable of almost anything. Today, nothing less than our survival is at stake. The problem is getting enough people to realize this blunt truth while there is still time to act (*Look*, Nov. 4, 1969). Yet fear will not be enough as a long-term motivating factor. We need love: "The one thing needed to recover and preserve the American environment is a reverence for earth—paying fair homage to the soil, the winds, the waters, and honoring the very spirit of their places" (McCarthy, 1970). "Whatever the theme, the practitioners of conservation information and education have one easy test of their solvency today: If they are not drawing fire from the flanks, what they are putting out is not getting to the heart of the problem. There is simply no easy compromise between the old economics and the new ecology" (Schoenfeld, in press). All of this suggests to us purveyors of ecological information and education that if we are to be "in tune with the dynamics of the age," which J. A. R. Pimlott once described as the essence of public relations (Schoenfeld, 1963), then we had better desist from merely husbanding our particular organizations and agencies. We must "get with" producing an enlightened citizenry that will, in the words of the author of the Environmental Quality Education Act, understand "man's unquestioned interdependence with nature," appreciate that "scientific advance is not always synonymous with progress," and "use an ecologic filter when making important policy decisions" (Nelson, 1970).

Can industry and government move beyond mere tokenism in their response to environmental degradation, with imaginative programs that demonstrate the relevancy of capitalism and democracy to gut issues?

The political and economic conflicts growing out of militant ecology will be enormous, Gerlach predicts: "The question is whether or not those responsible for damaging the environment will be wise enough and adaptable enough to see what is being demanded of them and accommodate to it. The key to holding us together is how business and political leadership responds. Confrontation is unavoidable because the environmental problem does not lend itself to tokenism—too many people are aware; too much is seen; the crisis is too great. The strongest argument for optimism is that the leaders of the movement are the educated people who know where the levers of power are and who are willing to use them short of taking to the streets" (Gerlach, 1970).

Can our society create a new consumerism that demands less goods and gadgets, and more capacity to preserve, protect, and defend our natural heritage?

The answers to most population-pollution problems can only be found in trade-offs. If something undesirable is to go, something desirable may have to go as well. You can't air-condition your home, for example, unless somebody is burning fossil or nuclear fuel to produce electricity. It is the making of sophisticated choices, then, the rendering of subtle value judgments, that is the essence of conservation today. Our first task is a good old American goal—to restore more freedom of choice. The consumer who *wants* to conserve must be given the *chance* to conserve—in the marketplace, in his home, at the ballot-box. And then we in positions of leadership will be increasingly put to the test of outlining the options in an unemotional, objective, self-disciplined manner. "If expertise comes wrapped in pretentiousness, over-emotion, and intellectual dishonesty, we only add moral insult to environmental injury" (*Scientific Res.,* Sept. 1, 1969).

The United States simply must start inventing genuine "political, economic, and intellectual processes that will give us, as a society and as individuals, more real choice about how we live" (Bowne, 1970). These are not the words of a Berkeley fanatic; they are the words of *Fortune* magazine. We must, in short, begin to engage, once and for all, in ecological thinking. As someone has said, we cannot ever do only *one* thing. When we try to pick out anything by itself, we find it inexorably connected to something else. And we cannot do everything all at once. We must rid ourselves of the mentality of the 30-second commercial and the 30-minute comedy. Environmental housekeeping is a never-ending serial.

Put another way, what is really at stake in the '70's is us. We must demand of ourselves the same high quality we demand of the environment.

What is necessary is an unflagging respect for the world, and for man. For dissent and diversity. For those natural amenities that husband the prosperity of the human spirit. For those human institutions that protect freedom of choice. If we simply regret what we have done, we must regret that we are men. It is only by accepting ourselves for what we are, the worst of us and the best of us, that we can hold any hope for the future (Hochbaum, 1970).

To paraphrase John Gardner:

We will not find our way out of our present troubles until a large number of Americans acknowledge their own special contribution. The path to recovery will call for courage and stamina. Our salvation will not be handed to us. If we are lucky we will have a chance to earn it. Many things are wrong. Many things must be done. There is no middle state for the spirit. It rises to high levels of discipline and decency and purpose—or it sags and rots. We must call for the best or live with the worst (Gardner, 1970).

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DISCUSSION

DISCUSSION LEADER JAMES T. FLOYD: Thank you. I think Dr. Schoenfeld has really done a job in identifying this new problem.

MR. DOUGLAS WADE (Northern Illinois University, DeKalb, Illinois): Mr. Moderator, I would like to ask Dr. Schoenfeld what he sees as a whiplash return at the present time among our institutional organizations? Apparently this is occurring. How do you interpret this? How do you get around this whiplash?

What are the motivations needed to keep us moving forward on these movements?

DR. SCHOENFELD: I think that is a superb question, Mr. Wade, and if I really knew the answer I would be working for Batten, Barton, Durstine & Osborn at $50,000.00 a year, of course.

The new motivation, the "guts" motivation, that we are seeing all of a sudden is fear, as I sense it.

The new environmentalism is based on fear for human survival. This is the dimension that we have not really seen in conservation, and what little we know about motivation would suggest that this is a good short-term energizer but a poor long-term base, and that we are going to have to replace fear with love; that the only thing that will sustain this movement is a rebirth of respect for land; love of the land and love of fellow men.

If we remain on this Jeremiah-type of "kick" I think we will run out of gas, so to speak. I am banking that we will see it evolve into a bona fide ecological conscience.

DISCUSSION LEADER FLOYD: Do we have any other questions?

MRS. NAN S. STORKE (Wheaton, Illinois): Mr. Moderator, I think I represent that young housewife you are talking about. My husband is even in Rotary, and I am bringing pressure to bear on him.

I have come into this meeting purely as an interested citizen. I wish it had been better advertised.

I appreciate your remarks about fear, love, and respect, because I do think I personally have been motivated by that fear, and a latent respect for nature and our environment has been aroused in me. I trust that it will be a long-term thing, and that I at least will convey it to other housewives.

Also, the comments on the potential of this housewife and her mechanical kitchen are appreciated.

DR. SCHOENFELD: I am delighted that we have a living, breathing specimen. (Laughter)

And, of course, one of the very interesting reactions about this whole thing is the reaction of those of us who say that we have been in this business a long while. You know that for years we have been saying, "Now, if we could just get people to listen, boy, what wouldn't happen!"

And now the reaction of many of the old bur oaks is, "Who the heck are all these troopers? What are they doing in the act? They don't know the ground-rules. They don't know the literature. I am not sure we really want them along."

I think we will overcome this shock before long and issue our membership cards, collect our dues, and get off to the wars.

And if we do not, these housewives will simply take over, believe me!

DISCUSSION LEADER FLOYD: Are there further questions?

MR. STANLEY J. KERR (Denver, Colorado): Mr. Moderator, I have two questions to address to Dr. Schoenfeld.

First, how do the existing organizations avoid being swamped? What steps do you recommend that they take in order not to be swamped by this new mass movement, just sheerly being overwhelmed by the numbers of people involved?

And secondly, what steps do you recommend that we who have been active in this movement take to maintain interest after April 22nd among the young people who are so stimulated?

DR. SCHOENFELD: If you will pardon my saying so, what you have just verbalized is this feeling that I mentioned. You are more concerned with an old organization surviving than you are with growing, and I say this is nonsense. In a sense, you have to get on the bandwagon.

What are you worried about all these numbers for? How can you be swamped?

For years you have been saying, "Gosh, if people would only join!"

Now you are saying, "What am I going to do with all these troops?"

For God's sake, just issue some operation orders. You have had them in your portfolios for years. Trot them out. Tell these people where the front lines are and what are the objectives. If we are really good we have these plans.

Secondly, I do not personally think there is going to be any problem with sustaining momentum provided the establishment reacts. This, to me, is the $64.00 question. Will existing organizations change to accommodate this new spirit which is qualitatively different in ethics and in tactics? Will government change? Will industry change?

This is what will turn off this new generation. This is my guess, anyway. And when they get turned off, this becomes very dangerous.

What has kept this country alive is responsiveness, and I am betting on our system that we can continue to be responsive; but the pace of that response will have to accelerate. There is no question about it.

MR. ART HULETT (Bureau of Sports Fisheries and Wildlife, Washington, D.C.): I have been interested in the remarks here this morning. My concern is that I see a "scattergun" approach to the solutions of any problems affecting our environment; and I am concerned that there does not seem to be evolution of strong leadership anywhere in the private sector or even in government that would direct the energies of all of the many, many little guerilla bands that are off fighting their own little wars towards a coordinated battle; towards a coordinated army that will help win the war against pollution and against preserving our environment.

Do you see any beginnings of organization pulling these scattered groups together?

DR. SCHOENFELD: Let me make just two comments on that, Mr. Hulett.

Yes, I do see encouraging signs of coordination at the presidential level in Judge Crane's three-man council, although I personally would think it would be disastrous if we lost our present diversity because, as in any ecosystem, it seems to me the more diverse we are the more stable we are as a long-term movement.

I would just like to say this, though; Do not expect any magic out of these new environmentalists. After all, we professionals have set the pattern for schizophrenia from Washington on down.

Since when was the SCS coordinated with the Bureau of Sport Fisheries and Wildlife? Since when was the Corps of Engineers coordinated with the Park Service?

My God—we have had 60 years to bring this about! Don't whimper if a new generation cannot pull it off in two weeks. (Laughter and Applause)

THE COMMUNICATOR'S ROLE IN RESOURCE DECISIONS

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The January issue of *CF Letter* was devoted to an in-depth examination of the mushrooming student involvement in the struggle for environmental quality. We explored what many campus groups are already doing and the outlook for environmental teach-ins which will be held on over one thousand campuses across the nation on April 22. We posed some questions about the meaning of the growing student crusade for a better environment. And we quoted some of the students involved.

Among the "fan mail" we received from our readers on that issue of *CF Letter* was one from the head of the information section of a state wildlife agency. I want to share his comments with you. He wrote, and I quote:

[1]Private consultant since June 1, 1970.

"I am somewhat dismayed by the inflammatory quotes attributable to some of the students who are in the fight for a clean environment. Their tactics are not the kind we need in this effort. There is already far too much emotion being generated."

He added that some of the quotes we used were "not worthy of the publicity" we gave them. "These kinds of inflammatory remarks are absolutely unnecessary," this information chief wrote.

As you might imagine, I did what most editors would under the circumstances. I promptly reread that issue to see what the fuss was about. I must confess that I found no "inflammatory" quotes. But whether the words we quoted were inflammatory is not really the point; that is a subjective judgment at best. Language that inflames one man might do absolutely nothing for another.

What is important, it seems to me, is the point of view expressed by my "pen pal" in the state wildlife agency. He seemed to be saying that because he believes some words to be inflammatory and emotional, we shouldn't have printed them. And that because he disagrees with the tactics proposed by some newcomers to the struggle for environmental quality, those tactics shouldn't be reported.

It seems elemental to me that if we are to understand what the student movement is all about, we have to know what's happening, what they are doing, saying and planning. We may agree or disagree. But we have a responsibility to tell it like it is. As communicators we do the public, and ourselves, a disservice if we do not.

Whether we like it or not, there are new forces at work in the fight to put an end to environmental degradation, as Dr. Schoenfeld pointed out so well. And we had better understand them.

Not just the young are involved. There is increasing concern among adults as well as students about what is happening to our life-sustaining environment. Environmentalists of all ages are enlisting in the struggle, some in the old organizations we know so well, but many in new coalitions and organizations of aroused citizens.

The "establishment" is under attack—in government, industry, academia and all segments of our society. Established wisdom is under attack. The credibility of government and industry is being questioned. Our system of government, our values and our life styles are being questioned. The priorities of a society which spends billions to put men on the lifeless moon while the quality of life on earth is increasingly degraded and even threatened are being challenged.

There is broad frustration with things as they are, with business as usual, and this frustration is not limited to our seeming inability to stop the pollution of our air, water and land. Our society is disordered and replete with tensions and alienation. Just as we have failed to cope with the problems of urban decay, poverty, race, housing, hunger, crime, drugs, and a war that drains our human and financial resources, so have we failed to cope with the wastes of our general prosperity.

Now, however, despite the innumerable crises which bombard us, the environmental crisis is "in" as an issue. (Or is it precisely because so many despair of solving other crises that the environmental issue has been seized upon by so many?)

Whatever the reasons, for the first time, public and political awareness of the environmental crisis have grown to the point we have long awaited—the time for action. The communicators have sold their story. Newspapers, magazines, television, radio, books—all now fill our minds with news and horror stories of our polluted world. The traditional sources of information about the dangers of pollution—our venerable conservation organizations and government resource agencies—have been augmented, and perhaps even supplanted in some cases, by the popular, mass audience media. News of the environmental crisis is abroad in the land. The few voices in the wilderness from the conservation community have been joined by a chorus.

The public is being inundated in a tidal wave of news about the environment. Some of the popular media's coverage of the environment is perceptive and of high quality. But much of it is old news, rewritten and sometimes updated with a timely news peg. And too much of it simply views with alarm and is content to merely paint the dirty pictures of air and water and land pollution.

This is the stuff that has turned the public on—along with the all too visible evidence of environmental deterioration which surrounds us.

There will be more of this propaganda against pollution. And at times it will appear to be a form of pollution itself—of puffery and political prose demanding simple solutions and quick cures. This is a necessary element in the development of public understanding of environmental problems.

But where do we go from he- ? How do we cope with mounting public desire for a better environment? How do we harness the vast public energy now becoming available to work for a better environment?

Where does the professional conservation and environmental communicator fit in? Do you fold your tent and steal away in the dark of night? Do you fight to maintain your status quo? Do you broaden your own sights and horizons?

As I see it, the communicator's role in environmental decision-making is now more challenging than ever. Elected officials—and the informed public which prods and pushes and supports or opposes them—are now groping for answers. There is a hunger for direction and meaning.

In addition to the "news" and facts and dire warnings of impending ecological doom, decision makers and opinion lenders in our society need analysis and interpretation. They need to know the choices for action. They need to know the alternatives. They need scientific and technical knowledge translated and communicated to them in terms that are understandable to intelligent laymen.

They need to know who the competing interests are and they need to know the competing versions of "truth." They need to know what's at stake in a given resource controversy—environmental costs, money costs, or both. They need to know what the law requires and what the law permits. They need to know what the responsible agencies can and are dong. Or are not doing.

That, in brief, is part of the challenge to communicators in the resource field. You have to give the public the information it wants to make an informed choice. You have to make this information available to the public, to the press, to elected political officials. You have to help the press, the public and the politicians know what questions to ask.

There is another aspect to the challenge facing professional communicators in resource agencies: You have to get the message to the managers in your agencies that the public cares and wants a piece of the action. Increasingly, citizens are asserting their right to be informed, openly and honestly, and to participate in environmental decision-making. Citizens are no longer content to leave environmental decisions to the Big Brothers—Big Government, Big Industry, and Big Academia.

There have been too many Santa Barbara and Gulf oil spills traceable to inadequate government and industry study and inadequate regulation.

—Too many Everglades jetport decisions which have had to be reversed.

—Too many five, 10 and 15-year abatement proceedings while Lake Erie dies and other bodies of water become increasingly contaminated, while our urban centers are shrouded in degrading, debilitating and sometimes deadly fumes.

—Too many Turkey Point power plants to be enjoined from thermally polluting Biscayne Bay.

—Too many factories and power lines built with little or no concern for their environmental impact.

—Too many fine sounding laws whose promises have not been fulfilled, whose programs have not been adequately funded.

Is it any wonder that informed citizens are asserting their right to environmental quality and their right to become involved—and will do so more and more? The resource agency which fails to be responsive to this informed public does so at its own risk and overlooks a magnificent opportunity to build support for its own worthwhile programs.

The rising crescendo of public concern and mounting barrage of anti-pollution and pro-environment news, while enormously welcomed, also presents an enormous problem. Caught and shaped by massive propaganda about the environment, the public could be overwhelmed and seek escape by tuning out, or be overcome by a sense of hopelessness and doom. Some may be led to believe that the problem is being brought under control. Some may seek refuge in simplistic proposals which offer the promise of a quick cure.

But some will continue to probe and seek solutions through rational, informed judgments—and they rely on you and all other communicators to provide the information which will enable them, and us, to make wise decisions on the future of our environment.

Thus the decisions will depend, ultimately on what is communicated to the public. All who toil in the environmental vineyards stamping out the press releases, news stories, speeches, studies, reports, surveys, position papers, etc., now face a greater challenge than ever before. We now have a greater responsibility than ever before to give meaning, shape and form to what's really happening to the environment and to point the way to what ought to be done in order to have an environment fit for people. We need to help bring about confrontation in its finest sense—the confrontation of competing ideas and genuine alternatives.

People deserve and are capable of understanding important news and its meaning. An intelligent public, eager to take action, awaits your words. Tell it like it is.

ATTITUDES AND COMMUNICATIONS ABOUT WILDLIFE

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THE PROBLEM

One of the most important tasks for natural resource agencies and organizations in the 1970's is to create an "ecological conscience" in the public mind. We must create an understanding that man is a part of the environment and that he is dependent upon it. Creating an interest in wildlife and an understanding of wildlife ecology may be a means of creating an awareness and an understanding of the environment. There is no doubt that an environmental awareness movement is underway.

Natural resource agencies and organizations realize that the key to the conservation of wildlife and the environment is an educated public. Some important questions confronting agencies and organizations are: (1) How can they most effectively communicate wildlife ecology and management concepts to people? (2) What are the public educational gaps in wildlife ecology and resource management? (3) How can agencies most effectively communicate the various wildlife management alternatives to people? (4) What wildlife management issues are important to people, and on what issues is there consensus and where is there disagreement?

Attitude research may provide some answers to these questions. If we know what people believe, this knowledge has implications for the development of policy and communications.

Although agencies and organizations may differ in their philosophies about what is proper wildlife management, they are all interested in communicating effectively. By effectively, I mean they want to "sell" their ideas. To be most effective, in my opinion, a message must be designed for a "target" audience—an audience which is characterized by a type of attitude.

Three types of "target" audiences can be visualized as three interlocking circles (Figure 1). The differences and similarities among these audiences are based on opinions, attitudes, or preferences. The area of overlap represents the amount of behavior that is shared by all audiences. Within a given audience, persons associated with it have many opinions in common. In addition, each type has a hierarchy of opinions (Guttman, 1959). The more important opinions are used to distinguish one audience from the others.

In the practical sense, suppose the communicator wants to design a

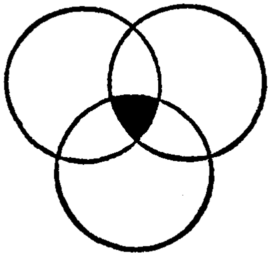

Figure 1.—A conceptualization of three audiences sharing behavior.

television program about wildlife conservation for hunters. If research can identify a type of wildlife attitude associated with hunters only, the communicator can use this knowledge to design a message for the hunter audience. On the other hand, suppose the communicator wants to design a television program for hunters and birdwatchers. If research can identify a type of attitude which is shared by both interests, the communicator is in a strategic position to design a message that would appeal to both interests simultaneously.

OBJECTIVES

In order to gain insight about how to communicate most effectively, research (Erickson, 1969) was undertaken to: (1) determine some types of attitudes about wildlife and its management, and (2) suggest hypotheses about the relationship between wildlife-attitude types and selected demographic and other characteristics.

Q-METHODOLOGY

Q-methodology, a research approach primarily developed by Stephenson (1953), was used to identify wildlife attitude types. Stephenson (1967:5) states that Q-methodology is "a method by which an individual can model for himself what his attitude of mind is about complicated topics, issues, or situations. Its primary concern, therefore, is with a person's subjectivity as he describes it, not as we (psychologists or onlookers) infer it. All measurements in Q are central to the person—the scales, so to speak, are in the person's own mind. The method begins with data for a single case and then proceeds by comparing it with data from others. It begins with what one person models about himself and compares this with models provided by others. The models are subjected to factor analysis."

Q-methodology is being used in clinical psychology, communication and marketing research. In the natural resources area, it has been used in outdoor recreation research at the Ohio State University and the University of Missouri, Columbia. Zoologists have also used it in the field of numerical toxonomy (Sokal and Sneath, 1963).

Q-sort Instrument

The instrument used in Q-methodology is called the Q-sort. This instrument consists of self-referent statements that are sorted along a continuum according to some instruction (*e.g.*, from agree to disagree). Self-referent statements are by nature a matter of opinion, not a matter of fact. Consider, for example, the following statement: "I see no reason for trying to preserve a vanishing species like the timber wolf. These animals are destructive and serve no useful purpose." A person may agree with this statement, disagree with it, or be neutral or uncertain about it. Each person, then, can respond to a self-referent statement as he sees it. Stephenson (1967) has proposed that a person's self-referent opinions are the basic elements in mass communication.

The Q-sort instrument developed for this study consisted of 80 statements of opinion about wildlife. The development of the Q-sort instrument was conducted in three phases: (1) conducting exploratory interviews to obtain statements of opinion, (2) building a "theory" about some important attitudinal variables and writing a structured sample of statements for the Q-sort instrument, and (3) checking the reliability of the instrument.

The first phase in developing the instrument was to obtain a range of statements of opinion about wildlife and its management. In an attempt to obtain this range, interviews were conducted with a variety of persons: hunters, birdwatchers, farmers, and persons who do not participate in wildlife-related activities. Both men and women were included in each variety. Construct elicitation (Kelly, 1955; Monaghan, 1966, a, b) and the focused interview (Merton, Fiske, and Kendall, 1956) were used as exploratory interview techniques.

Interviewing was conducted in the Columbus, Ohio area and at several county fairs some distance from Columbus. Arrangements for personal interviews were made by telephone. Interviewing was done in the homes of the interviewees, and interviews were tape-recorded, if possible, with prior permission of the interviewees.

