TRANSACTIONS:

Fortieth North American Wildlife and Natural Resources Conference

Conference Theme:

Adjusting Consumptive Demands to Resource Capabilities

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Formal Opening—Fortieth North American Wildlife and Natural Resources Conference

Daniel A. Poole
President, Wildlife Management Institute, Washington, D.C.

Good morning, ladies and gentlemen. Welcome to the Fortieth North American Wildlife and Natural Resources Conference.

Perhaps we should congratulate each other on being here today because, in this day of involuntary frugality, some of our colleagues found that their employers lacked the wherewithal for them to attend. They are casualties of the back pedaling that occurs when Washington and the State Houses get the economic jitters.

The budget pruners obviously regard resource management and environmental protection as luxuries. When times are not good, air and water pollution prevention, soil and moisture conservation, wildlife, forestry, outdoor recreation and all the rest are run through the wringer. This is what is happening now. An example of the budget pruners' lack of understanding is the sensible Water Bank Program, which carries an appropriation authorization of only $10 million a year. The Water Bank was second on the Administration's list of program terminations to reduce federal expenditures by $4 billion annually. Just think of it—abandoning a modest wildlife habitat conservation program, representing only one-quarter of one percent of $4 billion, rated second place in the budget pruners' plans to get the federal ship of state on an even keel.

Just a few days ago, the Administration announced that $11.2 million of the $21.2 million impounded in the Water Bank Program is being released for protecting wetlands. This is good but, unfortunately, I fear that the money is being spent more in the interests of the national economic situation than in support of high conservation purposes of the Water Bank Program.

Many invited participants to the Administration's mini and summit economic conferences last fall tried to pin the donkey's tail on the conservation and environmental movement. They charged that inflation and unemployment are aggravated by the costs of required air and water pollution abatement and prevention. But Russell Peterson, Chairman of the Council on Environmental Quality, would not buy that line. He told the gatherings that environmental programs account at the most for about one-half of one percent of the inflation. Nor are they any more responsible for high interest rates. "With such basics as energy, food and shelter contributing in a major way to inflation," Peterson said, "it is stretching the point to blame the minor economic impact of the nation's clean air and water program for the inflationary crisis."

There really is little evidence that the budget pruners hear or believe Chairman Peterson or any of the rest of us. With the exception of energy, new fiscal year budget requests in the natural resources area barely keep pace with inflation. And many programs credited with being a plus for natural resources—including some projects of the Army Corps of Engineers and the Bureau of Reclamation—do not qualify as such to many of us.

The 94th Congress is unknown territory for the conservation and environmental movement. Many members have been added and some old friends and some old antagonists are gone. New chairmen are in place and there is need to establish contacts and confidences. Those of you from states with new members of Congress should become acquainted with them and with their staffs. There are fresh troops for all of us to inspect and inform in agriculture, forestry, and fish and wildlife.

Several sound conservation enactments are possible this year. There are the amendments to the Fish and Wildlife Coordination Act. Their purpose is to give federal and state fish and wildlife conservation agencies an early voice in the siting, planning, construction and operation of federal and federally permitted water projects.

While federal water resource agencies have worked more closely with fish and wildlife interests in recent years, much room for improvement remains. Amendments to the Fish and Wildlife Coordination Act will be introduced in the House and Senate soon. If approved, they will assure broader consideration of fish and wildlife in major water projects. Everyone interested in the long-term future of these resources should support and work for these essential amendments.

In this same field, another matter deserving attention is a study, now under way, to develop policy recommendations regarding the handling of economic and environmental values in water and related land resources projects. The Water Resources Planning Act required that environmental factors be considered along with economic factors in evaluating federal water resources projects. The guidelines for accomplishing this were set forth under the principles and standards developed under that Act and made effective in late 1973. Last year's Water Resources Development Act authorized further study and recommendation of policy alternatives for evaluating water resource proposals. There is apprehension that this new study may be an effort to resurrect economic factors as the primary justification for project approval or disapproval.