In the second phase of instrument development, the statements of opinion were placed on three by five cards. Then, the cards were sorted into piles according to a similar idea in the statements. For instance, two piles contained statements which indicated the idea of scarcity or abundance of wildlife. Two other piles contained ideas about the negative or positive values of wildlife. There were five piles with different management ideas. The various ideas represented by the statements were hypothesized to be important attitudinal variables with respect to wildlife management, and these ideas were expressed as a structured (factorial) design so that they could later be tested for their importance by analysis of variance.

The design consisted of three effects: (A) animal population situation; (B) image of the animal or situation; and (C) management decision. There were two levels in effects A and B and five levels in effect C. For instance, the levels within effect C were labeled as follows: (1) protect from man and other animals; (2) maintain, preserve, or increase; (3) decrease or control; (4) hunt or trap; and (5) no action. The 2 by 2 by 5 design yielded 20 basic combinations of levels (A1 B1 C1, A1 B1 C2 . . . A2 B2 C4, A2 B2 C5). For example, a statement generated for the combination A1 B1 C1 was "The white-tailed deer is a harmless and graceful creature that should be protected from hunting. There are too few of them to permit a hunting season." A second statement for A1 B1 C1 was "In the Arctic regions, the polar bear is dwindling in number. This is a beautiful animal. I think they should be protected from hunters." I wrote four replications of the 20 basic combinations, making 80 statements in the Q-sort instrument. The statements written for the various combinations came either from ideas expressed in the exploratory interviews or from this writer's experience. In some cases, the Q-statements were partial quotes from statements made in the exploratory interviews.

The third phase in the development of the instrument was a reliability check on the operational definitions of each level. This was done to insure that the meanings communicated by the statements were reflected by the structured coding. Six persons were involved in the reliability check, and each of the three effects were checked three times. To begin, each person was given a brief definition of an effect and levels within it, and then was asked to sort the instruments according to the definitions provided. In the case of effect A, "Animal Population Situation," statements that represented scarcity were placed into one pile and statements that represented abundance into another pile. If any statements were not placed into the proper pile as defined by the code, the statement numbers were recorded and each person was asked why he placed the statement as he did. These statements were later rewritten to fit the operational definition designated for each level.

Interviews

Interviews using the Q-sort instrument were conducted with a sample of 49 persons. These persons were chosen according to a structured design. The design consisted of a wildlife orientation effect with four levels: (1) hunter, (2) watcher, (3) farmer, and (4) other. There was also a sex effect. The operational definitions of the wildlife orientation levels were as follows (hunter and watcher activities occurred in 1966 and/or 1967):

(1) Hunter: A person who hunted.

(2) Watcher: A person who fed animals (birds, squirrels, etc.) in his yard; a person who took a trip into the outdoors especially to observe wild animals; and/or a person who set up a bird bath or bird house. A non-hunter.

(3) Farmer: A person whose occupation has been farming.

(4) Other: Neither hunter, watcher, nor farmer. The sample was not randomly chosen to represent a population either in terms of size or demographic characteristics. Instead of a random selection, people were chosen to fit the structured design. Using Q-methodology, neither large nor random samples are needed to determine attitude types.

Male and female hunters and female watchers were randomly selected from a list of people who volunteered their names at sporting goods and garden stores and pet shops. Persons defined as "other" were located by making house-to-house contacts to obtain volunteers. Female hunters were obtained through personal contacts. Farmer interviewees were located at a local county fair.

In the interview, the 80 statements were sorted into 11 piles according to a quasi-normal distribution:

Pile number	1	2	3	4	5	6	7	8	9	10	11
No. of statements per pile	2	4	6	9	12	14	12	9	6	4	2

The pile numbers became the raw scores for the statements and these scores were converted to standard scores in the analysis of data.

Interviewing was conducted by eight interviewers and the writer. The interviewers were a mixed group consisting of undergraduate students, graduate students, special students, and two non-students. They were paid $3.00 per interview by the Ohio Cooperative Wildlife Unit. Interviews averaged 1 hour each.

Analysis of Data

The Q-sorts of 49 persons were intercorrelated and these data were subjected to a "principal components" factor analysis followed by varimax rotation of the factors. Factor analysis discovered: (1) "factors" or types (patterns of similarity) among the intercorrelations, and identified (2) the strength of a person's association (called "loading") with each "factor" or type. A type can be viewed as a hypothetical person.

The ultimate objective in Q-methodology is the determination of typal-arrays, which are the listings of statements for each type according to their Q-sort scores. Typal-arrays are determined by an elaborate "weighting" of each person's Q-sort according to the person's loading with each type. The higher a loading, the greater "weight" his Q-sort receives in calculating the typal-array.

The attitude of a type was determined by examining the ends of the arrays for a theme. The structured code (*e.g.*, Al B1 C1) underlying the statements assisted in identifying a theme. In addition, analysis of variance of the structured code of each typal-array provided support for the themes identified by subjective procedures. The new multiple range test (Li, 1964) was used to discover the differences among levels in the structured design. Statements with a standard score greater than ± 0.84 were used in writing a type description.

WILDLIFE-ATTITUDE TYPES

Factor analysis of 49 wildlife Q-sorts identified 9 wildlife-attitude types. Only two types had a sufficient percent of variance to insure an accurate and conclusive interpretation; these types were labeled "protectionist" and "reductionist." Analysis of variance of the structured design of both typal arrays showed that the management decision effect was significant at the one percent level. This indicated that the persons reacted to this effect in the structure most strongly.

For the protectionist type, the ends of the array began as follows:

Strong Agreement Statements

Standard Score	
+2.40	Many rivers and streams contain sewage and materials that are harmful to fish and other life, and these materials are causing their decline. In order to increase fish life, pollution must be controlled no matter what the cost to society.
+1.95	Although the bald eagle is known to feed on fish and other small animals, I think we need more men enforcing the law to protect these birds from being destroyed by bullets. They are almost gone from the earth.
+1.86	In the Arctic regions, the polar bear is dwindling in numbers. This is a beautiful animal. I think they should be protected from hunters.

Strong Disagreement Statements

Standard
Score

—2.23 I think setting aside parks for vanishing wild animals like the American bison is a waste of public funds. The bison may be a part of our heritage, but there isn't room in this world for these animals, except in a zoo-type environment.

—2.11 If large numbers of elk are starving during the winter at Yellowstone National Park, let them starve. Man should keep his nose out of nature's affairs.

—2.06 Why should we try to save birds such as the whooping crane from extinction? If that's the way nature is going to take its course, let it take its course.

These statements give some indication of what the "protectionist" thinks is most important.

Further examination of array revealed the following: Persons of the "protectionist" type are primarily concerned about saving vanishing wildlife such as the bald eagle, polar bear, and whooping crane. One of the best ways to preserve wildlife, in their view, is to protect some species from hunting. They are strongly in favor of taking positive action by providing habitat for wildlife. In particular, they want parks to protect vanishing wildlife such as the bison. Moreover, the bison should not be reduced even if it is overgrazing the grasslands. They are concerned about saving starving wildlife such as deer and elk, and they would like to see them fed. On the other hand, they would be opposed to feeding the black bear in Yellowstone National Park. They are in favor of reducing nuisance animals (*e.g.,* pigeon) by "birth control" methods, but they are not in favor of an elimination of these animals. They enjoy having birds around in the winter and would like to see governments spend money to increase them in the city. There is some indication that they are quite sympathetic to domestic animals such as stray cats.

For the reductionist type, the ends of the array began as follows:

Strong Agreement Statements

Standard
Scores

2.65 The red-winged blackbird is a pest to farmers' crops. Sometimes they are so numerous that you can't even see the sun. I think studies need to be made to find some antifertility agent that will prevent them from having so many young.

2.22 Although the woodchuck or groundhog is scarce, hunting and trapping of this animal should be permitted because this animal is destructive to farmers' cropland.

1.75 The red-winged blackbird is increasing rapidly and in some areas is a menace to farm crops. I think a hunting season on this bird would be desirable.

Strong Disagreement Statements

Standard Scores

—2.04 The red-winged blackbird may be a menace to crops in some areas where they are plentiful, but I think they should be protected from people shooting at them. With all of our technology, we ought to be able to find some way to discourage these birds from causing damage.

—1.95 If it weren't for the many red foxes, rural areas would be crawling with mice. They're a helpful creature and I wish there were even more of them around. Biologists should make studies to learn how to increase them.

—1.95 There may be plenty of pigeons in some cities, but they have as much right to be there as we do. Man should not interfere with their presence.

Persons of the "reductionist" type view many wildlife species as destructive to crops or livestock *e.g.*, the red-winged blackbird, woodchuck, and red fox. They are strongly in favor of hunting and control of destructive wildlife and are generally opposed to the preservation and increase of it. In particular, they are opposed to efforts to increase the red fox, crow, chipmunk, and mountain lion. Although persons of this type want to hunt and control wildlife, they are in favor of preserving a few species of wildlife for future generations. They are also concerned about such things as controlling water pollution, but at the same time believe that pesticides are necessary for controlling nature.

Between the two types there was a strong consensus of agreement for the following statement:

Many rivers and streams contain sewage and materials that are harmful to fish and other life, and these materials are causing their decline. In order to increase fish life, pollution must be controlled no matter what the cost to society.

This statement suggests a kind of message that may appeal to both types.

Most of the sample of 49 persons was related to the "protectionist" type. A visual inspection of the kinds of persons (*e.g.*, hunter, watcher, farmer, and "other") associated with these types suggested some hypotheses: (1) the "protectionists" are more apt to be watchers and "other" than hunters, and (2) the "reductionists" are apt to be farmers; hunters and watchers are not. These hypotheses can be tested in future studies.

IMPLICATIONS

The findings of this study have some important implications for conservation communications. Information about wildlife attitudes:

(1) enables communicators to predict the kind of message content that would strongly appeal to an audience,
(2) helps identify gaps in public understanding about wildlife ecology and management, and
(3) can be used in designing messages for all mass media—radio, television, newspapers, and magazines.

Suppose we want to develop a television program about wildlife management for persons of the protectionist type. Let us assume that protectionists are primarily women bird-watchers. In order to develop an effective television program, we must consider the attitude of the protectionist type. The primary attitude is one of concern for the preservation of vanishing wildlife. This attitude was determined from opinions strongly held by persons of this type, and it becomes the central theme around which communications should be developed. Thus, protectionists would enjoy a television program telling what is being done to save vanishing wildlife. For example, we might create a television program titled *Defenders of Wildlife.* The program description in *TV Guide* would read:

> In this documentary, conservation officials are interviewed about their work to preserve America's wildlife. Tonight, we travel to Yellowstone National Park to discuss with naturalists the various, sometimes controversial, means of saving a large wintering elk herd from starvation.

The study also showed that persons of the protectionist type oppose the reduction of bison to the carrying capacity of the grasslands. This information suggests that an educational program should be developed on the concept of carrying capacity. We will have to be careful in the design of this program because the urge to preserve is felt fairly strongly by the protectionists.

Suppose we want to develop a television program for persons of the reductionist type. These persons perceive some wildlife species as destructive and they want to hunt and control them. A television program that may appeal to this type might be titled *Man Against Nature*. The program description in *TV Guide* would read:

> This documentary program shows us how man competes with nature in the struggle for survival. Today's program shows us the crop damage caused by the red-winged blackbird and the new and unusual methods being used to control this menace to mankind.

FUTURE STUDIES

Q-methodology is highly recommended as a public attitude and communication research approach. Information derived from studies using Q-methodology has implications for management policy, as well as for communications design. Q-methodology may also be used to evaluate the effectiveness of present educational and management programs and predict the successfulness of proposed programs.

To educate people about conservation requires that we inform them of the various resource management alternatives. Since the completion of this study, the important statements of opinion related to the wildlife-attitude types have been used in small groups to stimulate thinking about various wildlife management alternatives. A group of 48 persons, for example, was subdivided into 6 smaller groups. Each person in a group received a list of 10 statements which were strongly related to a wildlife-attitude type. Each person was asked to agree or disagree with the statements and then the statements were discussed. The objective of the discussion was to obtain the greatest possible consensus of agreement on the statements. After a vivacious discussion period, a representative from each group was asked to identify the statements of greatest disagreement. This promoted additional discussion. The extent to which this approach creates an awareness of management alternatives and changes opinions needs to be investigated.

It seems probable that the results of Q-type studies may be useful in selecting persons to participate in discussions of resource management alternatives. Factor analysis, for example, determined the strength of each person's relationship to the two wildlife attitude types and data from this analysis could be used to select persons who are and are not strongly related to these types. Various alternative situations related to resource management could be presented and then people would be asked to discuss the alternatives. Through interaction with others, hopefully, people will understand each other's point of view and achieve a greater consensus of opinion on resource management issues. Studies are needed to determine whether these objectives would be accomplished.

Four questions that natural resource agencies may want to answer are as follows: (1) What additional wildlife attitude types are there and what is the relationship of various publics (*e.g.*, hunters, bird-watchers, campers, non-wildlife oriented persons) to these types? (2) How do people living in the inner city, suburbs, and rural areas relate to wildlife? (3) What are the attitudes of various publics about environmental deterioration and management? (4) What do scientists versus the public perceive as solutions to environmental problems?

Answers to these questions will help us understand what people are trying to tell us about wildlife and the environment.

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DISCUSSION

MR. BRIAN GEILS (Utah Student Chapter, Wildlife Society, Logan, Utah): Mr. Moderator, I would like to ask the speaker a question. It seems that he has identified the two poles of opinion. How closely, however, do certain individuals fall within this? What is the amount of deviation among them?

It seems to me that there are going to be very few people who hold strong protectionist or strong reductionist principles. Most people fall in between.

How successful is it going to be to aim a message towards one group when there are only very few people who hold that strong opinion?

DR. ERICKSON: I will try to answer the question.

Really, the standard deviation is not involved here; but I would predict that there are quite a few people out there who are members of this protectionist type. This is just a hunch, and I think this information could be determined.

Likewise, I think there are a large number of people of this other type, too.

To what extent people fall in sort of a mid-ring between these I am not really sure at this point. Further study is needed to identify these kinds of people, and when I made the analysis, there were only nine different types, but when you try to interpret what this data means you find that it is very vague, and there is so much overlap it is difficult to get a good separation.

These first two types that I pointed out, however, really did have good representation, and it was fairly clear. So, there are some other types out there, and these kinds of things need to be investigated.

The other part of your question was with respect to how do we get the message across. I am not sure exactly how to answer that.

MR. GEILS: You sort of answered it in the first part, that if there is strong separation, then it would be possible to direct different messages; but if most people fall within the middle, I am wondering if you might be turning some off if you are presenting a message to, let us say the reductionists, and a great mass of your population, as with your TV programs, happens to be a little stronger towards the protectionists—then they are going to find out, "Well, I really don't want to shoot off all the redwings. I'd like to have a few redwings, but not at the cost of the farmers' production."

DR. ERICKSON: All right; I think that you would really have to pretty well define the message for that target group, but you could use combinations of things.

At a certain point, there are certain things that they do agree on. They are not very strong. They may be down towards the middle of the array, and they might be going for that kind of program related to those statements.

You would have to find statements of commonality between the two if you were going to try to appeal to both at the same time.

ESTABLISHING OBJECTIVES AND EVALUATING PROGRAMS

ALLAN MURRAY

Department of Mines and Natural Resources, Winnipeg, Manitoba, Canada

Over the years many I & E agencies have had difficulty getting recognition, money, staff or attention. It was only the most far-sighted administrators who gave their I & E agency the attention it deserved, and I suspect they did so despite the best efforts of I & E people themselves to obscure the reasons for their existence. In short, I & E people have been reluctant, afraid, or unable to state clearly just what they were trying to accomplish in the name of conservation.

What in the world are we here for?

For what purpose are we spending the citizens' money?

What is our intended impact on society?

These are the kinds of questions that the administrators of our agencies are entitled, indeed obligated, to ask us as I & E people. Are we able to answer them? I suggest that the goals and objectives of most I & E organizations are so fuzzy and unclear as to be meaningless documents in any kind of a management context.

It is my purpose is this brief paper to: (a) justify the rationale for defining objectives, (b) to outline the criteria for the proper definition of objectives, and (c) to discuss briefly the idea of evaluation of I & E programs. A mystique has grown up around this whole objectives and evaluation business to such an extent that some of us have been frightened off or else we have adopted such a defensive position about our present management system that we are afraid to try something new.

I think we have no choice left but to look seriously at this approach to managing an I & E program. The pressure on governments for money is increasing and if your agency is the same as mine we can foresee some tough days ahead financially. On the other hand, dozens of I & E agencies exist and are not likely to be disbanded. So the question now becomes how can we make the most effective possible use of our resources of men and money. The answer, I suggest, is by clearly defining our objectives. Once we have done this we are able to outline alternative means of achieving them. In choosing the most desirable alternative the matter of cost and staff time becomes a factor to be considered and compared.

Here are several things to keep in mind in defining an objective:

1. An objective is a statement of the end or the aim of a particular action. It tells where we want to be or what we want to have happened when an activity is concluded. Now obviously there are different levels of objectives. At the activity level an objective will be quite precise and will probably require redefinition or at least re-examination each year. By activity level I mean production of a film or a magazine or TV series. These need regular re-examination. At the program level—and an example may be a Hunter Safety Training program—the objective will be quite precise but probably doesn't require re-examination every year.

2. The objective in either case should be realistic and probably attainable. It should be defined with full knowledge of the constraints of men and resources that are available for the task. It is meaningless to say our objective for a waterfowl identification training program is "to make hunters competent to identify waterfowl in a hunting situation." Obviously this can't be done and the objective ceases to have any relevance. But it would have relevance if it said "to make 30 percent of the hunters competent in a hunting situation, 70 percent of the time, for seven main species of waterfowl." Now you have something concrete to strive for. And what's more you have something that is measurable.

3. The third thing about an objective is that the statement should not identify the means by which the end is to be achieved. It should not restrict the methods of reaching the objective, but it should encourage and suggest ways of measuring the effectiveness of alternatives.

For example: the objective of a hunting season information campaign may be defined as "the reduction of the queries and misinformation held by hunters in the fall season." This statement does suggest a way to measure the effectiveness of alternatives—by counting the queries and seeing if there are more or fewer than in previous years.

We all have, or can readily get, some idea of how many queries our field staff and head offices get from hunters looking for new information or wanting an interpretation of material already distributed. We know, or should know, how many hunters we have, where they hunt, when they hunt, when and where they buy licences, how many queries we get by phone, or by mail or in person. We know how many prosecutions are made in which ignorance of the law rather than deliberate law breaking is a factor.

Armed with this knowledge we can analyze our problem and design alternative methods of tackling it. Having chosen the alternative that on balance seems most realistic within the context of our operation we can set it in motion and finally, when the last shot is fired and the last mallard is retrieved we can measure our program's effectiveness by counting the number of queries and causes for prosecutions. We can determine numerically if our objective has been reached.

Our measures of evaluation should be clearly stated before we start any activity to attain our objective. We should know before we start what the measure of our success or failure will be. And our superiors must also know and agree to these indicators. Furthermore we should agree on and write down what is an acceptable minimum reduction. A reduction of two queries over a whole hunting season may not constitute success in the director's eyes. Before you start, find out and agree on what will be an acceptable effectiveness level. It is a good idea to state this limit in the definition of your objective—*i.e.* to reduce by 20 percent the queries and misinformation held by waterfowl hunters, etc.

But we're not home free yet. We must make one more test. This one for efficiency. How much did it cost to reduce the number of queries? One way to describe the efficiency of our program would be to measure the cost of reduction per hundred queries. Both you and your boss may find it is preferable to scrap this particular information program and just answer the queries as they arise naturally because it will save your agency a substantial amount of money. This is what management is all about: How to allocate scarce resources of men and money for the attainment of essential or desirable ends.

As I & E people, we cannot make sound decisions on the allocation of our resources of men and money unless we have objectives clearly stated in operational terms together with an evaluation system to measure the effectiveness of the program and tests to measure the efficiency of our own performance as the implementers of the program.

One of the dangers of this system of objectives, effectiveness and efficiency is that they may find us out.

One of the real benefits is that we may find ourselves out.

For example, is our series of publications about small mammals really doing any good? Or should we scrap it and spend the money on a school filmstrip about small mammals? For what purpose do we seek to inform the public about small mammals? And is it worth the cost? Indeed, we must ask ourselves, how much does it cost in time and money and is that the best way to spend these resources in terms of our main objective?

What are we trying to accomplish with the float that we put into the annual agricultural parade? If its only purpose is to keep the parade sponsors happy then let us say so in our objective. And let us and our boss clearly understand just how much it is costing to keep the parade sponsors happy.

On the other hand, if we think the float is doing some good, let's define what good it is doing. And then let's measure it. I know that not all of you agree with this, but it is my view that unless you can measure your results you probably shouldn't be undertaking the activity in the first place. These are hard lines but it seems to me that our professional integrity as I & E people depends on taking just this approach.

Right now some of you are bursting to make the statement that the cost of measuring a program's effectiveness is prohibitive. And some of you tell me that survey firms have quoted astronomical figures for performing such a service. Well, I don't believe it.

We ran a survey on the attitude of hunters to game laws in Manitoba and in the process we learned a great deal about the effectiveness of our hunting regulations brochure, and the whole thing only cost us about $1,500.

This survey incidentally clearly indicated the kind of trap we can so easily fall into. Manitoba's regulations brochure was a publication specialist's nightmare. It was garish, poorly designed, poorly written, and hard to follow. In our view few hunters would read it all and fewer would keep it around for reference.

But what did the hunters think of it? They thought it was great!

91 percent of all hunters over 51 years of age read it completely, while 86 percent of hunters between 36 and 50 years also read it all. But the young hunters were not quite as impressed—only 76 percent of the 18 to 25 year-olds read all of it. New hunters irrespective of age didn't regard it too highly either—only 73 percent of hunters holding a license for the first year read all of it, whereas 88 percent of hunters who had held a license for 11 years or more read it completely.

What does this mean to us as I & E people? Well, it seems to say that there may be trouble on the horizon unless we can reach the young hunters and the new hunters more effectively. And in Manitoba about one quarter of our hunters are under 25 years of age. It also means that my intuitive judgement of this publication was wrong. I judged it from my own perspective and from my own values, and these obviously were not the same as those of the average hunter.

This does not mean we should ignore our intuitive senses in evaluating I & E activities and output. Obviously we must put considerable reliance on our intuition because our methodology for measurement of I & E programs is woefully weak—due, I'm sure, to lack of concern. But I think we need to use statistical measurements wherever possible to make sure our intuitive senses are kept as sharp in reality as they are in our imagination.

The study we had made on hunter attitudes was conducted by the University as a teaching-research project The cost to us was minimal, the benefit to the university class was apparently significant and certainly the value of the study to us was considerable. I think that instead of wringing our hands and wailing about the high cost of surveys and measurements we would do better to use our inventiveness and search around for solutions that are within our means.

Let's look at another example. The wolf population of this continent is in serious trouble, although in Manitoba it is not in jeopardy over most of its natural range. There are pressures against the wolf in two neighboring jurisdictions—the state of Minnesota and the province of Ontario. There is a danger these pressures could spill over into Manitoba. We decided to try to forestall this by presenting Manitobans with some facts about wolves which hopefully would dispel some prevalent myths about these carnivores. We chose to do this with a publication which was subsequently completed and distributed.

We wrote this publication with two objectives in mind: (1) to give people new information about wolves and (2) to change their attitudes toward wolves.

To make our evaluation we prepared a questionnaire which was given to relatively matched groups of students and sportsmen. Some of each were questioned without having even heard about our booklet, the others were given the booklet before being tested. There was a significant increase in knowledge exhibited by the readers of the booklet. There was also a difference of attitude toward wolves by the readers as against the non-readers.

To all of this some of you may say so what? We could have told you that from our long experience in this field. But could you have told us that at least two sections of the booklet completely failed to convey new information to the readers? We know this because on the questions about these areas both the readers and non-readers scored alike.

The effectiveness of the booklet was documented and so were its weaknesses. This information will be valuable in any revisions of the booklet and in the preparation of new booklets. Some will argue, and rightly, that our survey will not stand up to rigorous statistical analysis. They'll argue that on such a sketchy and Mickey Mouse analysis one cannot draw accurate and detailed conclusions about the booklet's effectiveness. Well, I agree that its findings are not Holy Writ. But I do contend that it is better than no survey at all; it is better than relying solely on intuition; it is better than throwing up our hands and saying it cannot be measured—so why try?

The cost of this questionnaire survey which was reasonably adequate as a performance indicator of this activity was several hundred dollars, including staff time. Considering the expense of reprinting this booklet for the next five years the evaluation costs are quite justifiable. After all, what's the use of reprinting a booklet if it isn't accomplishing its objective?

Turning briefly to evaluation. There are four basic criteria:

1. *Volume Indicators*—straightforward measurements of volume or size: how many hunters reached, how many magazines mailed, how many viewers, how many letters. These indicate work volume but not quality or efficiency.

2. *Performance Indicators*—measure production or efficiency of operations of an activity. For example, comparing the volume or quality of work with a previous year's results, with the predetermined target quota, with results in other similar operations. These results might then be related to unit costs or staffing ratios. Generally, we need to use several Performance Indicators to properly evaluate an activity or program.

3. *Measures of Effectiveness*—indicate achievement in terms of contribution to the objective. Going back to our hunter queries example, measure of effectiveness would be the amount of reduction of queries. The measure of effectiveness differs with objectives and should be carefully thought out.

4. *Measures of Benefit*—relate to program accomplishment and are

usually expressed in monetary terms. This is a particularly difficult one to manage in our field since benefit in terms of public knowledge or behavior is hard to price in dollars and cents.

Let me sum up:

An I & E agency needs to have clearly stated objectives at all levels. These must be consistent with the overall objective of the Department or Commission and with the specific and narrower operational objectives. Generally I & E sections are services to resource managers and our objectives must be related to their aims and goals:

1. Our objectives must state what is the end or aim of a particular activity.

2. It must encourage analysis of alternative means of reaching the goal. We should not write objectives to fit the accomplishments of our magazines, for example. Instead we must define our objectives in light of our management needs and then see if the department magazine is the best alternative for reaching the objective.

3. Our objective should suggest ways of measuring the effectiveness of the various alternatives. We must learn to cost out the various alternatives and measure their effectiveness one against the other. This, of course, is a traumatic experience because it may be that our departmental magazine, our pride and joy and the winner of national acclaim, is really not the best and most efficient way of reaching our objective.

4. It should be realistic and attainable and it might well prescribe time periods and acceptable minimums of accomplishment.

In the final analysis, we are trying to change people's behavior by using propaganda techniques. We want people to stop polluting, or to stop shooting hawks, or to go here instead of there to catch fish, or to ask permission of land owners before crossing private land or to buy duck stamps, or to plant hedgerows, or to not cut down hedgerows or to not shoot too many ducks, or to not start shooting too early in the morning or continue too late at night. We want people to tell their legislators they favor an increase in license fees or they are opposed to the building a jet port next to a park. The list is endless and in virtually every instance we want people to do something or stop doing something. Behavior is measurable. If we do not measure it how do we know that our efforts to influence it are reasonable and acceptable.

I & E organizations on this continent are, with few exceptions, guilty of a simplistic approach to our job and, even worse, afraid to apply sophisticated management techniques because we fear we will fall short of what citizens can rightly expect for their money.

What should we do about it? I suggest that we all start now to outline in operational terms our objectives for next year and to clearly state our Performance Indicators and tests. Start gathering the data with which you will be able to make comparisons.

I suggested that the conservation magazine, for example, may find its future shaky if it is subjected to objective analysis. At the time many magazines were started 20 or 30 years ago they were probably the best if not the only way of reaching a large audience. But times and societies change. I & E programs cannot keep pace with a changing society unless we are able to measure them in terms of their impact on society. At an earlier North American Conference a speaker said that "The effectiveness of information-education work cannot be measured in concrete terms, only in concrete results." I agree wholeheartedly and I say we can only measure results when we know what it is we want to have happen and when we have set up adequate monitoring devices to see if it does happen.

COMMUNICATING CONSERVATION THROUGH MAGAZINES

GEORGE LAYCOCK

Cincinnati, Ohio

Almost any magazine you pick up today is likely to include an article on conservation. Conservation is in. Ecology is big. In the Madison Avenue lexicon of soap-peddling aids, environment is the bright new word. There are in this country more than 15,000 magazines. They range from house organs of a few hundred circulation to *Reader's Digest* with 17½ million copies printed monthly. And editors of magazines everywhere seem eager to meet the current public interest in conservation. Travel magazines have conservation. So do labor union journals, life insurance company magazines, air line magazines, and chemical company magazines. Admittedly, some of their conservation type articles stretch the definition. Not everyone agrees with the editor of the oil company magazine who classifies as conservation writing an article telling of his company's concern for the caribou of the North Slope. And recent months have seen a flurry of such Alaska stories in oil company magazines. The fact that they feel compelled to offer this defense reveals the level of public concern for the environment.

This sudden flowering of interest is welcome. The world about us cries for attention. But if the broad interest in the environment should reach a peak and diminish, as some fear it will, the old experienced publications will continue to plug away at conservation Among these old-line conservation voices are several groups of magazines. There are the periodicals published by the state departments of conservation, or game and fish. They have published a remarkable amount of conservation copy. There are the magazines published by the independent conservation organizations. Among these are *Audubon,* the Izaak Walton League's *Outdoor America, American Forests, The Sierra Club Bulletin, National Wildlife,* and several more, most of them characterized by straight talk on conservation matters. Then there are the commercial outdoor magazines. More than 35 years ago *Field and Stream,* which today employs Mike Frome to cover the conservation front, already had a "Conservation Council" with such names as T. Gilbert Pearson and Horace M. Albright. But every outdoor magazine in business today can accomplish still more in conservation writing.

Reciting history, or recognizing the good guys does not in itself get the job done. We must constantly ask how we can use this medium to accomplish *more* in behalf of the endangered environment.

In this respect I would like to look for a moment at the state conservation publications. They have a grand potential for solid conservation work even beyond what they are accomplishing. The state magazine may be the *only* contact the state agency has with a large percentage of the people it serves. For this reason alone, the best possible effort is justified. And for this reason, greater expenditures of funds would be justified for magazine work in many states.

Successful magazines are changing, growing creations. While they are not newspapers, they are, properly edited, a reflection of the times. Too many state publications still carry subject matter that was tired and dull a generation ago. Good white space is given over to articles of limited interest. We are told once more about covered bridges, or how the art of the village smithy hasn't really expired although blight has killed the spreading tree beneath which he stood. The best that can be said for the old hackneyed article idea is that it insulates one more editor, or political group, from the necessity of coming to grips with water pollution, air pollution, pesticides, or stream channelization. In these troubled days fresh and timely article subjects scream for attention. There is not enough space to handle them all. Too often, of course, politicians establish editorial policy and dictate the tone of magazine content.

Let us examine what is a fairly recent and hopefully an extreme example. A new administration decided that the conservation magazine of one of our most populous states would become instead a more general chamber of commerce type periodical. Game and Fish money still carried a share of the cost of printing and production. Allow me to survey completely the table of contents of the most recent issue, that of April, 1970. One article describes the home of the state's first governor. Another tells how to make artificial tulips out of Easter egg shells. Others describe a visit to the capitol city's zoo, a visit to the capital city's parks, a glass factory's pouring of a telescope lens, and a maple syrup festival. Still another article describes how elderly people spend their spare time. There is an article on the dairy industry, a sports car rally, a harness race meet, and a company that makes pick-up coaches. There is also an article telling about the Lions, which I hasten to add are of the service club variety and not endemic to this state. This is topped off with the recipe of the month—Spare Rib Pot Pie and Kiss Pudding. This tax-supported publication replaced a conservation magazine. It is offered to the people of a state at a time when the same state boasts such environmental challenges as 10,000 new acres of strip mine ravaged land every year, dull gray air, rich in sulphur dioxides and floating particulates, and a river famous because it catches fire.

I do not single out this state because it is the *only* one failing to come to grips with the vital issues. But in its efforts to entice new industry, it does rank as an outstanding example of a strange rationale current in some circles. We are assured that the ills brought on by too many people and too much unbridled industry can be cured by more people and more industry.

Such conditions beg a cure; a new age of enlightened politics, an awareness among leaders of the genuinely vital issues of the day. There is a need for an atmosphere that permits—even demands that the state conservation publication tackle the environmental issues.

There are in the stacks of state conservation publications some outstanding examples of what vision, funding, and an honest knowledgeable approach to editing, writing, and illustrating can accomplish. A prime force in bringing an end to the spreading of DDT in Michigan was that state's magazine *Michigan Conservation*. Dr. Ralph A. MacMullan, director of the department, decided the time had come to grasp the nettle.

In the January-February, 1968, issue of *Michigan Conservation*, he said that his department would, "In the interest of the people of Michigan, seek appropriate legislation against hard pesticides. Right now, for instance," he added, "there is no reason why another ounce of DDT should be applied anywhere in this state."

Conservation writing can not please everyone all the time. My personal experience has reaffirmed this many times. But honest conservation writing demands that the story of environmental threats be told, and let the laws of gravity guide the falling chips.

In Michigan, the agricultural community counter-attacked. The state legislature, top-heavy with rural representatives, sliced from the funds of *Michigan Conservation* the $10,000 used to place the magazine in the state's school systems.

To its credit the Michigan Department of Conservation did not alter its magazine's hard line toward hard pesticides or any other ecological threat. Through its magazine, the department assumed a position of real leadership; demonstrating the potential which a state conservation magazine really has.

Articles on ecological trouble spots are not the only subjects available to editors and writers. Some state magazines do an excellent job of presenting straight natural history to their readers. The wonders of the natural world offer motivation for our conservation writing. Mystery, surprise, tragedy, beauty are all around the person venturing into the fields and woods. And the good conservation magazine can convey this to readers, particularly young readers. The state publication can be an important aid in the school systems.

The Conservationist, official periodical of the State of New York Conservation Department, does an outstanding job in this direction. And still it does not ignore ecological issues, hunting, fishing, or activities of the department. A number of other state magazines also do excellent work in this area.

If you were privileged to design a new state conservation magazine today, or redesign an old one, what thoughts should guide you?

First, define your aims. What is the job you would assign this publication printed and distributed at public expense? How can those paying for it be given the greatest value over the longest period of time? To make it a PR effort for the department's programs or personnel is not sufficient. Aim for a balanced publication that tells the story of the resources and helps readers understand resource inter-relationships.

Such matters as the size of the magazine are often a matter of available funds. But a magazine does not have to be thick and heavy to have impact. The *Missouri Conservationist* does an excellent job in 16 pages, the same number of pages it contained when it was created three decades ago.

Having defined your aims, determine your audience. The temptation may be to design a magazine specifically to appeal to the leaders of the state's sportsmen's clubs. This is a temptation worth resisting. Design your conservation periodical to appeal to a broader audience. There are commercially successful, and highly experienced magazines, catering to the national hunting and fishing audiences. As a general plan, state publications neither should nor can compete with them. Each state has a special story to tell in natural history and conservation, and it should lean heavily toward the young readers. This is where the hope lies.

Recently a fifth-grade Ohio girl sent to the office of the Outdoor Writers of America a hand-written letter that is both revealing and touching.

Dear Sir,

I am a 5th grader at Fairfield Elementary in Maumee, Ohio. I want to help fight pollution of our air, water & land. I want suggestions from you as to how to conquer this problem. I am one of many people who want to stop this distruction of our planet. I am most serious about this request. Please send me any or all ideas which would help me to decide what I can do to overcome this terrible peril. Thank-you very much.

Sincerely yours,
Jane Downs

Eleven-year-old children were once carefree about the outdoors. Now they speak of overcoming "this terrible peril." These are the concerned citizens, and one of the few bright spots in a depressing prospect for the future. They do not ask for comfort, or to be told that the "terrible peril" does not really exist. More than many adults, these young readers sense that the peril is everywhere around us. And they ask *us* what they can do. Enlightened conservation magazine staff members are in a position to seek out the best answers to their questions, and to supply these answers. This is the audience that will read you, and they will read you on an adult level if you tell it like it is.

Finally, you need to consider how straight you will talk. If you do a major water pollution story, will you speak only in generalizations, or will you name companies and municipalities? Good conservation writing does not grow out of orders to keep everyone happy at all costs. The editor, whether of a state publication, organization periodical, or commercial magazine, is the conservation crusader. He sets a pace, understands this challenge, and accepts the role.

As never before, conservation writing presents a challenge. There is a pressing story to tell. Even more important, there is a public hunger for the truth. Facing the truth, as depressing as it is, is our only hope for survival as a species. This is the challenge of conservation writing today.

DISCUSSION

MR. DALE JOHNSON (New Mexico): The author was perfectly right when he talked about the truth; and I think there is one other challenge that really faces any of the conservation writers today, and that is to stay on the real, factual side.

As I see it, one of the biggest threats to maybe slowing down the great conservation movement of today would be the fact that we get mis-facts and we cry, "wolf" when there is no wolf there.

I look at this as being one of the problems that we are getting into because sometimes emotions go far beyond where facts lay.

My only question to the author is whether he thinks that this is a problem in the conservation writing?

MR. LAYCOCK: Yes. The handling of facts and the presentation of them is, of course, the challenge, and is a real challenge to the conservation writer today.

This becomes more than a responsibility for the conservation writer, and I do not mean to be backing away from any problems, but he deals with people who know more than he does about their specific areas, and their areas of specialization, and he needs to know where to find them, and how to deal with them.

Today we have many more conservation writers than we had a few years ago. Newspapers have taken people from sports desks, and magazines have taken staff people and said, "This is your new assignment." So, they become conservation writers; and they have to gain some degree of understanding of it very quickly.

My answer to your question, however, is that, yes, there is a constant challenge to weigh the facts that are gathered and present them in an honest fashion.

MR. ANTHONY HIGGINS (Bloomington (Ill.) *News Journal*): As I am here not as a professional editor in this field of journalism, Mr. Moderator, but as a generalist of the editorial page who has a personal and professional interest in conservation. I should like to say that it seems to me that the editors of conservation magazines, of state publications, or of official publications will do very well to come of age, as should the editorial writers of the metropolitan papers in their vicinity.

I am sure Roger Latham would agree to that, although he does not feel that he needs to use editorial writers as much as they need to be used; and perhaps Mr. Zeldin would agree over there.

It seems to me, however, you can multiply their effects by gaining the enthusiastic support or even argument or discussion among the editors who are writing editorials and perhaps design articles that probably do have more readership.

MR. DAVID BROWER (San Francisco, California): I am a Friend of the Earth, and I am accompanied by another, Dale Jones, from Seattle. Will the real Dale Jones please stand?

One of the things that occurs to me and has occurred to me recently is that there is no environmental crisis because about a month ago we had environmental issues of *Time, Life, Sports Illustrated*—you name it and they had their special issue. This month, however, there is practically nothing going in any of the magazines. So, this must really be all done.

I am wondering, George, if you can suggest to the audience what routes we must take to keep the pattern, and not create the illusion that one issue in the year can solve the problems.

I certainly admire what is happening in the *Audubon* Magazine, the new *Audubon* Magazine, and one of the good new magazines.

But how can we encourage these other publications that are reaching such large audiences to keep at it in an interesting way?

MR. LAYCOCK: I wish I had a simple answer for that one.

It is the same question that has been asked before and has come up repeatedly, I think, about how we can maintain a high level of interest in conservation in the public in general.

I am hopeful that these national magazines, with their grand circulations and their costly production, and a big staff, will not have, following one special issue the desire to back away from these problems and go looking for something else.

Time now has a regular section on environment. There is some evidence that there will be a continuing interest in it.

MR. ZELDIN: If I might add a comment to the answer, Dave, this is a real question that a lot of us have been wondering about, and one of the effective techniques I found is to make sure if you have a newspaper which is going to put a full man on the environmental aspect, make sure the editor hears from the people when they hear from him.

If you have a personal contact with the editor, the managing editor, the editor of the editorial page, let them know when they have something. Congratulate them when they have good coverage.

In a good way, a friendly way, point out when they have missed your story.

Get the information to them through you. Help them to find the truth. Help them to see the story they develop.

If you have an organization you can turn on get the organization to do it—not in a mass mimeographed letter or postcard, but in a quiet, intelligent way, and have someone knock out two or three sentences on a typewriter and say, "We appreciate what you are trying to do. We need more of this kind of work."

This is the kind of work that public information people as well as general environmentalists can do, and can help newspapers and magazines covering the general press do more of, so let them hear from it when they are doing it right; and help them do it right by supplying the information to them.

DR. SCHOENFELD: If I may add one other answer, Dave, you keep on making the kind of news that you have been making and the press will cover you. That is the real answer. Congratulations! (Applause)

MR. WILLIAM ANDERSON (Oregon): One thing that I think will determine the magazine publisher's continued interest in this subject is how well these articles sell. In other words, how many of these magazines disappear from the newsstand?

So, if you see them, I would encourage you, if you see a magazine with an environmental issue in it, to buy them, whether you read them or not. (Laughter)

MRS. ROBERTA WYNN (Library Service, Colorado): I am representing a little different viewpoint on the idea of finding facts for your basic material.

Librarians also need to be educated by those of you in the resource field in order to be able to find the type of information that their constituents need. This is an interplay between various patronage factions of the people. The public people will be coming to the librarian for assistance. We have your publications to give to them.

You might say we are a "middleman" between the publisher and the paper.

If, however, the librarian, the middleman, does not understand the language of what is going on, what is being done, then they, in turn, may be misinterpreting as the middleman.

I have been trying to say for years, educate your librarians.

DISCUSSION LEADER FLOYD: This might be one of the ideal objectives that Mr. Murray was speaking of in his formal presentation.

ROLE OF THE OUTDOOR WRITER IN COMMUNICATING CONSERVATION

ROGER M. LATHAM
Outdoor Editor, Pittsburgh Press, Pittsburgh, Pennsylvania

The membership of the Outdoor Writers Association of America is made up of full-time outdoor editors of newspapers, part-time outdoor editors of newspapers, staff members of outdoor magazines, free-lance writers in all outdoor media (including book authors), a good number of information and education personnel from state and federal conservation agencies and a sizeable group of persons who have outdoor programs on radio and television.

The membership also includes outdoor photographers and artists who specialize in this field.

As you can see, the term "outdoor writer," as used in this sense, is rather comprehensive.

Within the organization, there are about 700 members who qualify as outdoor editors of newspapers. There is no doubt that the total number in the country exceeds 1000.

It is difficult to estimate the reading audience of this group of writers, but it seems likely that it would exceed 40 million and might be as many as 60 million or more. The total reading, listening and viewing audience might reach close to half the population of the country.

This assumption is based upon a survey made by the Bureau of Outdoor Recreation which showed that 90 percent of all people in the United States participate in some way in outdoor recreation. Almost certainly, some of the remainder would have a passive interest in nature or in natural resource conservation. Thus, it is reasonable to expect that outdoor writers and broadcasters actually reach a bulk of the people in the nation at one time or another.

There is also reason to believe that this audience represents an almost total cross-section of society, since people of both sexes, all ages and nearly every level of income, read materials on such subjects as nature, outdoor recreation, conservation and, more recently, the environment.

From my 13 years of experience in this field, I believe the outdoor writer has a very receptive audience. He does, that is, if he diversifies his writing and presents it in an interesting, palatable fashion.

I have very positive feelings about the role of the outdoor writer in communicating conservation. I believe, because of his tremendous audience and his potential for influencing public opinion, that he must accept his task with dedicated resolve. He cannot afford to be flippant, inaccurate or otherwise irresponsible.

Incidentally, when I refer to an outdoor writer for a newspaper, I am thinking of the serious columnist. Those who merely report who caught how many fish yesterday, as is the custom in so many coastal city newspapers, are not outdoor editors. They are fish reporters.

It is so encouraging to see how well the newer breed of outdoor editor is accepting this role. He still writes about hunting, fishing, camping and other outdoor pursuits, but almost every one is devoting more and more space to conservation and environmental quality. In fact, quite a few have become full-time natural resource writers.

To my mind the writer's responsibility in regard to conservation can be placed in two very broad categories: (1) the need to induce a conservation concern and a conservation ethic in the minds of all Americans and (2) the need to convince the people of the United States that their physical, mental and perhaps spiritual well-being can be enhanced by the recreational use of these natural resources.

It hardly seems necessary to say that the present greatness of America was achieved through the abundance of her natural resources and the exploitation of these resources. But it is obvious that her greatness cannot continue, if these resources become exhausted or lost because of careless misuse.

This is the most important point the outdoor writer needs to make—that our future, and our very survival in the face of an exploding population, are dependent upon our conservation efforts in behalf of these resources.

So, the number one responsibility of the outdoor writer is to develop this ecological conscience, this conservation ethic, within each individual American so that he will want, and even demand, clean waters, green forests, an unlittered environment and a place where he can go to escape his artificial world back home. This ethic does not exist now in the vast majority of people. Our littered highways and byways and our scenic sewers prove that. But it is imperative that his concern for the environment be developed so that America can be placed upon a safeguarded and sustained natural resources level.

The outdoor writer's second goal is to convince people that outdoor recreation offers one of the finest opportunities for the average citizen to keep physically fit and mentally sound. Young people with keen outdoor interests seldom get into serious trouble with the law and develop into better, more sensitive, citizens because of their outdoor experiences.

Man needs these unspoiled resources for his stability and happiness. We see Americans taking 15 million pounds of aspirin each year; more than 20 billion sleeping pills (up 1000 percent over 20 years ago); and better than a half billion dollars worth of tranquilizers.

The outdoor writer has a variety of ways of reaching a maximum audience—and it is imperative that he reach this cross-section of society.

If I may use myself as an example, I write three columns a week—two in the daily paper and one in the Sunday edition. On the average, two out of three of these carry a positive conservation message. The third one may be a "how-to" item, but in this case the aim is to get people out of doors. Or hopefully, it will provide knowledge which will make their time spent out of doors more enjoyable or more rewarding.

My full page on Sunday includes selected outdoors and conservation news items, questions and answers, a book review and a series of short blurbs or comments under the title "Rambling Afield."

I write for both of the magazine sections published by my paper. For the one magazine, I write a series of articles on natural history subjects, averaging one about every second week. For the other, the *Roto* magazine, I do articles with pictures on a whole variety of outdoor and conservation subjects. Many of these are in color.

I also regularly use the Section Page of the paper for rather lengthy series on trips that I take or on subjects requiring far more space than a single column. These are always accompanied by pictures and other illustrative materials.

In addition, I free-lance in many ways and places; write an occasional book, or book-length report or plan, as a consultant; and give more than 100 lectures on conservation or outdoor subjects each year. Most of these lectures are illustrated with color slides which I take.

I also serve on several committees and task forces in conservation, conservation education, outdoor recreation, environmental planning and other related subjects. Thus, as you can see, an outdoor editor can become totally involved.

An outdoor writer can be effective in his efforts.

All over the country, we have many examples where these men (and sometimes women) have instigated and led a fight to offset some destructive development, to clean up a river, to prevent the drainage of a marsh or to defeat some irresponsible office-seeker.

I have had the satisfaction on a number of ocassions of seeing a bill introduced into our state legislature as a result of a column. I have seen a negligent governmental agency spring into action when a conservation problem was called to its attention. And I have seen what public sentiment and public pressure can do when people are awakened to the conservation facts of life.

And speaking of governmental agencies, they are missing a bet when they do not enlist the aid of knowledgeable outdoor writers.

These men can gain public support for the agency many times when it has failed miserably in its own efforts in this regard.

Explain the problem or the proposal to him; show him what you plan to do on the ground, if possible; and then let him carry the ball for you. Sure, I know that you cannot do this with every outdoor writer—some are just not qualified in one way or another. However, as time goes on, and as more and more of these men are specifically trained for conservation journalism, they will become more and more valuable to you. Most will want to tell your story and to be helpful, once you convince them that your objective is sound, sensible and ethically acceptable.

An now let me summarize.

If an outdoor writer is successful in his mission of conservation communication, he will effectively educate his readers and create a concern for clean waters, a green and clean landscape, an undefiled atmosphere and the prosperity of the combined fauna and flora. In addition, he will activate people, organizations, agencies and government to do something positive about the state's or nation's conservation needs.

The outdoor writer has an obligation to write seriously and objectively, with positive dedication. He must acquire a background of knowledge through self-education, above and beyond his formal education. He must learn the facts before he writes and then present his analyses with honest and careful conviction. Above all, he should be constructively critical. He is likely to accomplish much more if he is as free with is praise for a job well done as he is with his criticism of those who blunder.

The outdoor writer, if properly educated and directed, can be a potent force for conservation in America.

DISCUSSION

MR. DAN SAULTS (Sport Fisheries and Wildlife, Washington, D.C.): While I agree that the outdoor writers are growing, we had a recent example in Washington in which the *Washington Post* and the *Evening Star*, both fine newspapers, decided that they would join the environmental-pollution battle. They did it rather well; but in neither case did they ask outdoor writers to have anything to do with it.

The *Post* chose Haynes Johnson; The *Evening Star* chose Wollen. They both did a rather good job. Yet neither one of them had any basic training in it in any way.

The question, Dr. Latham, would be this: Do you see any evidence across the country that the outdoor writers are being accepted by their publishers as people who are authorities on environmental pollution?

DR. LATHAM: Mr. Saults, this varies tremendously, as you and I both know.

I would say that in quite a few cases it is happening. Of course, more and more papers are beginning to employ full-time resource writers, and these I consider outdoor writers, because most of them are graduated from that field, or from that profession.

I realize, however, that in many, many cases the editor does not consider his outdoor editor as being broad enough or capable enough to cover this subject. I do not know whether that is the writer's fault or whether the editors are overlooking their capabilities. But I know in many cases, that they assign this to someone who has no background in it, believing they might write in a more appealing fashion for the general public because of their background.

I do not know that this is necessarily the case, although many of our outdoor writers are hunting and fishing editors strictly and would not be qualified either.

MR. SAULTS: Thank you.

If I can add a second part to that, you commented that you were getting a good many letters from women, or getting a response from women readers.

I discussed this with Ray Heady from the *Kansas City Star,* whom I think has gone home, and who found in his place a growing phenomenon which pleased him greatly.

Do you think this is again true across the spectrum of the outdoor writers whom we will see out in Idaho this summer?

DR. LATHAM: If they are diversifying their writing beyond the ordinary hunting and fishing, I think that is very positive.

And incidentally, I might add that when I speak to different groups that the most responsive audience that I have is among the ladies' groups—the garden clubs. And if I get a message across to them I get action. I even get reactions from husbands, but action, nevertheless!

They do not mind writing a nasty letter to a legislator or getting on the telephone, and they do it.

DR. J. J. SHOMON (National Audubon Society): Dan Saults and I are living examples of the bur oaks that Clay was talking about previously.

I have a comment that I would like to make, and then ask Dr. Latham a question.

At the last Annual Meeting of the American Association for the Advancement of Science, held in Boston, there were 7,000 scientists present. They were very strongly convinced, that if we are going to make any headway in this country, and in the world, in stopping environmental deterioration, we were going to have to think in very determined ways about recycling, and they pointed very strongly a finger towards industry and towards business, saying, in effect, that industry has to be just as much concerned about the proper disposal of its product as in putting it out on the market.

Dr. Latham, the question I would like to ask you is this: One of the most serious things that we see in our big cities, and I speak particularly of New York, is the terrible litter problem; and one of the things that you see in New York, and all of the other large cities, are the terrible conditions of the streets and subways.

The thing that most clearly identifies our problem is the littered newspapers all over the place.

Just recently the *New York Daily News* came out with a very fine pictorial spread on what needs to be done to improve environmental quality. They showed all these pictures. They pointed the finger at everybody else but not at themselves, you see.

The *New York Times* at times comes out with a Sunday issue weighing 11 pounds, and half of these newspapers are later found in the streets.

Do you see any hope that particularly the newspaper outdoor writers may be able to educate their own people in their own constituency about this problem of the proper disposition of the products that are put out on the market?

DR. LATHAM: I think this can be a part of the role of the outdoor writer, certainly, and I hammer away at littering all the time, and try to be specific about it.

I do not recall that I have ever talked particularly about newspapers as part of the litter, but I have mentioned such things as walking down the street behind two or three children who were unwrapping candy and throwing the papers on the street as they progressed, and how many papers there were there.

I think, however, that this educational process is best initiated and consummated in the schools. If you reach these children when they are six or seven or eight years old you can accomplish more than you can by writing. Of course, hopefully the teachers will pick up items that you write and read them to the children, and I know they do. This is good.

With regard to this, however, and the disposal of all products, I discovered that it has been very rewarding for me to take the reverse trend, or the reverse system on my writing, and that is if a company does something, whether it is to control pollution or to prevent litter of their products, or something else, I make a big thing of this. Here is a positive move by a company, and I get a tremendous response from the company. The president, or somebody, calls up and says, "Thanks for that nice plug."

I think you do more that way than you do by just heckling them all the time and criticizing them, because suddenly they realize, "Gee, we did something great, and we had better keep doing this!"

And I do not know, Dr. Shomon, any other way to answer your question except to say that I feel that the children can really teach their parents about littering.

If I can take one additional second, I will tell you a little story. Some friends of mine went on vacation recently. They always told their children to never throw paper out the window of the automobile; to throw it on the floor in the car.

The children were left with the grandparents for this week while they were in Florida. The grandparents, as one of the first things they told the parents when they returned home was that they had the darndest time teaching their children not to throw paper on the floor of the automobile, but out the window. (Laughter) This is one of our problems.

MR. WALTER SHEPP (University of Akron): I think there are perhaps two extremes of the kinds of information we should be getting across. There is the long-term building of understanding. There is the immediate attack on specific problems as they arise.

Certainly the outdoor writers need to be doing both.

A good example of the latter was the recent Resources Supply Act, and the fact that part of that was attributable to a single mailing from the Sierra Club, which came at just the right time, and came to the right areas. I know in our particular area we did get a number of letters out to the various people in the vicinity.

One of the Congressmen had so many he had to mimeograph a reply. Our Congressmen did vote the right way.

I think our Congressmen can play a big part in this, but I wonder if we do not need, perhaps, more coordination of conservation groups who will be aware of all the hearings and all the bills coming before committees, so that the outdoor writers, the teachers, the conservation groups, and all those interested will be alerted to just what is coming up, and what is critical at a given moment.

I do not know of any way, and I do not have any good way of knowing what is going on in my particular area.

DR. LATHAM: As with many other outdoor writers, I rely very heavily on the Wildlife Management Institute; the Wildlife Federation; and the Sierra Club, and others, who do have regular newsletters, and among these you will find that practically every problem is aired at one time or another, and I include the Izaak Walton League, and so on.

So that if you are on several mailing lists, and the right mailing lists, I do not see any reason why you should miss very much; and I have other ways of keeping my ear to the ground in my own state, of course; but naturally I do depend largely on news releases and items that may come from one source or another.

These are quite dependable, and to my mind well done.

If it is a very serious problem, then oftentimes you will be bombarded, and this is good, also.

DR. RUTH L. HINE (Wisconsin Department of Natural Resources, Madison, Wisconsin): Mr. Moderator, I have been interested in the many interesting comments made this morning from all the speakers on the emphasis on communicating conservation problems.

I just wanted to underscore, and perhaps someone made the comment, the need for the type of writing that perhaps, if you would inflame nature's interpretation, which would help to create the really basic awareness of the land, something that would help people to love the land as Clay pointed out, or perhaps point out the ethics that Dr. Latham spoke of.

DR. LATHAM: Miss Hine, I am on the Advisory Committee for our State Department of Conservation on outdoors conservation education, and one of the things that I keep preaching is that if we can teach outdoors, and outdoor participation, participating in outdoor activities, whatever they may be—hiking, swimming, camping, fishing, and what-have-you—that once we get people interested in the out-of-doors for some value that they receive personally, then they are going to become conservation-minded automatically, because they do not want their fishing waters spoiled, or they do not want the canoe on a river that smells to high heaven, or they do not want a landscape destroyed where they are going to be hiking, or what-have-you.

I think that is an approach that I use in my own writing because, as I mentioned, many of my magazine articles are natural history, nature interpretation, and that sort of thing.

I even use in my columns oftentimes some incident that occurred where nature is involved in general, but I attempt to interpret it in one way or another—how it affects people; what the conservation impact might be; or what-have-you, and I find if I am talking about a dying deer that I found in a stream and rescued, and then went on from there to show the winter conditions as they refer to wildlife, that I get a great response from young people and women, and others, who might otherwise read a couple of paragraphs and then discard it.

They will go through it once you have stirred their imagination with a little incident like that.

"HOW MANY OF YOU DRIVE WHALES?" A PLAN FOR CONSERVATION EDUCATION ACTION

W. JANE WESTENBERGER

Conservation Education Officer, U. S. Forest Service, San Francisco, California

Once upon a time there were children—in Vermont or California, Missouri or Iowa, Manitoba or Nova Scotia—who went forth into the world each day to grow and learn and seek their way. It was a relatively clean, beautiful world full of marvelous patterns and processes which lay open to their touch and in turn touched them. One of Walt Whitman's poems describes this very well:

> There was a child went forth every day;
> And the first object he looked upon, that object he became;
> And that object became a part of him, for the day, or a certain part of the day, or for many years, or stretching cycles of years.

Whitman goes on to describe the purple lilacs and the young lambs, the clear water, the early corn and the apple blossoms, the fragrance of salt marshes, and the clean air which was the world of children somewhere, molding, influencing and helping them to be the adults they became.

Do you remember the places and experiences you faced each day as a child? Do you remember those things which helped to make you the scientist or teacher or conservationist or whatever, which you are today—which flavored the personality you have become?

Have you thought lately about the places we now send children into, each turn of the earth? Is the world of stench and crumbling cities, of garbage and burning streams of sewage, of noise and dark brown air the kind of world we want our children to go forth into every day?

Surely, no one truly wants this kind of "habitat" for children! We may not be able to agree upon the seriousness of environmental problems or even on what our difficulties are; we may not be able to agree on pesticides and petroleum or the proper solution to water pollution; but we can agree that children deserve better than the deteriorating world we see around us.

Of course, it is true that not all children have had a world of clear streams and meadows and red morning glories in which to exist! Far too many children have already grown up in the worst by-products of man's increasingly complex technology. Now, however, man is affecting his whole planet so swiftly and extensively that the very fabric of life may be in danger, and the time may be upon us when no child—or adult—can have the kind of world Walt Whitman describes so eloquently.

Once we have agreed that future generations have the right to have a viable, productive, attractive place in which to live, we must consider the actions available to us to assure this future. Basically they are in two realms: current individual and societal actions which will stem the journey to biological oblivion and place man in better balance with his environment; and, implementation of sound conservation education programs to prepare children to deal appropriately with the environment in the future. Frankly, both tasks are difficult, but they are obviously crucial. Frankly, I am glad my assignment is to deal briefly with the latter.

One of the very first steps in activating conservation education is to accept that it is *everyone's* business. Everyone has a stake in the result, and everyone must make contributions to the effort. There is no longer time for fruitless and dangerous perpetuation of the good-guy-bad-guy syndrome which says that the "bad-guys" do all the damage to the environment and "they" should be doing a better job of educating our children. As Pogo says, "We have met the enemy and it is us."

In the general practice of conservation, it is so easy to be *for* conservation even if it means restriction of activities, higher taxes, loss of profits, and other changes of behavior, as long as it is someone else's activities being restricted and someone else's pocket being tapped. So it is in education. It is too easy to criticize schools for inaction or poor programs, but, even though schools *must* retain the major responsibility for conservation education instruction, they cannot and must not do the job alone. Top-notch educators must contribute the best educational techniques now available and conduct the programs, but other specialists, including wildlife scientists, must contribute their knowledge and skills and support. These scientists must be a part of the team, and too frequently they are not.

What about you? How long has it been since you found out about conservation education programs in your local school—whether or not you happen to have children in classes there? How long has it been since you offered to share and translate your hard-earned knowledge and skills with the local school district or the nearest teacher-training institution? How long has it been since you have done some general reading and study on other aspects of the environment than the ones you consider your specialty? How long has it been since you did anything but shake your head and talk a lot about the problems?

Ironically, while enthusiastic participation of everyone in conservation education programs is vital, this involvement has its dangers. Such a situation is occurring now. There is much chaos and some hysteria in conservation education, because so many people are concerned about the seriousness of environmental problems and want to "do something." The result is, for example: too many attempts in some places to inculcate children with a narrow view of one problem without regard for any ecological ramifications; too much emphasis on teaching conservation in the field of science without regard for the economic and political ramifications of conservation action; too much emphasis on the negative aspects and not enough on constructive conservation activities; too much concern with identification of species and with esthetics to the exclusion of sound concept development. What then are the characteristics of a sound program which concerned citizens should be supporting and taking action on?

There is increasingly general agreement that an effective conservation education design is one that causes children to develop lasting, usable concepts about the environment. It is not enough to know 40 mammals, 32 birds, and all the edible plants of the California foothills. It is not enough to have a great deal of interesting information about the out-of-doors. Children—and all of us—must know, accept, understand, be emotional about and incorporate into behavior patterns at least two concepts. They are (and they can be stated in a number of ways): man is dependent on the resources of this planet for his own life and all the material things he wants; and, the environment in which man exists is an intricate web of interdependencies and interrelationships. There are many other related and very important concepts, of course, but these two seem to be the core or the pivotal ones. If these two realities were clearly understood, accepted at a "guts" level, and actually were an influence on human interaction with the environment, we would be on our way. Any conservation education program you support should utilize the conceptual development approach and include at least these two concepts.

A second vital element of a sound program is that it should extend from the earliest possible age level through at least the college experience. Concepts are not developed—do not become ingrained—overnight. They are developed over a period of time through involvement with a great variety of succeedingly sophisticated learning experiences—not all of which may be in school, of course. This facet of conservation education is one in which a partnership between educators and biologists or other specialists is particularly critical. A wildlife biologist may possess a vast store of information about the environment which could be used as building blocks in developing concepts, but it takes a skilled teacher to form these into a pattern which is appropriate for different children. Ecological concepts are complicated and must be conveyed in a variety of ways.

A third necessary component in a conservation education plan is that the instruction must spread horizontally across subject areas. There is scarcely a subject area which does not have a contribution to make. Most frequently, existing conservation education efforts are assigned to the science field. When this is true, only a part of the job is done. It is in the science realm that children may acquire much of the information about the world which helps to construct concepts, but it is in the area of social studies that conservation action most frequently must take place these days. It is in the areas of economics and politics, in particular, that we now face our greatest challenges and dilemmas. Very, very few conservation education programs are preparing children to make the very difficult choices which must be made if man is to survive.

A recent event illustrates all too well, and with some humor, the type of dilemma we face. A conservation organization was holding its meeting shortly after the first well-publicized oil leak occurred near Santa Barbara, California. The drilling accident was very unfortunate, of course, and everyone was deeply concerned about damage to wildlife. During the sessions it became very "stylish" to start each conversation and presentation with appropriate remarks of denunciation. Increasing concern was expressed about the fact that the famous gray whale migration was about to take place, and everyone certainly hoped the whales would not be affected. Incidently, you should know that on occasion the group accepts a contribution from an oil company—not the one responsible for the oil slick, however. A representative of the donating company happened to be in attendance at the meeting, and, of course, heard the many comments being made. Finally, he felt he could no longer remain silent, and the question he asked brings into focus, I believe, the dilemmas we usually refuse to acknowledge. His conversation went something like this. "The oil slick *is* a very unfortunate thing, and you are to be commended for your concern about wildlife and scenery and gray whales. I must ask you one question, however. How many of you drove a gray whale to this meeting?"

Perhaps I should ask the same question. How many of us here in Chicago would honestly be willing to give up our automobiles today to save gray whales or anything else? And what would happen if we did? It is all too obvious that a great many drastic changes must be made in human activities—no doubt including the elimination of our present form of automobile—but we cannot ignore such things as the economic ramifications of such changes. An effective conservation education program must arm children to face these difficult alternatives squarely and with usable knowledge and concepts. Did the conservation education efforts many of you have stimulated or assisted with include this element?

Earlier it was mentioned that some conservation education programs deal too much with esthetics. This statement needs elaboration. It was not intended to imply that appreciation of the beauties of the outdoors was unimportant. On the contrary, for a great many people such appreciations add a special and important dimension to the quality of life. This is not true of all people, however, particularly those in the so-called underprivileged groups. Their lives are bound by so many seemingly more immediate problems that the appreciation of a redwood forest or an alpine lake or a high mountain sunset is difficult for them to understand. Children from this kind of environment need more than esthetics.

Equally untrue is the related assumption that development of esthetic appreciations automatically produces effective conservationists. As a matter of fact, many of the people who thoroughly enjoy outdoor activities are the most inadequate conservationists. There is little educational evidence that merely teaching children to enjoy nature will cause them to be knowledgeable conservationists.

An additional element which is valuable in effective conservation education programs is a series of varied outdoor learning experiences.

These may last from a few hours to a week or longer. They range from use of an outdoor "classroom" or study area at the edge of a schoolyard to residency in a special outdoor school. When these experiences start in the lower grades and continue through the upper, when they are a part of the continuum of conservation education activities, when they are relevant, and when they take every advantage of the direct, personal involvement in and observation of the workings of our planet which is possible in the outdoor study area, they can be one of the most valuable portions of a conservation education plan. And, again, wildlife specialists and other professional resource managers have invaluable knowledge, skills and working areas which should be included in the conservation education effort.

Now that you have been given the "instant" course on the content of effective conservation education plans, what do you do after you leave this meeting to help such programs get started or improve the ones you already have? In brief, some or all of the following steps might be needed. All of them have worked someplace. The order in which they are presented is not necessarily significant and should be adapted to specific communities or states.

Important steps include:

1. *Formation of a community-wide or state-wide advisory team.* This team should include representatives from education, business, industry, science, government, etc. The group provides information, advice, political support and perhaps helps devise a master plan. The team may be appointed by a governor, a state board of education or superintendent, a local school board or other appropriate unit. The group could be self-appointed, but if so, at some point must have a constructive relationship to existing institutions.
2. *Mounting of an effective information campaign to inform people about the need for and elements of a conservation education program.* All facts of the media are generally willing to lend a hand with this. Much community support and understanding is needed, and this is one way to get it. Don't overlook field-trips for citizens to show them effective and sound environmental management as well as damaging activities.
3. *Searching for and helping with acquisition and development of outdoor study areas.* These should include: outdoor study areas on school grounds; a variety of habitat areas within a short distance of the school; more distant places for all day or one night trips; a site for a resident outdoor school. Don't overlook land managed by various public agencies including county, state and Federal units.

4. *Encouragement, writing and support of any needed legislation.* Many places need additional legislation to enable or support some facets of conservation education programs.
5. *Searching for and helping to acquire funding for various facets of conservation education plans.* For many communities this is the biggest hurdle. Possible sources include Federal education funds, business and industry, private donations, state or local taxes (many efforts are being made this year to seek new sources of taxes for conservation education), private foundations, and professional societies.
6. *Promotion of and assistance with in-service and preservice teacher education.* In the long-term view, this may be the most critical element of all. While some "pioneer" states include sound conservation in their teacher training programs, nationwide this is the weakest part of our conservation efforts. Until all teachers are thoroughly prepared to teach children about the environment and human relationship to it, we will not succeed. Most current efforts will only be transitory successes.
7. *Searching for and helping with improved instructional materials* which take the concept development approach and are ecologically sound. This is an excellent place for team efforts.

Other actions may be discovered which are particularly needed in a particular community, but the preceeding seven steps, successfully carried out, could mean the difference between survival and extinction. Frequently, a single member of the community, such as each of you, is all that is needed to provide the catalyst that starts the action.

Clearly, action is needed. We can no longer afford the search for scape-goats, nor the constant and futile recitation of the ills of our planet. We can no longer allow ourselves to hide behind our activities as specialized resource managers or researchers and expect someone else to do the education job. We must become part of the team and give our time and talent to the conservation education effort. We must remember, however, to contribute appropriately and not expect untrained teachers to immediately imbue children with our "sacred" and frequently very complicated ecological discoveries. Much of what has been discussed, though oriented particularly to conservation education programs for children, also applies to efforts of resource agencies and organizations to educate the general public. Both levels must be reached—and soon—if we are to survive and be able to send our children out each day into a world fit for living.

DISCUSSION

MR. KEITH HAY (American Petroleum Institute): Mr. Moderator, I am with the American Petroleum Institute, but I am not going to talk about gray whales.

I would like to talk, however, about some things you mentioned with regard to interpreting things to children.

I do not believe that environmental educators today are going far enough in this respect. You mentioned the outdoor experience, and I have seen, time and time again, where teachers, environmental education teachers, will take children out on a bus and will go out through the city, past a lot of ugly homes that have been built, buildings, and they will point out on the right the black smoke coming out of the factories, but they will ignore the gaudy hamburger signs, even the service station signs.

They will go right past a tic-tac-toe development that was built by developers who only wanted to make money; built in a beautiful valley that should have been preserved from a nature standpoint; get out to the nature area and identify birds and the contour of the mountains, ignoring some of the really classical points of the environment, and ignore trying to teach the children that the physical environment is a very important part of the environment, too; that indoor air pollution is just as important as outdoor air pollution.

I would like your comments on this aspect.

As far as bridging the gap in the truly environmental education, it would be of considerable interest to me.

MISS WESTENBERGER: I did comment about this in passing, and I find increasingly that good educational programs that are conceptual in nature and do become integrated with all subject areas do include the kind of thing you are concerned about.

When you start talking about the economics and the political action, and all the rest of this, the effect on every individual, wherever he lives, on the kind of conservation action that is necessary, you cannot avoid the things you have been discussing.

There has been a tendency in the past I think to overemphasize what is out there, the outdoor thing, without relating it to the child in his own home life. I was guilty of that, too, in the early days, but I can assure you that many of the best programs do include the elements you are talking about.

MR. JOSEPH WHITE (Pittsburgh, Pennsylvania): I wanted to comment on this last question.

As a member of the board of directors of the Association of Interpretive Naturalists of the United States and Canada, I would like to say that AIN is trying very diligently to bridge this gap from the old style of nature study to environmental interpretation; and in programs such as our national meeting to be held on April 1 through 4 in Hershey, Pennsylvania, we will be covering the interpretation of environments where the person finds himself.

We are finding more and more that we are—and I think Miss Westenberger will agree here—that this is the type of thing where interpreters have gone the wrong way and have neglected to interpret the direct environment.

You may have to confine your interpretation of mammals in the ghetto to rats; and you may have to get your plant identification down to the ordinary weeds that grow in the sand lot, but I think that, generally speaking, the professional interpreters in the United States have begun to bridge this gap and are beginning now to interpret and to show the little problems as well as pointing out the problems of industry, and of problems completely unrelated in bringing children from a ghetto-urban center to a definitely suburban or rural center, showing them this is the way life should be and then sending them back to where life is.

MISS WESTENBERGER: I agree. I know some of the work you are doing. I would challenge you to help teachers acquire the same kind of skill, however.

MR. SHAPTON (Michigan): All through the paper I had the idea that we did not have enough trained leaders, and I suppose you were referring to teachers.

In Michigan, we have approximately 82,000 teachers. Some of them are doing an excellent job in putting across the concepts which you mentioned. On the other hand, however, the bulk of them are not aware of the importance of these concepts. I suspect many of them do not know about the concepts.

I feel that some of our universities have failed to put across the concepts for these teachers.

So, how are you going to establish a crash program, develop an ecological conscience among all teachers, because you mentioned we have to get them at an early age. Is that right?

MISS WESTENBERGER: Right!

MR. SHAPTON: So, how are we going to carry on a crash program, especially in view of the fact that the United States has 200 million people, and 30 years from now we will have a thousand million?

MISS WESTENBERGER: As the man said earlier, that is the $64.00 question.

In part, money would be an answer. If you were to give me $6 million I could do it in a couple of days. Obviously, this is not going to happen.

I can only tell you that in one state in which I work we have just recently made conservation education mandatory in the public schools. That does not automatically assure good training, but teacher training institutions at least must train teachers to teach anything that is mandatory in the schools.

We are making every effort possible to put together all of the energies of a wide variety of organizations that are interested to get into the local level, and to be there to help train teachers.

We are working with administrators to help them be aware of this, and hopefully get them to release teachers from some class responsibility so they can take sessions.

We are also working on a state-to-state basis with deans of education in teacher training institutions. I am sorry to report this is the most difficult group we have now. I am really discouraged about the fact—and anyone here who is doing a good job is excepted—but I am discouraged by the fact that teacher training institutions say to go away and leave them alone.

Perhaps you who represent many, many communities throughout the nation could be the catalyst that goes home and says to your local college or university, whoever trains the teachers, "By golly, you have to get with this and do it! I am here to help you, but I am also here to keep at you to get to it."

I think this may help.

There was a feeling at one time we could train 15 teachers and those would go home and train 15 more. We do not have that kind of time, but please go home and nag. (Laughter)

MR. WADE: Miss Westenberger, I think you have just started to open the door on this teacher training situation. I come from one of the largest ones in the country, and we have approximately 7,000 elementary and secondary majors.

If some of you people who are on high levels throughout the country would get on the ball, get a list of the trustees of the universities, get a list of the officers and the key people in those universities, and start writing questions to them, and just asking questions, "What are you doing in this line?"—and then have a little excerpt in there that indicates this is considered an important area at the present time in teacher training, I am talking now about introductory courses to all elementary majors and secondary majors in environmental education, some sort of a package that would give them a really good introduction across the board, some of the things the panel has been talking about this morning, I can see how it would help, because I can see how it refers to me.

You see, we have always been kind to the big agencies, to write and support them, or not to support them, but now we have to do a turnabout.

So, if Roger Latham, and Mr. Laycock, and yourself, and others would write to these universities, I think you might start getting results.

It is going to take a little pressure, and we might just as well use pressure because this is a good way to do it in my opinion.

DR. LATHAM: I do not have a question, but I would like to comment on the last.

Joe White, and two other persons and I, volunteered our services in our own Pittsburgh area, Allegheny County, to do this for the teachers of that county. In other words, we were going to take them on a series of field trips; provide them with a series of lectures from resource personnel; and we were going to show them the problems; what is being done about them, and try to give them an on-the-ground education.

We did this strictly on a volunteer basis; that is, we asked for their participation on a volunteer basis; and the result was rather disappointing. We did get the ones out who were already interested, but very few others.

It could have been a very fine thing, and a very rewarding one; unfortunately, however, we did not have the county superintendent, or whoever does it, say, "You shall attend"; and if he had, we could have made this a successful venture, and at least had them off the ground. Unfortunately, however, it did not work out successfully.

MISS WESTENBERGER: You have hit on a very good point. That is why so many times people like yourselves simply volunteering, or suggesting that you can do something, or that you know the answers, will find that this does not always work. You do have to convert the administrative level first.

I am tending to believe more and more that despite the fact that I once testified to a state legislature to the opposite, that during some interim period this is going to have to be a requirement in teacher credentialing, and this requires legislative action in many states.

This is again where many of you can perform a service, realizing that merely making it mandatory does not necessarily mean the quality will be good, but at least it is a step in the right direction.

Almost all of the teachers at the elementary level can teach reading, writing, and arithmetic, if they are good teachers. They should be teaching conservation, too. And it is happening in a few places now.

MR. SAULTS: Mr. Hay asked the first half of my question, and the other gentleman made my second point, that education is much too important to be left to educators.

Therefore, let me say welcome, Miss Westenberger, and I will accede to that.

MISS WESTENBERGER: You may be right, but you are not going to be able to muster enough people to do the day-by-day, month-by-month, and year-by-year job. You may be able to get some of the administrators, but you are going to have to be able to see that they are good enough to do the job.

DISCUSSION LEADER FLOYD: I will turn the meeting back to the Chairman.

CHAIRMAN SCHNEPF: In closing, I want to assure Miss Westenberger that we wanted her to remove her skepticism about being last on the program. We did so for obvious reasons, to conform with the old adage that says that we save the best to the last.

I want to thank all of the participants, and I want to thank all of you for coming.

GENERAL SESSION

Wednesday Afternoon—March 25

Chairman: WERNER A. BAUM
President, University of Rhode Island, Kingston

Vice Chairman: ROBERT L. HERBST
Executive Director, Izaak Walton League of America, Glenview, Illinois

THE FIGHT FOR A CLEAN ENVIRONMENT

REMARKS OF THE CHAIRMAN

WERNER A. BAUM

The air controllers are doing all they can to keep jet discharges from being ejected into the atmosphere. As a result it is going to be a highly abbreviated session this afternoon.

Unfortunately, three of the four scheduled speakers are unable to be with us and so we'll only have one paper. Afterwards we shall proceed directly to the appraisal of the conference program.

I would now like to introduce to you the gentleman sitting on your left, the vice chairman for this session. He will lead the discussion following the paper. He is Mr. Robert L. Herbst, executive director, Izaak Walton League of America.

He was formerly a forestry instructor at the University of Minnesota and also a deputy commissioner of conservation of Minnesota.

Perhaps the newest thing about what is happening on the scene is the fight for a clean environment. Certainly the concern for a clean environment is not a new one among the professionals. Indeed, those of us who have been worried for some time about various pollution problems get concerned over some aspects of the situation at the moment, in that it may prove to be more harmful than beneficial over the long run. We have a serious long-range problem on our hands, in which there are not going to be any overnight solutions. It is a problem which will require diverse, dedicated effort for a long period of time.

If there is doubt on the part of anybody about the fact we are dealing with an old problem, I was reminded of that just a week ago, when I happened to pick up off of my book shelf the play entitled *The King* which was written about twenty-five hundred years ago. I had never noticed it before or, on the other hand, may have forgotten about it, but that book or play as the case may be, opens with a discussion of the problem of atmospheric pollution which was becoming unbearable. Perhaps that puts some perspective on the nature of the problems with which we are dealing.

The first (and unless a miracle should occur) and only paper to be presented is that by Mr. Karl R. Bendetsen, chairman of the board and president of the United States Plywood-Champion Paper Corporation of New York City.

Mr. Bendetsen comes from the Pacific Northwest. He is a graduate of Stanford Law School and has been admitted to the bar in California, Oregon, Ohio and Washington.

He has served as a special assistant to the Secretary of Defense and Assistant Secretary of the Army. He also has served as Director General of the United States Railroad and Under-Secretary of the Army.

It is now my distinct pleasure to present to you Mr. Karl Bendetsen.

RESPONSIBILITY OF INDUSTRY IN THE ENVIRONMENT

KARL R. BENDETSEN
Chairman and Chief Executive Officer, U.S. Plywood-Champion Papers, New York City, New York

In Genesis 1:26 we read that God gave man "dominion over the fish of the sea, and the birds of the air, and over the cattle, and over all the earth."

Failure to exercise that dominion with wisdom and foresight could ultimately bring us face to face with the spectre of an environment inimical to health, happiness, and even to the survival of man. The dominion which God gave man is not the sole property of those who are living today. It is indeed for us wisely and prudently to use the resources over which we have dominion, but it is also mandatory for us to assure that those who follow in the generations to come may also have the same opportunity wisely and prudently to exercise that same dominion. God has given man a choice to elect good or evil. Man may abuse or wisely use his God-given endowments. He may lay waste through abuse of resources. He may also lay waste through abuse of his power to procreate.

As human beings we are in, and of, and part of the natural world. Heedlessly to deplete nature is to deplete mankind. Wise dominion, therefore, demands a deep sense of responsibility for creative use and not destructive abuse of our natural resources.

The task of preventing the degradation of our environment will demand massive monetary and technological resources. And more than this, it will demand the wise courage to make an irrevocable commitment to the marshaling of these resources with imagination, intelligence, and foresight.

In January President Nixon felt that this subject was of such importance that he chose "environment" as the keynote of his State of the Union address. Government at all levels is beginning to heed the national demand for clean air, clean water, for comprehensive, major improvements in all aspects of our environment.

Within the past year we have witnessed a great groundswell of public concern about our environment. Ever growing numbers of people of all ages wonder whether it is in jeopardy and, if it is, what should be done. The science of ecology has come of age. Scientists, ecologists, naturalists, conservationists—all are warning that the quality of the environment may be approaching an irreversible adverse trend. There are many warnings. May we today consider together some possible solutions?

That our environmental problems have been taken up as a public cause is salutary. It can lead to timely and constructive consequences. This can produce necessary action in the political arena, and things begin to get done. DeTocqueville, that perceptive French commentator, noted more than one hundred years ago the tendency of Americans spontaneously to band together and work in unison for the solution of common problems. In the quest for solutions perhaps the most difficult challenge of all is to retain perspective, and above all, to be rational. This requires of us, and especially it seems to me, those of us who are today thoughtfully assembled here, to exercise leadership to prevent hysteria and emotionalism from taking command. A parallel requisite is responsibly to bring realization to our fellowmen that it is far easier to identify problems and assign wrongs than it is to deal with them. For one thing, solutions will themselves require the use of great resources in time, money, technology and manpower. These cannot be wasted either and certainly they would be by misdirection, false panaceas and simplistic solutions. To date, there has been a notable lack of practical solutions and an equally notable public failure to be willing to face up to the cost of effective action.

It is clear to all of us that the genuine conservationist is not interested in tarnishing his great cause with shout-down tactics. Our cause—the future of mankind—is clear, and it is also crystal-clear to honorable men that they must assume the vast responsibilities of feeding man's needs while, at the same time, cherishing nature's.

My approach to resource conservation and to the control and disposition of liquid, gaseous, and solid pollutants is affirmative and positive. I am not one of those who contend that we cannot deal with our environment. We can, if we act rationally. Nor do I feel that we have run out of time. We have not. And if we have, why bother? Why not let us die in peace rather than in frenzy? The time has come to look beyond the apocalyptic rhetoric of the prophets of doom and to get on with the job, no matter how difficult and complex it may seem. We do have the time. Even the most pessimistic of our now well-known ecologists, Barry Commoner of Washington University in St. Louis, said recently, "We are in a period of grace. We have the time, perhaps a generation, in which to save the environment from the final effects of the violence we have done it."

Let us use that period of grace with wisdom. We can attain all of our environmental goals, but only by being rational rather than irrational, by being logical rather than emotional.

Consider the question of costs, about which there has been a plethora of irrational talk. Talk which conveys the notion that "someone else" will pay the cost. Who else is there but all of us? It is an indispensable characteristic of any and every political system, whether totalitarian, communistic, or our limited free-enterprise society, that the agencies of production and distribution by which societies are sustained must collect from the people enough to return to them the services and means by which they live—with enough margin left over to provide for growth and development: for new plants, new buildings, for metropolitan transportation systems, for educational and health centers, for whatever may become socially requisite and desirable. Otherwise society will first stagnate, then regress and finally die.

Our system of free enterprise is near and dear to us and, as the newest and youngest in concept of any in the world's history and the least known among the world's people, it holds the greatest promise.

Consider further the question of cost with a timely but limited illustration. Take the example of fish versus brownouts faced by electric utility companies. Again this is a question of what people are willing to pay for. Either we should decide that we cannot have both fish and power and opt for more power and less fish, or for less power and more fish, *or* we as a people can decide to have both. And who will pay for both? The users of the power. The cost ultimately must go into the rate system, no matter who owns the power plant. Otherwise the plant will ultimately cease to function for lack of money, and we would have unintentionally decided for no power. There is yet another cost, another price society must bear. The overwhelming impact that the population explosion must inevitably have will be to subvert our most enlightened efforts to save, let alone to improve the quality of the environment. If we are not somehow able to stabilize the nation's and the world's populations, all efforts to save the environment, no matter how massive, how expensive, will be futile and will come ultimately to naught.

I state this as a matter of deep personal conviction although as a businessman I am fully mindful that a zero population growth will have revolutionary effects on the American business system. Part of the hidden cost of a quality environment is fewer children in many American families and slower growth for many American corporations. We can be encouraged by Dr. Gallup's survey, which the National Wildlife Federation sponsored, but only time will tell with certainty how much and how fast people will pay for a quality environment. The rate of payment may be more important than the total amount. Literally, no one knows how much the whole cost will be. The sooner we get under way, the less it will be—staggering in any case. The President has proposed a five-year program for clean water estimated to cost $10 billion, with $6 billion of this total required from state and local taxes and bond issues to construct required municipal treatment plants. Implementation of this plan will require greatly increased state and local taxes within a relatively short period of time.

How then do we proceed? Pollution control must be paid for by the users of the environment, by the people who dwell in it. We shall gain nothing if we extinguish production and distribution unless we want to turn back the clock and return to a primitive, nomadic state. However enjoyable this would be, I suggest it is too late for this solution.

Effective control and disposal of liquid, gaseous and solid wastes, the outfall of our complex society, has several requisites. Take, for example, water pollution abatement. I do not believe this can proceed successfully by requiring each of hundreds of thousands of sources of pollution along major watercourses to be separately treated—at least not in the great metropolitan areas, all of which are on or near waterways.

For the abatement of pollution of water, it may well become necessary, in certain instances, to establish watercourses whose basic function will be the collection and transportation of waste to points where public waste reduction facilities will be established to provide adequate treatment, charging users utility rates.

We all recognize that there are still a few "wild rivers" in this country so untouched, so unspoiled that every effort should be made to preserve their natural quality. And this precludes any industrial or commercial development of any kind. At the other end of the scale there are rivers so industrialized, so urbanized, so polluted that no conceivable effort is ever likely fully to restore them. In such cases our efforts might best be directed to the protection of the receiving waters rather than to a fruitless struggle to rehabilitate the emptying stream. For example, saving Lake Erie could be far more important than cleaning up the Cuyahoga River—put a massive reduction plant at its mouth to treat all the wastes before they enter Lake Erie.

It may in fact become necessary to have a number of waste transmittal watercourses whose major function shall be to bring these wastes into relatively vast open areas to a concentration of treatment works for the reduction of these wastes, perhaps even a series of such works along the watercourse, so that before these streams reach the lake, the estuary or ocean, they would be clean again. A comprehensive system like this would take the burden off many another watercourse into which any waste transmission would be forbidden. Such waste transmittal streams and treatment systems, designed to serve large regions, perhaps total river basins, would require a complex of conduits, pipes, pumping stations, and waste treatment facilities that would also challenge our technology.

I have been convinced for many years of the economic infeasibility of requiring each and every pollution source along a waterway to treat and purify his own wastes. In 1965 I had the opportunity to suggest to President Johnson the concept of vast, publicly owned and operated regional treatment plants which would charge utility rates for the service. A faint glimmer of this idea found expression in the Water Quality Act of 1965, but the full implementation of this ambitious concept remains to be done.

It should be abundantly clear to all concerned also that we are not going to get the job done through punitive measures levied against the millions of sources of pollution. The levying of fines and other punitive measures is only one of the tools available in any program for a clean environment. And it is a very special tool that must be reserved, in order to remain credible, for exercise against only those polluters who knowingly, willfully, and flagrantly violate accepted standards.

The massive use of punitive measures simply will not work, alone. We must get this out of our thinking. If we do not, we will be locked in a struggle that will keep us in controversy for the next decade. What should we elect to do? Solve the problem, or debate it?

The battle against the pollution of air by gaseous effusion from the reduction of solids and in the disposal of solid wastes, requires a massive program of technological developments. The combustion of fossil fuels for transportation, electric power plants, industrial processes, domestic and institutional heating and incineration make up the bulk of the total tonnage burden of air pollution. We must clean up the combustion process in all cases and then control it. The means are generally available for reducing these emissions but not for eliminating them. They must be found. Techniques of controlling gaseous and solid by-products of combustion are still in their technological infancy. Again, no matter what courses are chosen to get clean air, we must develop the technology and then accept the higher cost of energy production and reduction of solid wastes.

The pollution of air from millions of incinerator stacks used in the reduction of solid wastes can be presently controlled only at each source. Until more effective measures for the reduction of solid wastes are found, this will require development of an economic air-pollution control package that can be fitted to each of these sources. At least as a first stage in the control of air pollution, packages such as these must be developed and applied. If they are readily available and not used—we will then know what to do—throw the whole book at violators.

The most fundamental need, therefore, in our strategy of attack on environmental problems is to define the requirements in the various categories of pollutants and to develop concepts for dealing with these requirements, realizing that they are inter-related—a fact not generally recognized. The second, equal, parallel, and additional massive requirement is the rapid development of new applications for the reduction of pollutant wastes. Inadequate progress has been made in antipollution applications research.

There does not exist within the federal structure an agency whose primary and sole mission is environmental improvement. I propose that there must be. It should be created. Many of its elements exist, but they lack priority, they lack organization of the disciplines in a massive, purposeful way for effective action.

The Federal Council on Environmental Quality appointed by the President under Russell Train is indeed an important step in the right direction and may well lead to such an agency.

I see such a new agency, given the priority and the required funding, as an essential element in the solution to the problems of environment. Under the leadership of such an agency, we could concentrate and marshal the resources necessary for a massive assault on the development of pollution abatement measures and devices for dealing with pollutant wastes and with the inorganic residuals that come from every single application used today. With regard to the solid residual wastes, the inorganic, no one has dealt with them adequately. Through such an agency, the great costs could be equitably shared by everybody. Under national leadership you, the scientists, engineers, and conservationists who possess the requisite disciplines, could be mobilized for rational, effective and successful action, just as we saw our national human and scientific resources mobilized for landing a man on the moon.

In consonance with my conviction that industry must take positive, collaborative, and coordinated action for maintenance of a clean environment, I have committed my company, U.S. Plywood-Champion Papers, to a planned, long-range program and investment in environmental control measures. Under this program we are engaged in an on-going effort to bring our old plants into compliance with all applicable air and water quality standards. And at some of our old mills, I can tell you that this is neither an easy nor inexpensive undertaking. Nevertheless we are doing it. We are designing our new plants to exceed the standards of today.

Later this year we will bring a new pulp and paper mill on stream at Courtland, Alabama. Because the mportance of environmental protection was in the forefront of our thinking when the site was selected and the plant designed, we are confident that it will bring us as close as the present technology will allow to our common objectives—production without pollution; fish and jobs.

Let me speak for a moment of just one other aspect of these efforts. In July, 1969, our company announced plans to construct a new forest products complex in southeast Alaska. Our contract with the U.S. Forest Service for the purchase of 8.75 billion board feet of timber in Alaska includes measures for protection of wildlife, fish, fish spawning grounds and water quality where logging will be carried out. To ensure that the goals of preserving Alaska's heritage of unspoiled air, water, fish and wildlife would be met, I asked seven leading ecologists to serve as a blue-ribbon panel, as advisors to us in every aspect of the planning, construction, and operation of this complex.

I asked that they constitute a continuing advisory group to the company before, during and after construction of the complex to ensure continuity of environmental protection.

You will appreciate the caliber of this ecological panel, which has the distinction, I believe, of being the first such panel so engaged by a major industrial concern, when I tell you that its members, distinguished in their respective fields, are Dr. Donald J. Zinn, president of the National Wildlife Federation; Dr. Stanley Cain, professor of natural resources at the University of Michigan, an expert on environmental control; Dr. Ian McTaggart Cowan, dean of graduate studies at the University of British Columbia, an authority on birds and deer; Dr. Donald Hood, professor of oceanography, University of Alaska; Dr. A. Starker Leopold, professor of zoology at the University of California, an expert on bears and blacktail deer; Dr. Kenneth Rae, oceanographer, University of Alaska; and Dr. R. Van Cleve, dean of the College of Fisheries, University of Washington, who will also advise on the protection of salmon spawning.

Working closely with these fine men of the ecological group has been something of a revelation both for my company and for them. As professional ecologists, they include in their definition of the term "conservation" the works of man, and they accepted with enthusiasm my request that they study in the living laboratory of southeast Alaska how best we could utilize these great forest resources with the minimal adverse effects on the ecology of the area. We are committed to following their recommendations for not only site selection—which they made to me recently—but for future operations in enlightened multiple-use forest and land management. Through this collaboration we hope not only to preserve but to enhance wildlife, water, recreational, aesthetic and other environmental values of the area. Of equal importance, we hope, in my company, that we are breaking new ground for future working relationships between industry and the ecological disciplines, business corporations and conservation groups. As a conservationist and as a businessman, I believe that through such working alliances, working together and with the government, we can and will provide sound, constructive, realistic solutions to our environmental problems.

Now, ladies and gentlemen, I have an afterthought which I wrote out late last night.

The Mayor of New York has decided that cutting out all traffic on two streets in Manhattan is a fitting way for his City to commemorate Earth Day on April 22nd. The New York *Times* commented upon this editorially and here I quote:

"Certainly we support Earth Day and enthusiastically endorse its purpose but blocking off our arterial streets and disrupting traffic is only a kind of urban problem."

Now, this in turn prompted me to ask as to just why two streets in Manhattan. In other words, if the purpose of Earth Day is to teach, then we should also be willing to learn in other areas. Therefore, why not something more then just New York? For example, how about taking into consideration the entire nation?

The editorial goes on to comment: "If traffic is to be a target, why not forbid all but emergency and commercial vehicles from entering Manhattan altogether on Earth Day?"

Again, I ask, why stop there? The problem is just not traffic and, certainly, it is just not confined to Manhattan at this time, at least it seems that way.

If we wish to dramatize the situation maybe we should cut off all forms of pollution entirely, everywhere in the United States for the 24 hours of April 22nd. This would mean, of course, no power, no light, no heat, no air conditioning, no newspapers, no television, no radio, no cars, no buses, no planes, no trains and, hopefully, no smoking.

It would also mean, of course, no production, no business and no jobs.

We can stay home and contemplate this unaccustomed quiet which would be like some ancient medieval village. The women would hate us because they would be caught dead without food defrosting and no stove to cook it on. Also, I suspect that a lot of men would want to go fishing and, further, some of them would even decide against it, especially when they realize they would have to walk or ride a bicycle.

Children would love it because many of the schools could not open. It would be a strange and awesome day indeed, a day which would long be remembered and from which I suspect we would learn much. However, strange as it may seem, it would not be a totally unpolluted day in our private lives. Quite the contrary. With the nation's toilets unflushed for 24 hours, pollution would suddenly become a reality for everybody. Indeed, such an all-out observance of Earth Day could prove in one respect counter-productive and self-defeating.

The correlation between New York City's November 19th, 1965 blackout and the upsurge of the City's birth rate the following July comes to my mind. This thought causes me to suggest that perhaps I did not have a very good idea after all.

DISCUSSION

VICE CHAIRMAN HERBST: Thank you, Karl, for a most interesting presentation.

It is very obvious, ladies and gentlemen, that he has sincerely concerned himself about conservation and about the quality of our environment.

I also think it is obvious that he has given, both as a businessman and as a conservationist, considerable thought as to the solutions to the threat of our environment. He posed a most interesting concept of controlling water pollution, and I am sure many of us are very appreciative of his company's decisions to move rapidly in reducing its effect on the environment and making a better quality of life for the surroundings.

MR. WALTER KLEPNER (University of Akron): I have a loaded question. It is common knowledge that in the past many government agencies set up to regulate and administer our natural resources have not done a very good job of it and sometimes they have been accused of representing the industry that they are supposed to be regulating more than the general public.

One problem has been that the citizen has had no recourse directly to the courts. Lately this has been changed somewhat and the courts have been giving citizens the right to sue and—as someone who is directly involved—what do you feel is the future role of this new development in conservation work?

MR. BENDETSEN: I think I understand the question.

For example, if everybody went to court, then, in turn, I suppose the courts would become congested. In fact, I am sure there would be chaos. On the other hand, I don't know quite how to deal with it. In fact, I don't think anyone does.

I think all of this has to be handled in an orderly manner or it will not get done.

If these suits were tried for the purpose of reaching milestone decisions, as part of the regular business of the courts, who knows, it might help and it might not. I have no way of predicting this. I was not able to predict such things even when I practiced law, and I certainly have not done that for a long time.

Further, as a former lawyer, I certainly do not want to take my own advice on this.

I am sure there will always be someone who feels that some agency is close to private business interests. However, I have not seen it. I recognize the charge is made, and I know it always will be made. Let me merely add here that charges are easy to make and, further, the more they are made, the harder they are to answer, even if they are entirely unfounded.

I trust that I have sufficiently answered your questions.

VICE CHAIRMAN HERBST: Do we have another question?

MR. DAVID BROWER (Friends of the Earth): I think I appreciate the dilemma that we find ourselves in as Earth Day approaches and I cannot help but compare the reaction in this audience to your concluding remarks, with what I think that reaction would have been at several of the student audiences that I have been addressing for the past three months.

I myself find a dilemma of perplexing magnitude here. For example, I was recently associated with an organization which uses probably some thousands of tons of your paper in connection with its books. Now, the same organization is, as you may know, involved in suing the Secretaries of Agriculture and Interior and other authorities about your organization's activities on the Admiralty Islands, their concern being in part that the major export of pulp to Japan is of vital concern here.

My question really is this—in your discussion of pollution and the intensity of it, do you think there is some counsel in the words of Fuller, who indicates that our goal for the seventies and henceforth is really to learn how to do more with less? In other words, do you think that there are possibilities when we waste less then we might actually have some savings?

I have been in touch with Dr. Teller, who is Dean of Engineering at Cooper University, who is trying hard in relation to recycling to encourage industry that they can save on occasion by not wasting into the streams but that the product can be used again.

Do you, in connection with your work along this line, especially in the plywood industry, have any intimation of this kind of benefit that might accrue from polluting less—not simply higher costs, but also the chance to save by recycling?

MR. BENDETSEN: Of course, the practice of recycling is something which my company practices to a very great extent. We employ every recycling device that we know about and that will work in our system. They do not all work in our system and we are anxious to find those that do.

I think that someone would have to be out of his mind not to want such systems.

One of the major elements of our process has been to recycle or we could not make any paper at all. We could not afford to and you could not purchase because, in that case, the price would be too high and it would be totally uneconomical.

The recycling units that we are talking about today cost on the order of some

$12 million a copy. This involves just one recycling unit. They are very valuable and very important and it doesn't pay for itself at all but it still would make the cost too high not to have them.

I think that the general technology along this line is still in its infancy and that there will be great opportunity for recycling.

Also, I would think this would involve different applications of these wastes. You know, it seems easy to forget that everything that we call waste comes from the earth. It doesn't come from anywhere else. However, now it is being returned in a different form. There is a suggestion to the effect that, with a sufficiently pointed and well-managed, well-conceived technological effort, and with the encouragement of the scientific disciplines which are today being discouraged by some people (and I am very sad about that), there could be found useful applications for these wastes that none of us knows about today.

All this would involve new break-throughs, creative thought, intelligence and so on.

Further, I think that what you are talking about is very important and will have a profound influence on the shape of an intelligent, effective and rational attack upon the problems of pollution.

As I said, all of this waste material essentially comes from the earth and therefore, there ought to be something we can do with it that is not necessarily injurious to a river.

Also, you need to encourage in your work an understanding of the facts that pointing fingers will not solve the problem.

The problem of organic waste, which is the consequence of every single recycling recovery treatment method today for dealing with many so-called wastes, has never been solved and has to be solved very largely in the future. Of course, there are some examples throughout the country where waste has been utilized for an actual product. Here I am reminded, for example, of the St. Regis Paper Company, in Rhinelander, Wisconsin, that grows a yeast from its waste and, in turn, manufactures a protein which goes into a cattle feed and also goes into various products you use in your home.

What I am trying to indicate here is that there are many opportunities for research in this area to make products that can be useful out of some of these industrial wastes.

MR. KENNETH PETERSON (Flint, Michigan): I am not quite clear as to why you assume that air pollution wastes can and should be reduced or eliminated at the source but that water pollution wastes cannot or should not be reduced or eliminated at the source. Could you answer that for me?

MR. BENDETSEN: The question is why I suggested in my remarks that whereas gas or stacked streams have to be treated at the source and pollutants to our water collected at a central place?

Well, I would not know how to collect nor do I think anyone else has suggested a way of collecting the countless stacks that emit some form of air pollution every day in every city in the country across the land. If there were a way of doing this in a metropolitan area, then I suppose it would be logical to expect that someone would suggest it in the reduction of waste entering our streams, rivers and other waters. However, as I say, it is not quite that simple.

It would be more economic and cost the consumer less if it were done in an economic manner—in other words, if every single source attempted to do its own treatment, it will never be as economic as if collected and treated in a single plant, for example, in the South.

Many people have mistakenly led themselves to believe that by going to each separate source, someone else would pay the bills, and, of course, this is false thinking because there just isn't anybody else. For example, whether a business is privately or publicly owned, if it does something and is unable to recover its cost or lay something aside for the future, it will die.

Therefore, the matter of cost is not a question of who pays for it. There is no society in which the people who live in it do not pay for everything. They are the only ones who can and the method does not make any difference.

My suggestion is based not on what I know many people would charge. While I may be an industrialist, I ame not trying to sneak out from something—because that isn't it at all, not in the least. I am just trying to search for a sensible way of dealing with this vast problem of billions of gallons a day of polluted waters. The heaviest source is municipal wastes. This is especially true with regard to total gallons and total quality and, of course, it has a destructive and violent action on a stream in the way of oxygen.

Now, as I have tried to indicate, if you are going to do the job, then, in turn, why not do it in the most economic way by doing it in one area on a total basis? This is all I mean by my statement.

CHAIRMAN BAUM: If I might, as a scientist, I have a question.

It seems clearly impossible to control atmospheric pollution in any way except at the source. With respect to a smokestack, with direct action being upstream one day and down stream the next, there is essentially rapid dispersal in three directions in an almost random fashion due to turbulence phenomena. However, in water, unless you are discharging directly into an ocean, if you are discharging into flowing water you have the pollutants confined to a hydrodynamic flow pattern, and you can deal with the flow pattern in an intelligent way. This is especially true if it proves to be economically feasible.

As I say, this is technically feasible in water but not in the atmosphere.

MR. GEORGE BYELICK (University Student): Let me first say that I understand the gentleman's rationale and support for his busineee interest. However, he keeps returning to the subject of economics. Also, in the paper, he is labeled as a man who is a conservationist.

I wonder if he would outline to those present here what supports that label for you? In other words, why are you a conservationist and what makes you a conservationist and the second part of the questions is this—what percentage of your budget or percent of receipts are spent on environmental quality research and stabilization? In other words, what do you put back into it for finding the answers to environmental problems?

In other words, the problem is simply this—would you define your background as a conservationist, or your interest in connection therewith and, secondly the percentage of your budget, of your company's budget, that goes into environmental matters?

MR. BENDETSEN: In relation to the first part of your question, I would endeavor to answer you in this way—I think a man is a conservationist primarily by reason of the convictions he holds. I think he is this by virtue of the things he believes in and I do regard myself as a conservationist and always have.

For example, I have advanced the cause of conservationism in that I am undertaking to create sustained yield forests that are an ever-renewable resource. I think that is conservation. Now, while you and I may not agree, nevertheless, that is my answer. I think I am a conservationist and, after all, it is a subjective matter. Of course, you are likewise entitled to your opinion in tihs respect.

Now, the capital budget in our company, of course, varies from year to year. This year we have had to defer some things we would like to have done because of the current economic situation, which requires us to. In other words, we do not have the necessary funds to build some of these things we would like to build. But it would be interesting for you to know that the things we are going ahead with include the building of facilities for the abatement of pollution in order to improve our water program. We have not deferred this, because these projects still have first priority and further, this year they will require the expenditure of about 30 per cent of our capital appropriations. At any rate, we are doing something, although, at the moment, it is not essentially everything we would like to do. (Applause)

VICE CHAIRMAN HERBST: If I may be permitted to do so, I would like to make one comment as an extension of that answer and I believe you should consider this seriously.

We as conservationists are very quick to jump to conclusions, to jump on the public agencies when they are doing something wrong. Of course, it is entirely proper that we do so but sometimes we jump on them too fast. After all, it is also our responsibility to know that when they do something proper, then why not take out a little bit of our time and thank them for what they have done?

For example, the Northern States Power Company in the vicinity of Minneapolis and St. Paul has been criticized for the plans they have for an atomic generation plant and rightfully so. There has been a question as to its effect on the ecology but they also formed a task force, developed a regional conservation plan for the upper St. Croix River and donated one hundred forty miles of frontage on the St. Croix River, twenty-five thousand acres, to the citizens of this country at no cost in fee title.

I wonder how many people have thanked them for this gesture.

There are many other examples of positive conservation work by industry and organizations for which they receive very little thanks.

Of course, as I said, this is not to mean we should not criticize them when something is being done wrong. I think we should offer solutions for the correction of some of these problems but, on the other hand, when they do perform positive conservation work, I believe it is only right to thank them also.

I believe we now have time for one more question.

MR. FRANK DUGAN (Richmond, Virginia): I appreciate very much the comments that if we are going to have a better environment that we need to pay for it and this applies to all of us.

I would like to question, however, whether or not a slump in economics is necessarily a cost that we would have to incur if we could somehow stabilize our population.

I would like to ask you, as a businessman and as a practical economist, if you don't think there might be some way, with our present economic technology, of stabilizing our population and, at the same time, preserving our economy and, further, if it is necessary that in order to have prosperity we must have an expanding economy? In other words, isn't there a conceivable way of expanding the economy other than by expanding our population? For instance, putting more of our efforts into production and spending money on things that would be less polluting to the environment than the wastes of our human population.

Just as an example, could not more time and effort be put into research on dreaded diseases and maybe on even better methods of improving our environment?

VICE CHAIRMAN HERBST: The question boils down to a balance between population and economic growth and whether that is possible. Would you care to com. ment, Mr. Bendetsen?

MR. BENDETSEN: This is, of course, a very timely question. I don't mean that as a trite comment but it really is a very profound question.

If we were a self-contained nation, which we are not, I think it is possible that we could maintain a satisfactory level of economic activity and provide for most of the reasonable aspirations of our people ultimately without a great population growth. I am not wise enough to know if we can do it, but I think it is possible.

If we must go to a world market to take care of some of our imports, that means we have to pay for them and maybe we can learn to get along without imports by giving up some things. I am one who says that anything is possible. On the other hand, I don't know how probable it would be.

I did suggest in my talk that we need to stabilize our population, and I think it is vital that we do so. Furthermore, the world has to also. If we stabilized our population and nobody else did, we would enjoy some release for a time, but not for the long pull. We would soon be inundated in one way or another. We would be a "have" nation. There would be, also, the "have-nots." Possibly the latter might destroy us.

May I summarize: First, we must stabilize because no matter what we otherwise do, our standard of living will ultimately be worse, far worse (too many people—not enough to go around). Second, temporarily it may cost us some tangible things in the short term to stabilize, but at all of the important things will be infinitely better in the long run (both quantitatively and qualitatively). Third, we must stabilize our population even if the rest of the world does not do so, but we have a major responsibility to persuade them to do so because unbridled growth of the world's population will adversely affect all of us in the long run.

VICE CHAIRMAN HERBST: Thank you very much. I think we have time for yet one more question.

MR. AL HAYES (University of Missouri): I have a comment not a question.

As we move into the decade of the ecological conscience, I would like to cast out the observation that we must be careful as professional ecologists not to prostitute ourselves into this realm of use of our expertise and advisory to the economic community. I think there are a number of instances where professional ecologists have been bought off and I am very delighted, certainly, that your corporation has chosen a five-star panel of ecologists, whom I am certain were not bought off. Therefore, it seems to me that this could easily happen to us and we would be every bit as suspect as a panel of experts in the area of ecology.

VICE CHAIRMAN HERBST: I think it is also true, in order for us to better the quality of our environment, that it will not only take government, industry, the professonal community and citizens at large, but it will take all of us working together on many matters in order to accomplish this.

I would like to wrap up the session with regard to the four speakers by indicating that we appreciate very much Mr. Bendetsen giving of his time here in connection with his remarks and in relation to the answers to your various questions.

MR. C. R. GUTERMUTH: I wish to thank Doctor Baum and Mr. Bendetsen for fielding these questions in the splendid way they have. Now, for the balance of the program the individual who has prepared a splendid critique on the over-all conference program and who has done, to my personal knowledge, a great deal of hard work in its preparation. I shall introduce him at this time and then upon completion of his presentation, if time permits, we will reopen this session to general discussion of those topics in which you have a personal interest.

We have in the audience here some truly outstanding authorities on various phases of natural resource conservation and so I think we could convert this into an extremely valuable discussion.

Therefore, I wish to introduce to you a former president of the Wildlife Society; a former chief of the Division of Wildlife Research of the Bureau of Sport Fisheries and Wildlife; a former leader of the Cooperative Research Unit Program and presently—while his heart is essentially in the field of wildlife conservation—the research scientist of the Office of Water Resources Research, Department of The Interior.

I am happy to present to you your friend and certainly my good friend, Doctor Daniel L. Leedy.

DR. DANIEL LEEDY: Thank you. Mr. Gutermuth, for that introduction.

In opening this summary may I say that I started attending these conferences in 1936. I have not missed one since 1946 but I am not so sure that as I stand here now that all of this exposure has qualified me for the job that I have been asked to do, namely to appraise this conference.

"Pink" mentioned that I spent some time in the Cooperative Wildlife Research Unit Program. We travelled around a lot together, he and I, and he referred quite often to the fact that he would like to take a little of the look of wonderment out of my eyes. He did this by showing me sights that he had seen in the country and getting me involved in different projects. In turn, maybe he thinks that summarizing this conference should be a part of my training.

Actually, I was pleased to get some comments together and I consider it an honor and a privilege to do this job.

MAN'S STAKE IN A GOOD ENVIRONMENT

An Appraisal of the Program of the 35th North American Wildlife and Natural Resources Conference, With Comments on Significant Trends and Probable Developments

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As one who started attending these conferences in 1936 and has not missed any since 1946, I should have some idea of what goes on at them. But I am not so sure, as I stand here now, that all of this exposure has been qualifying experience for the job I have been asked to do—appraise this extensive program in which more than one session often is under way at the same time. The Wildlife Management Institute, our host organization, allows considerable flexibility in the approach one may take, however, and it is a challenge, so I am pleased to try.

I propose to take a look back to see where we have been, the better to detect trends and see the progress we have made in natural resources management as reflected in this Conference; then, in accordance with your program, look forward and predict where we are going.

A LOOK AT THE PAST

Nineteen forty-six was the year when, as some of you may recall, the meeting was held at the Hotel Pennsylvania, in New York City. Your Program Chairman, Mr. C. R. Gutermuth, better known to you as "Pink," had appeared on the National scene from the State of Indiana as Secretary of the American Wildlife Institute. The 1946 Conference was sponsored by that Institute, as all earlier Conferences had been. That meeting reflected the hard work "Pink" had put into its planning and conduct. For the first time, the Wildlife Society was singled out for its role in helping develop the program, and, for the first time, there was a summarization of the Conference. Dr. Rudolf Bennitt of the University of Missouri was the summarizer.

Announcement was made at the meeting that Dr. Ira N. Gabrielson, still listed on the program as Director, U. S. Fish and Wildlife Service, would become President, and Mr. Gutermuth, Vice President, of the Wildlife Management Institute, which was to succeed the American Wildlife Institute. We are indebted to "Gabe" and "Pink" and the competent staff assembled by them for a series of highly successful meetings, since then, spanning a quarter of a century. One of those staff members who, along with Jim Trefethen and others, has taken some of the load off of "Pink's" shoulders in managing the Conferences in recent years, is Daniel A. Poole, the new president of the Wildlife Management Institute. With several years of experience as secretary under his belt, I am sure he will do a fine job as president.

Although we have been concerned at this meeting with some of the same things discussed at the 1946 Conference by E. Sydney Stephens, then Chairman of the Missouri Conservation Commission, under the title, "Where Are We and What Time Is It?", the present meeting reflects many changes.

In his talk, Mr. Stephens appraised the status of State administration of resources based on the statements of the respective State officials at that time, as follows: (a) 25 States lacked adequate legal authority to administer wildlife resources or to regulate their use, (b) 16 States employed no trained technicians or were not better than 20 percent equipped or manned, (c) 14 States gave no attention to the improvement or development of environment, (d) 21 carried on no cooperative programs with any group or individual—presumably within the respective States, (e) 14 made no effort in the field of conservation education, and 20 others admitted they were no more than 50 percent efficient in that vital field, (f) 23 did not carry on research, (g) 5 did not maintain forestry departments and 6 did not have cooperative forest fire prevention and control agencies, (h) 23 complained of the absence of adequate support of organized groups, and (i) the average tenure of the directors of State fish and game or conservation agencies was 5 years and 25 days.

Outdoor writers were taken to task by Mr. Stephens for not knowing, or writing about, the real meaning of conservation; and the plea was made to impart some of the essential background information produced by these conferences to the rank and file of people.

Environment per se was scarcely mentioned by Mr. Stephens; increasing human populations was not brought out as a problem; and pollution was not mentioned except for the implications of soil erosion. The word "recreation" was not mentioned. The need for leadership in conservation was stressed.

At this same 1946 Conference, Dr. Gabrielson pointed out some conservation gains over the then recent past: the fact that the public was better informed; better trained and more numerous wildlife technicians were available; key conservationists involved in military service were returning; and benefits from previous wildlife development work were becoming evident. However, he pointed out, also, that increasing numbers of people were seeking the out-of-doors for rest and recreation, with consequent increased pressure on wildlife; he warned of the dangers of exploitation for selfish interests; he talked of possible detrimental effects on wildlife of agricultural and industrial development; and he mentioned that there were increasing amounts of pollution in American waters.

"Gabe" and "Pink" have continued to alert the attendees of this annual Conference to current developments as related to wildlife resources throughout the years. They have encouraged action and exercised the leadership which Mr. Stephens pointed out as necessary.

To fully understand the biota and what "makes it tick," it is necessary to consider soil, water, temperature, nutrients, and other environmental factors. To manage wildlife on a sound basis, it is essential to know something about ecological principles and how to apply ecological knowledge. Much of wildlife management, however, is people management, including promulgation of legislation acceptable to the people, yet effective in regulating the harvest of game and preserving the required habitat.

With increased human population pressures, "people management" probably has assumed greater importance in managing natural resources than increased information on the wildlife species themselves; yet, more knowledge of both are needed. I would emphasize that in *dealing with people problems, we must not forget wildlife requirements.* Fish and wildlife are an essential part of our environment and must be considered in relation to other environmental components.

As Dr. Rene Dubos has put it: "Conservation programs, whether for wilderness or for man-made environments, usually are formulated and conducted as if their only concern were to the human species and its welfare. Yet they can be effective only if they incorporate another dimension, namely, the earth and her welfare . . . Man and the earth are two complementary components of an indivisable system. Each shapes the other in a wonderfully creative symbiotic and cybernetic complex. The theology of the earth has a scientific basis in the simple fact that man emerged from the earth and then acquired the ability to modify it and shape it, thus determining the evolution of his own future social life through a continuous act of creation."

In recognition of the fact that wildlife resources can not be dealt with effectively without consideration of related resources, the name of this annual conference was changed, in 1960, from the North American Wildlife Conference, to the North American Wildlife and Natural Resources Conference. Although certainly not overlooked in previous years, more attention to the human element has been evident in recent conferences. This is attested to by the conference themes for the past 10 years and the present theme, "Man's Stake in a Good Environment."

THE CURRENT CONFERENCE

As indicated by your program, the current Conference has included two general sessions—one dealing with "What's Happening to the Environment," and the session just ended, "The Fight for a Clean Environment." There have been 6 technical sessions composed of 42 papers. A half day was set aside specifically for business or open meetings of numerous organizations or groups concerned with natural resources.

These groups have taken advantage of the opportunity afforded by the Wildlife Management Institute to meet and discuss varied natural resource problems. In previous years, for example, much impetus was given to the development of the Wildlife Disease Association, to work in bio-instrumentation and telemetry, to pesticide-wildlife research, and to preservation of rare and endangered species as a result of discussions held under the umbrella of the North American Wildlife Conference. The germ of the 668-page book, "The Deer of North America," edited by Walter P. Taylor, was planted during a Cooperative Wildlife Research Unit meeting at the 1946 Conference by C. R. Gutermuth, who stressed the need for more monographs of game species such as Stoddard's book on bobwhite quail.

You are familiar with the many related meetings held this year in conjunction with the Conference; hence I shall not take the time to list them. Probably many of you enjoyed as I did, the excellent color films shown Sunday night by the Outdoor Writers' Association of America, and benefited from other meetings.

The Wildlife Society, however, merits special comment. Each year a member of the Society serves as Vice Chairman of the Program Committee and helps to develop the program. The annual business meeting of The Wildlife Society is held in conjunction with the Conference, and its president presents the Leopold Medal, highest award of the Society, at the annual Conference Banquet. This year the person named as recipient was Dr. Ian Cowan of the University of British Columbia. Many of the individuals serving as Session Chairmen and Discussion Leaders, and most of those presenting technical papers, are Wildlife Society members. In my opinion, this is a good example of symbiotic relationship in the wildlife field.

But let us consider, again, Mr. Stephens' question of 24 years ago, "Where Are We and What Time Is It?" in relation to this Conference.

I am sure you will agree that man's stake in a good environment is highly important. But man has not acted as though he recognized this stake, or his role in maintaining or restoring a high quality environment.

The general sessions focused on the impact of population increase and waste disposal, on agricultural pollution, and the responsibility of industry in maintaining a high quality environment. And they made it clear that cities are an important part of the environment. In appraising agriculture's contribution to environmental pollution, USDA's Cecil Wadleigh, director of the Soil and Water Conservation Research Division of ARS indicated that there has never been a more urgent need for sound conservation measures on the land. I suppose this could be extended or revised to state: "There has never been a more urgent need for sound conservation." PERIOD.

Russell E. Train, chairman of the recently created Council on Environmental Quality, gave an interesting and enlightening account of the work and planned activities of that Council. His address, and the discussion that followed, left Conference attendees optimistic about the potential constructive force of this Council, I feel sure.

Summarization or mere mention of each of the presentations made at this Conference, some of which you have just heard, is simply not in the cards. In the technical sessions, you were afforded an opportunity to learn about waterfowl programs from government officials of Canada, Mexico and the United States—people who are dedicated to conserving and managing this important international resource. Dale E. Whitesell of Ducks Unlimited described wetlands preservation and management as carried out by private enterprise, and John R. Woodworth presented the States' viewpoint on waterfowl management. He expressed the view that a too-conservative policy is being followed in setting regulations and urged that more species management studies of the type reported on by Grieb and others should be conducted. At the same time, Al Hochbaum decried the complexity of many of the new laws designed to divide up the limited harvest and urged that greater incentives be provided for waterfowl production through private management. The need for cooperative effort in managing the continental waterfowl resource was made clear by several speakers.

Complementing the attention given to environmental law in the general sessions were deliberations of the panel on the Public Land Law Review Commission. This panel served to emphasize the importance of the vast public lands to all the people of the United States; urged that no wholesale disposals be made of these lands; and pointed out the desirability of managing these lands on an ecosystematic basis for the good of all the people. Conservationists were urged to review carefully the reports and recommendations of the Commission and express their views with respect to possible legislation based on Commission recommendations.

Papers by Allen E. Peterson, Jr. and Arthur P. Chesmore on Massachusetts' estuarine protection programs, and John C. Peters' paper on success of Montana's State stream preservation law dealt with the environment, also.

Papers on animal control were limited to two—an evaluation of Ornitrol, a chemosterilant, on feral pigeons in northern Florida by Beckwith and Schortemeyer, and the effects on lamb survival of the blesbok near Pretoria, South Africa, when black-backed jackals were killed by "Coyote getters." Mr. du Plessis reported a dramatic rise in lamb survival following jackal control. Harold Carr and Fred Glover dealt with effects of sagebrush spraying on sage grouse.

Only one paper focused on wildlife disease—Brian F. Hunter's report on waterfowl botulism studies, in which he indicated that the larvae of blowflies (family Calliphoridae) were far more important than previously described as a source of toxin. There still remains a lot of deep digging, however, before we know all we should know about botulism.

Based upon a 13-year study in northern Minnesota, Gullion believes that the distribution and abundance of ruffed grouse in these boreal forested habitats are mostly dependent upon the distribution, abundance, and age structure of aspens. He reports that on a long-term basis, the progressive change in composition of this forest probably is the most important factor contributing to a general widespread decline in ruffed grouse numbers. The change in composition, he believes, is the result, most specifically, of the effectiveness of wildfire suppression programs. At the same time, John B. Lewis reports that ruffed grouse, once found thoughout much of Missouri, was almost extirpated by the early 1900's due to changes in habitat brought about by repeated burning and overgrazing. Grouse introductions in the 1940's failed, but he states that habitat conditions have improved since then as a result of fire protection and overall changes in land use. The more recent introductions appear to have been successful. Neither researcher generalized in reporting his findings. In wildlife biology, it is not safe to do so because of the many uncontrolled variables.

For example, was the establishment of a successful breeding population of pheasants on a study area in Pennsylvania, as reported by Myers, due to transplanted *wild-trapped* birds, as circumstances indicate in view of failures of repeated earlier releases of game farm birds in the area, or were other factors involved as well?

I was pleased to note that increased attention is being given to migratory webless game birds as reflected by four papers presented at this Conference. Duncan MacDonald and Thomas R. Evans discussed the overall accelerated Federal-State research program being developed in this area, pointing out that 33 projects have been initiated in 22 States, in addition to two studies by the Bureau of Sport Fisheries and Wildlife; and one paper each dealt with band-tailed pigeons, white-winged doves and woodcock. With increased hunting pressure and problems of maintaining adequate habitat, at least for some of these species, this accelerated program is timely, and the new or improved techniques and the information coming from this research, much needed.

The paper by James T. McFadden, "Long-Range Planning for Great Lakes Resources," was, in my opinion, one of the more signifiicant presentations of the Conference. As McFadden pointed out, we are beginning to realize that the biological resources of the Great Lakes must be managed within the context of the entire system of Great Lakes marine resources, with their diverse and frequently competing uses. New integrative approaches to problem definition and management decision-making within a systems-wide context are needed so that society can define an optimal course to pursue in developing the natural environment. The experimental program embarked on by the University of Michigan and described by McFadden will explore various configurations of disciplines and cooperative inter-agency approaches to resolve an environmental planning problem which now confronts us.

Important in resource planning and decision-making processes and in gaining public support for operations and management after the plans are formulated, is the problem of conservation communications. As indicated by Roger Latham, if an outdoor writer is successful in his mission of conservation communication, he will effectively educate his readers and create a concern for a high quality environment. Furthermore, he will activate people, organizations, and government to do something positive about conservation needs. The Technical Session "Conservation Communications," dealt with the communicator's role in resource decisions and means of communicating ecological and conservation concepts. Had Sydney Stephens been present, I feel sure he would agree that much progress has been made in this area since 1946.

SIGNIFICANT TRENDS

Administration

In looking at the past, I summarized some of the findings of a survey on State conservation administration as reported on by Mr. Stephens at the 1946 Conference. Although no direct comparisons can be made between what he reported and the current situation, we can state, with assurance, that the States have made significant progress. I dare say, all of them have some kind of legal authority to administer wildlife resources and regulate their use; they all employ trained technicians; they all have research programs; they all engage in some type of public education programs; and they are all concerned with improvement or management of fish and wildlife habitat. Also, they are giving increasing emphasis to long-term resource management planning.

Cooperation

There is, in my opinion, better cooperation among conservation agencies now. There is better understanding between such organizations as the Bureau of Sport Fisheries and Wildlife and Ducks Unlimited. In addition to cooperative programs of long-standing, we now have a relatively new agency, the Bureau of Outdoor Recreation, which provides money from the Land and Water Conservation Fund for acquisition of wildlife and other areas. Progress is being made with respect to the international management of waterfowl and other migratory birds. Many American biologists have participated in research, training and other conservation activities in Africa and other countries—activities of a type which Dr. Bennitt, in his Conference summary, nearly a quarter of a century ago, hoped would come to pass.

Research

Research is being funded more amply than in the past, and on a broader basis, through new programs such as the Sea Grant Program, Environmental Science Services Administration, and the Office of Water Resources Research, as well as by the old-line agencies. For the most part, today's research is more sophisticated and better designed, some of it combining laboratory investigations—under controlled conditions—with field studies. Much progress, for example, has been made by this approach in better understanding pesticide-wildlife relations. An example of this was Keith's report on brown pelican pesticide relations, and on related studies.

Training

Graduates coming out of our fish and wildlife and conservation schools are better trained than formerly. In addition to a good foundation in biology and ecology, they have more knowledge of sampling procedures and statistics. Some of them have knowledge of systems analysis and computer programing. Also, many are taking considerable work in such areas as economics, sociology, and political science in order to better participate in natural resource planning and to deal more effectively with people.

Public Awareness of Environmental Pollution and Human Ecology

One of the most significant trends, however, is the increasing awareness, on the part of the public, of environmental pollution and the need to do something about it. The real motivation, Schoenfield suggested at this Conference, is fear; but he believes this must be replaced, over the long haul, by love and respect for the land. Some people now relate increasing human population, affluence, and relatively uncontrolled use of technology to the pollution problem. Many are beginning to realize that they are a part of the environment and that what they do affects the environment and other living things. They are beginning to ask themselves what kind of a world they want to live in and how they can help maintain or create a good environment for themselves and others to follow. But the goals are vague, as are the ways of achieving them.

Environmental and Conservation Law

In addition to the many legislative acts passed in recent years dealing with water and air quality, water resources research, wilderness, wild and scenic rivers, rare and endangered species, and other environmental matters, we see more activity on the part of lawyers to help resolve problems concerned with the environment. The Environmental Defense Fund has done much to stimulate interest in environmental law among scientists and others. The Center for the Study of Responsive Law and the Conservation Foundation of Washington, D.C. have been concerned with law and the environment, also. Conservationists are looking, increasingly, to the courts for assistance in requiring or encouraging industry, administrative and regulatory agencies, planners, and public utilities to give more weight to protection of the environment and to natural values.

Recreation, Scenic and Other Values

In speaking of the scope of the 1946 Conference, Rudolph Bennitt said, ". . . I still look forward to the day when we shall hear men discuss the management of songbirds, wildflowers, and the biota of a city. . ." While not stressed in the present Conference, the theme of the 1962 Conference was "New Horizons for Outdoor Recreation" and last year's theme was "Conservation in an Urbanizing Society."

These conferences are, indeed, no longer American Game Conferences, although game problems still receive merited attention. They reflect the changing times and help guide the course of action.

A scattering of States are now supporting research and management programs specifically for enhancing non-game forms of wildlife. The Bureau of Sport Fisheries and Wildlife has a growing rare-and-endangered species program. Last year, this Bureau sponsored a meeting on "Man and Nature in the City." Visitor centers and marinas have been constructed on national wildlife refuges to permit more enjoyment by the public of bird-watching and other recreational and natural history pursuits. The problem is likely to become one of how to manage the encreasing numbers of recreationists and other visitors without detriment to wildlife and the areas involved. At some time, decisions may have to be made to restrict attendance or activities to retain the desired qualities of the environment in these areas. At this Conference, John Smail dealt with the ecology of shorebirds and mentioned possible conflicts with recreationists on a National Seashore area.

We see increasing evidence of the Soil Conservation Service's efforts to help solve both rural and suburban problems generated by erosion, drainage, and floods. But even so, at least on a regional level, concern is being expressed about that fine organization's small watershed program in which consideration for man is believed by some conservationists to be harming the natural environment.

Again, with respect to recreation and esthetics, we note that the Departments of Interior and Agriculture have developed and announced criteria to establish national scenic and recreation trails under the National Trails System. They are studying candidate rivers for possible enlargement of the Wild and Scenic River System also, and the Bureau of Outdoor Recreation is focusing much attention on recreation areas and facilities in urban areas.

These are a few of the trends in the field of wildlife and related resources as I see them. More could have been mentioned—the increased attention to estuarine and marine resources, and opportunities for utilizing, in natural resources research and management, satellites and other aerospace age technology, as was illustrated in the panel session on remote sensing and in Daniel A. Panshin's paper on Oregon's cooperative albacore project, for example.

A LOOK AT THE FUTURE

It is probable that many of these trends will continue throughout the 1970s. Growing human populations will continue to result in increased use of natural resources. Concurrent problems of waste disposal and the need for techniques of recycling materials will be with us still. There will be continuing pressure to build freeways through parks, or reservoirs in areas of scenic beauty. "Developments" will tend to reduce or alter wildlife habitat. Such actions and results will continue unless the public decides now is the time for a change; and unless ecologists, engineers and others can determine how areas can be developed without degradation.

In the past, there has been a tendency for values which can be measured more or less completely in dollars to dominate public agency decisions at the expense of other values—social, ethical, natural, esthetic, inspirational, or scientific. It is probable, as someone has suggested, that during the 1970's economic analysis will become "ecologized" and consider more of these values. It is probable, also, that we shall see some reorganization of Federal conservation agencies, with subsequent carry-over to State and local agencies to facilitate coordination. Changes in the structure of committees in Congress might be involved as well. This might be helpful in looking at, and treating, the environment as a whole rather than in bits and pieces.

Natural resources and their management need to be related to the goals of society. Enactment of Public Law 91-190 on January 1, 1970, to establish a National Policy for the Environment and provide for a Council on Environmental Quality may help establish these goals. The Council is directed to "encourage productive and enjoyable harmony between man and his environment." As you know from Mr. Train's address, this Advisory Council to the President is now functioning. If we had a similar national policy for population, the outlines of which are spelled out in the historic Presidential message of July 18, 1969, and both policies had adequate public support, we might be well on our way to a better world.

The science and technology which helped get us where we are today, hopefully, can, in the course of time, and with the right planning and leadership, provide the means to achieve our goals. Existing science and technology, for example, while not having all the facts desirable on long-term effects of low-level pollutants, nevertheless, is adequate to permit the United States to make giant strides toward a cleaner environment.

There are other signs of the future—both encouraging and discouraging. To feed the millions of new mouths, agricultural and biological research has developed new high-yielding strains of corn, wheat, and rice. Production of these grains has been stepped up remarkably; yet to take full advantage of these new strains in countries like India and Pakistan, it will be necessary to develop a network of power plants to provide energy for pumping water to irrigate the land and to manufacture nitrogenous fertilizer. Both the thermal loading from the power plants and the nitrogen, some of which finds its way into the water, may have unfavorable ecologic impacts and offset some of the benefits. However, as pointed out by Dr. John E. Cantlon, president of the Ecological Society of America, the required curricula of agricultural students are being altered to include a broad environmental viewpoint so that the graduates will be aware of the large environmental problems and of the flaws in narrowly specialized strategies for maximizing food yields and profits.

The same might be said of the curricula for wildlife and conservation students in general. In my opinion, the curricula, already broader than most insofar as the fundamentals of ecology are concerned, will be developed in such a way that students will have increased flexibility in their training.

Specialists will continue to be needed in wildlife research in such fields as biochemistry, pathology, physiology, biometry, taxonomy, and animal behavior. In preparation for resource management and for participation in resources planning however, I predict there will be increasing numbers of students who will become generalists, getting a broad background in socioeconomics, political science, and perhaps law, as well as in biology and the physical sciences. These generalists will need to know their limitations and, at the same time, know how and where to get the technical information they lack. Some students may obtain degrees in a combination of fields such as wildlife and economics, engineering and ecology, water resources and law, and forestry and sociology.

Indicative of the need for a combination of training was the call for a special court to try pollution cases only, made by Illinois Attorney General William J. Scott in December, 1969. If this court was, in fact, established (here in Cook County, Illinois), I believe it would be the first of its kind in the United States. Mr. Scott indicated that the judge for the new court should be a trained specialist in pollution problems.

As is true in some other fields now, graduates of wildlife schools are finding employment opportunities somewhat more limited than in the past quarter of a century. Hopefully, however, with a broadened base of training, future graduates will find additional niches in which they can contribute increasingly to better resource planning and management.

I predict that biologists and ecologists will play an increasingly important role in planning and in political and public agency decision-making in the resources field. They will be called on for more facts and predictions relating to ecologic impacts of pending developments. In this respect, for example, more research is needed to determine how much use or abuse renewable natural resources can take so that future generations can be assured of their natural heritage—including fish and wildlife. Legal standards, based on sound biology among other things, and enforcement of those standards, are needed.

I believe one of the hopeful signs of the future is youth's sensitivity to environmental problems. If we could capitalize on this and utilize a substantial part of youth's energy in "doing their thing" to promote conservation instead of displaying dissatisfaction with the "establishment," we would gain needed brain-and-muscle power.

Recently, to involve the youth of the Nation in the fight to prevent contamination of the environment, a series of student pollution seminars was sponsored across the Nation by the Federal Water Pollution Control Administration. Arrangements were made for representative students to serve in an advisory capacity to the Secretary of the Interior on a continuing basis.

A September, 1969 report to the President's Environmental Quality Council recommended Federal support for the formation of Schools of the Human Environment at universities. In his foreword to the report, Dr. Lee A. DuBridge, Science Advisor to the President, said: "The enthusiasm of the student participants (in the study) suggests that there are many among the student generation who can employ their concerns about the future of our society in useful ways in programs of the sort described. One of the authors of the report is herself a student and the report illustrates the serious and cogent work such young people will do if given an opportunity."

The report suggests a shortage of broadly trained professionals to deal with environmental problems. This may be one of the niches I spoke of a moment ago. I should think that graduates of wildlife conservation departments could fill some of these gaps because many of them are well trained as ecologists. I am concerned that wildlife biologists, who were among the first to appreciate and understand environmental problems, are being left behind in the current wave of interest in environmental management.

The nationwide Environmental "Teach-In" or Environmental Action program hopefully will capture the interest of student activists and enhance conservation also. These "teach-ins" are scheduled nationally for April 22, 1970—"Earth Day." I think we can count on the students to give politicians, administrators, and policy-makers some worthwhile ideas for goals and action programs in the conservation field. They may very well provide some of the manpower, also, to accomplish conservation objectives. Youths' interests and involvement may persist long after "Earth Day" if the "establishment" responds to their challenges in a dynamic way.

Dr. James E. Allen, Jr. Assistant Secretary for Education, and U.S. Commissioner of Education, has indicated that the Office of Education is going to promote the development of Environmental/Ecological Education at every level of learning as a major activity in the 1970's. He has proposed that teachers follow-up the National Teach-In by organizing and planning regional "Ecological Environmental Teach-ins for Teachers in the Summer of 1970." There will be need for guidance from well trained, sound ecologists in this effort.

RECOMMENDATIONS

The pattern developed for these Conferences over the past two and one-half decades has, in my opinion, been very successful. These meetings have become an institution in themselves. I would recommend no radical departures in the foreseeable future. It is desirable, I think, to have several well coordinated panels or symposia dealing with specific subjects as was done this year. Subjects for these panels may vary from year to year to ensure that meaningful new information will be presented. At the same time, I think it is wise to have, as has been customary, other, more general technical sessions to serve as an outlet for presentation of current scientific findings on almost any aspect of wildlife and related natural resources. The subject areas should be broad enough to encompass papers on the basic biology of, and management techniques for, wildlife, whether game or non-game; on habitat and environmental problems; and on people problems as related to conservation, or lack of conservation. Examples this year were the papers by Deborah Stevens and A. N. Moen, and by David L. Zirul, respectively, on wind as an ecological and thermal force, and on the home range of the red squirrel.

The Institute's program committee, composed of representatives of most of the larger national conservation agencies or organizations, is to be commended for the selection of relevant themes for these annual conferences and for the selection of competent, broad-gauged speakers who address themselves to these themes in the general sessions.

I can only say, keep up the good work! You are providing the facilities, the vehicle or mechanism, the guidelines, and the needed leadership for a most important and productive annual meeting. This was one of them. Opportunities for improvement of the conferences probably are greatest among the speakers, who may not follow your guides; and among those attendees who may have fruitful ideas, but do not avail themselves of the opportunity to voice them during the discussion periods so they are published in the transactions.

Finally, I view this Conference as an historic one, not only because of the "walkouts" of mailmen and air traffic controllers which have affected it but in that, after a quarter of a century, we see a "changing of the guard" in the Wildlife Management Institute. Dr. Gabrielson, still in there pitching, has become Chairman of the Board; "Pink" is as dedicated, hard-working and effective as ever in his role as Vice President and as our Program Chairman; and we now have as President, Dan Poole, a product of the Cooperative Wildlife Research Unit Program, which the Institute has helped to support since its inception. Time marches on! I think it is fitting to show these men and their wives and professional associates our appreciation for a job well done, and to extend them our best wishes for the future. (Applause).

CLOSING REMARKS AND ACKNOWLEDGMENTS

C. R. GUTERMUTH

Vice President, Wildlife Management Institute, Washington, D.C.

I first at this time want to thank Dan Leedy for that splendid historical resume and critique of this program. It is a tremendous job to analyze all of the papers of a conference of this kind and then get into the presentation the well-grounded thoughts that he has stated in analyzing where we are going in this important work. So thanks again, Dan.

Our sincere thanks also go at this time to Doctor Ray C. Erickson in the Bureau of Sport Fisheries and Wildlife, who represented The Wildlife Society as vice chairman of the Program Committee this year. Ray did an outstanding job again and it's always refreshing to us to see this cooperative support that we have in the promotion of and staging of this conference.

Dan Leedy and I noticed many others here who have cooperated with the Program Committee back through the years.

We are likewise grateful to the working press. While I always say I have not seen a newspaper since I got to Chicago, I am confident that we have had fairly good coverage. When you stop to think that the daily papers never have to hunt for news in the large metropolitan centers like Chicago, I believe we have received good coverage here.

I also wish to thank the wire services.

Also, we are most appreciative to the Chicago Convention and

Visitor's Bureau for providing the efficient and courteous personnel to handle the conference registration desk.

At this time, before I go any further, I would like to recognize some of the old-timers here because I am pleased to see, at this late hour, people here in the audience such as the representative of the Canadian Wildlife Service. I think he was active in this work starting way back around the turn of the century. He is a former chief of the Canadian Wildlife Service as we call it now, from Ottawa, Dr. Hoyes Lloyd.

Also, we have another distinguished authority, Martin Bovey, who has written such books as *The Saga of Waterfowl* and various other works.

We have mentioned something about the changes in our organization. Up here in the front we likewise have a very distinguished, cooperative person for many years, a former chairman of the board, who stepped aside graciously in order to make room for Dr. Gabrielson as chairman of the board. Therefore, at this time I would like to present to you a Past Chairman of the Board and a very faithful person here at this late hour, Dr. Egbert C. Hadley.

Normally in the closing hours, I always have two patient souls, both Gabe's wife and my wife, to take a bow. However, they were honored is such a nice way last night that perhaps it isn't necessary.

Now, back here is my hard-working secretary. You know, before I always introduced her as "Rose" but she has a new name now and so I am now going to introduce her as Mrs. Lloyd W. Swift. (Applause)

Also, among our old-timers, I see another distinguished man in the audience who, some many years ago, was the summarizer of one of our conferences. He did a truly outstanding job.

The fact of the matter is that he brought together more facts and information on the history of this conference than I have known for a long time. He is the distinguished Doctor Edward Kalmbach.

Now, I believe I have never expressed thanks publicly to our staff but, for many many years, these individuals have worked hard and in many cases their wives as well. Take this year, for example. We got started a little bit late with our registration but the wives pitched in and we got the registration started on time. Therefore, I want to express, at this time, my thanks on behalf of the Institute and on behalf of all us to these wonderful people who have been in charge of our meetings over the years.

At this time I want to ask each of them to stand.

The first is Phil Barske and his wife, Doris, Bill Morse, and Bill Allen.

Unfortunately, Len Foote had to beg off at the last minute because of an illness of some type.

Now, anyway, since it is so late, unless there is someone who really has some burning question, I think perhaps we might adjourn at this time. I had originally thought we could talk further about some of these important issues that we were presently confronted with, such as the Public Land Law Review Commission, whose report is due on June 30th. We did have an interesting discussion and, Mr. Clepper, I want to thank you again for pinch-hitting and presenting the paper for Hamilton Pyles, who has done a truly outstanding job in analyz- the Public Land Law Review Reports. After he had his paper prepared, he was taken to the hospital and was not able to come.

We have covered most of the things at one time or another that perhaps we might comment upon here today. For example, we have gone into the jetport in Florida, the matters of pollution in the sea and maybe, therefore, we can pass on and close.

I want to thank the Palmer House because it has been a good host hotel. Maybe I ought to say at this time that despite the two strikes that we have had a registered attendance of some 1122, which places this conference among the most successful of all these meetings. We had a capacity crowd at our annual banquet last evening totalling 525.

I also wish to thank Jack Morton Productions for the variety show that was produced for us at our banquet session last night.

Doctor Leedy mentioned that I was the Program Chairman of the 1946 Conference in New York City and, therefore, perhaps I should add that this completes my twenty-fifth of these large international meetings. While I am appreciative of all the help that has been received from innumerable sources over the years, I take some personal pride in the success of these conferences. I think they have been good and I think they have been beneficial, and I hope, as Dan brought out in his summarization, they continue in a progressive and constructive manner and are improved as best they can be from time to time.

With that, I am going to say that our next conference will be held in the great Northwest for the first time. The 36th North American Wildlife and Natural Resources Conference will be held in Portland, Oregon, at the Hilton Hotel there on March 7-10, 1971. I hope all of you will be there. We urge all of you to get your reservations in early so that you will be able to get to stay at the headquarter's hotel.

With that, I am going to wish all of you a safe journey home and happy landings and adjourn this conference.

REGISTERED ATTENDANCE AT THE CONFERENCE

ALABAMA

Jack C. Avery, Oharles D. Kelley, Claude D. Kelley, Raymond D. Moody, Walter Rosene.

ALASKA

Ed Bellringer, Bud Boddy, Thelma Boddy, Mrs. S. De Leonardis, Salvatore De Leonardis, William H. Griffin, John J. Hall, Jim Harper, Richard J. Hensel, Mrs. R. J. Hensel, L. J. Kajden, David R. Klein, Lloyd McCollum, Wallace H. Noerenberg, Sig Olson, Royce Perkins, Don H. Strode.

ARIZONA

Steve Black, Kenneth F. Brown, Phill Cosper, Steve Gallizioli, Robert A. Jantzen, John A. McComb, Jack Mantle, Lyle K. Sowls, Bob Stonoff, Roy E. Tomlinson, Charles E. Viers, Fred J. Weiler N. A. Bill Winter, Peg Winter.

ARKANSAS

William J. Allen, Sammy Barkley, Bobby Conley, Dave Donaldson, W. D. Gaines, Andrew H. Hulsey, Lawrence N. Owens, Carl A. Perrin, Gene Rush, Jim Sabin, Randall G. Taylor, D. Ray Whiting.

CALIFORNIA

Ben H. Anderson, G. Ray Arnett, David R. Brower, Julie Cannon, Maynard Cummings, Seth Gordon, Richard Grant, A. E. Hall, Jr., Ellen Stern Harris, W. E. Howard, Eldridge "Red" Hunt, Brian Hunter, Steven C. La Marine, Howard Leach, Kenton C. Lint, Mrs. Kenton C. Lint, Wayne Long, Albert B. McGee, Jr., Rex E. Marsh, Archie S. Mossman, Thomas W. Riley, Robert G. Schwab, John Smail, Jane Westenberger.

COLORADO

Maurice D. Arnold, Jim Bailey, Pete Barrows, M. S. Carter Lt. Gen., Kay Collins, Eugene Decker, Christine A. Enright, Fred A. Glover, A. F. C. Greene, Jack R. Grieb, Retha Grieb, Peter Hansson, Frances D. Hill, Ralph R. Hill, Bob Jacobsen, E. R. Kalmbach, Jack F. Kamman, James O. Keith, Stanley J. Kerr, Phil Lehner, Wayne R. Marion, Terry A. May, John Olson, Lawrence E. Riordan, Susan Riordan, Errol E. Ryland, Wayne W. Sandfort, Mrs. Wayne W. Sandfort, John L. Schmidt, Dwight R. Smith, Harold W. Steinhoff, Gus Swanson, J. E. Townsend, Jack F. Welch, Dale L. Wills, Roberta Winn, Harvey R. Woodward Carol M. Yeager, Lee E. Yeager.

CONNECTICUT

John M. Anderson, Theodore B. Bampton, Philip Barske, Mrs. Philip Barske, John A. Bissonette, Philip H. Burdett, Roland C. Clement, Donn E. Critchell, Charles Dickey, Rudy Frank, Coleman Holt, Peter A. Jordan, E. S. McCawley, Jr., Robert D. McDowell, Jim Shaw, Michael J. Stula.

DELAWARE

William K. Du Pont, Anthony Higgins, Wilbert Rawley, Norman Wilder, George R. Wright.

DISTRICT OF COLUMBIA

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FLORIDA

Dr. S. L. Beckwith, George W. Cornwell, James T. Floyd, Earle Frye, Gary L. Hickman, C. Eugene Knoder, Jim Powell, James Schortemeyer, Nova Silvy, Doris Southwell, F. Don Southwell, Sandy Sprunt, H. E. Wallace.

GEORGIA

Richard L. Bailey, Robert S. Baker, James L. Byford, E. L. Cheatum, Jack Crockford, Dorothy Deer, Herald A. Demaree Jr., George A. Gehrken, Professor James H. Jenkins, R. Larry Marchinton, Don Nichols, Carroll J. Perkins, Paul A. Schrauder, Lonnie L. Williamson.

HAWAII

Evelyn M. Pratt, Jerome J. Pratt, Ronald L. Walker.

IDAHO

Howard E. Ahlskog, Mildred Ahlskog, Walter R. Brower, Ernest E. Day, Hugh Harper, Maurice Hornocker, Kenneth E. Hungerford, Paul C. Keeton, Elmer R. Norberg, Glenn Stanger, Roger M. Williams, John R. Woodworth.

ILLINOIS

Bill Anderson, Richard D. Andrews, Lester E. Arnold, George Arthur, Ray Banys, Joan Barton, C. R. Batten, Alfred Behm, Louis Bell, Frank Bellrose, Mrs. Frank Bellrose, Wendell H. Berry, Jr., Harry V. Bierma, Dale E. Birkenhalz, A. J. Boehm, Jeanne Bonynga, Harry J. Bredfeldt, E. Carl Brown, Larry Brown, George V. Burger, Edward O. Cardwell, Gerald L. Clawson, Mrs. Gerald L. Clawson, Ronald J. Cook, Mrs. Ronald J. Cook, Edwin L. Cooper, Gerald E. Cummings, Mrs. G. Cummings, Jerry De Camp, S. T. Dillon, Leonard Durham, Jack Ehresman, Jack Ellis, Dave Engelman, Thomas R. Evans, Mrs. Thomas R. Evans, George B. Fell, Gene Filer, Edwin Franks, Carl F. Fuerst, Paul Gaebel, Thomas R. Garrick, Robert Gaylord, Mrs. R. Ginger, Mrs. Joseph M. Greeley, Robert E. Greenberg, Vernon D. Hagelin, Fred L. Hall, Rex Hamilton, Wallis S. Hamilton, Bruce Hannon, H. Gordon Hanson, Henry R. Hartshorn, Robert L. Herrst, William L. Howenstine, Dr. L. Barrie Hunt, Mrs. Hazel L. Hurlbutt, Joan Imhoff, William Jarvis, Mrs. Eileen Johnston, Blair Joselyn, Dewey M. Kantz, Mrs. Dewey M. Kantz, Mrs. Geraldine Karling, Fred Karp, Dave Kennedy, Samuel S. Kent, Jr., Robert H. Kielly, W. D. Klimstra, Ed Kozicky, John N. Krull, Ronald F. Labisky, Lisa Lauterstein, Michael S. Lenich, A. C. Lopinot, H. William Lunt, Royal McClelland, Kenneth V. McCreary, Douglas E. McGarvey, Richard McGee, John Madson, Marge Markin, W. D. Marks, Earl Meisinger, Thomas Meldan, Gary Milburn, E. Ronald Miller, James K. Mitchell, Jim Moak, Robert A. Montgomery, Gertrude B. Moore, Leonard T. Morse, Mrs. Irene L. Mostek, Raymond Mostek, Robert Lee Muery, Dr. Charles Nadler, Mrs. Nancy Nadler, Richard Oldenburg, Robert W. Pearson, Mark Perkins, Gunnar A. Peterson, Donald F. Phillips, Rutherford H. Platt, Ronald Pointer, Renate Prell, Fred C. Pullman, Paul Rasmussen, Neil J. Reid, Mrs. Stuart Reller, Michael Richardson, C. F. Riefstahl, Larry L. Rockwood, Lee Rogers, Mrs. Samuel Rome, E. J. "Buss" Ruffing, Edward Z. Ruth, Glen C. Sanderson, J. Henry Sather, Robert A. Schacht, William H. Schoenherr, Gary J. Senn, Paul Serina, Dean Sheaffer, Karl P. Sideritz, Charles M. Smith, Kenneth A. Smith, Donald Sparling, George Sprugel, Mrs. Robert F. Steinhoff, Mrs. Jack Stone, Nan S. Storke, Raynor Sturgis, Richard Suiter, Barbara Taylor, T. Don Taylor, John B. Thompson, W. P. Trost, Stan Twardy, David Urban, David R. Vance, Dave Venerable, Mrs. James T. Venerable, Tom Venerable, Bill Vint, Douglas Wade, Mrs. Douglas Wade, Richard Wagner, Robert D. Walker, John E. Warndock, Donald R. Weber, Edwin V. Weiss, Doug Welsch, William Welsch, Roger Wharton, Dale E. Whitesell, Mr. Francis Wilcox, Mrs. F. Wilcox, Robert A. Williamson, Jay Wilson, M. R. Woulfe, Vincent Young, W. D. Zehr.

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Bob Barratt, Richard Bishop, Donald W. Cummings, Margaret Jean Fisher, Sherry R. Fisher, Joan Geisler, Lee Gladfelter, Harry M. Harrison, Arnold O. Haugen, Keith D. Larson, Dr. Keith McNurlen, Mrs. Keith McNurlen, Robert B. Morrman, Fred A. Priewert, David Roslien, Sylvan Runkel, Mrs. Sylvan T. Runkel, Max Schnepf, Ries Tuttle, Mrs. Vera Tuttle, Marilyn Weier, R. Wayne Weier, Larry D. Wing.

KANSAS

George C. Moore, Dwight R. Platt, Chester B. Rideout, Eleanor Rideout, Anice Robel, Robert Robel.

KENTUCKY

John L. Franson, Louis A. Krumholz.

LOUISIANA

Ted B. Ford, Joe L. Herring, Clark Hoffpauer, Fant W. Martin, John D. Newsom, Edward Ray Smith, Max W. Summers, Richard K. Yancey.

MAINE

Gordon W. Bell, Donald K. Christie, Phillip L. Coggins, Malcolm Coulter, Ada Graham, Frank Graham, Jr., Howard Mendall, Robert W. Moosmann, S. D. Schemnitz, Howard E. Spencer, Jr., R. V. Thurston.

MARYLAND

C. E. Addy, Edwin M. Barry, T. S. Baskett, Carl W. Bucheister, Mrs. Noble Buell, Nicholas J. Chura, Walter F. Crissey, Mrs. Walter Crissey, Mrs. Helen Davey, Stuart P. Davey, Hank De Bruin, Roy C. Erickson, Edith Fredine, Gordon Fredine, Hugh Galbreath, Aelred D. Geis, Harry A. Goodwin, Mrs. Carolyn M. Hardgrove, Thomas J. Hardgrove, Carlton M. Herman, John E. Johnston, Mrs. Madge Johnston, Daniel L. Leedy, Duncan MacDonald, Donna Martinson, Kahler Martinson, Ray Puzio, Donald A. Spencer, Jeff Swinebroad, C. H. Wadleigh, Clark G. Webster, Mrs. Clark G. Webster.

MASSACHUSETTS

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