Significantly, public notice of opportunities for the public to comment on the subject was given only eight days in advance of registering for the public hearing. A similar inadequate time frame is established for planning and executing the National Conference on Water, scheduled for April in Washington, D.C. Knowledgeable persons should strive to participate in establishing new water policies and planning procedures for the United States.

There is need this year for Congress to extend the Wetlands Acquisition Fund, begun nearly a decade and a-half ago to hasten the purchase of wetlands valuable to wildlife. Its goal was to aid one arm of the federal government in the acquisition of wetlands ahead of drainage stimulated or assisted by the second arm of the same federal government. To date, only 82 percent of the authorized $105 million has been appropriated and only 66 percent of the target 2.5 million acres has been acquired in fee or placed under conservation easement. Funds advanced under the Act are to be repaid starting July 1, 1976, using three-quarters of the annual Duck Stamp income. If the program is not extended, all federal wetlands purchases will come to a halt, because this is the only authority under which lands presently are being acquired. Actually, the cost of the total target acreage now greatly exceeds the authorized $105 million, but extension of the program and postponement of the repayment have the best chance of gaining congressional approval, given the present economic situation.

This coming fiscal year is one of particular concern for the U. S. Fish and Wildlife Service and the State Wildlife Agencies. The Service has been vested with responsibilities for major new wildlife programs—marine mammals, endangered species and the world convention on threatened and endangered animals and flora—but it is not getting funding to fully implement them. As the Service leadership has stated and as congressional records attest, proper administration of these new authorities requires close coordination with state wildlife agencies. However, no funding is requested by the Administration for this most important phase of the program. Because of this, the Service and the state wildlife agencies have been placed in an untenable position. The Administration and the Congress have committed the federal and state fish and wildlife agencies to more than the Administration and Congress appear willing to pay for. Yet, the professionals, not the politicians, are being blamed for what is happening.

Again this year, Congress has an opportunity to provide basic authority for the Bureau of Land Management to administer the resource values of the 451 million acres under its control. Unlike the U. S. Forest Service or the National Park Service, the Bureau of Land Management lacks clear-cut mandates for managing the nearly 20 percent of the U. S. land surface under its control. The Senate has twice passed an adequate bill, but it has been held up in the House Committee by a bipartisan element that holds the notion of vested interest supremacy in the use of national resource lands. BLM's recent reports on the "Effects of Livestock Grazing on Wildlife, Watershed, Recreation and Other Resource Values in Nevada," and its appraisal of range conditions for the Senate Appropriations Committee show the dimensions of its inability to effectively manage the natural resources for which it is responsible.

Other issues could be singled out for comment—the plight of the National

Wildlife Refuge System; the allocation of lands in Alaska under the terms of the Native Claims Settlement Act; the necessity for regulating strip mining; the imperative need for land use planning; the question of energy development, both offshore and inland; and the need for a revised national agricultural policy that avoids waste of soil and water resources.

By tradition, these opening Conference remarks attempt to assess the current standing of national and state natural resources programs, particularly for renewable resources, and with emphasis on fish and wildlife. Understandably, the outlook may appear brighter one year than another. In my opinion, the outlook this year, in some ways, is not at all clear and not at all encouraging. The Administration and the Congress want to get the country on the upbeat. There likely will be an outpouring of money to begin projects and create jobs. There are calls to suspend the National Environmental Policy Act in order to shorten the time and the distance between the United States Treasury and the wage earner's pocket. A breakdown of NEPA and relaxation of other environmental statutes could undo the progress that has been made in these past few years. It will take understanding and patience on the part of all sides to prevent this from happening.

Now, all of these issues and more are tied in with the Conference Theme—"Adjusting Consumptive Demands to Resource Capabilities." Intelligent use is at the heart of conservation programs, regardless of whether renewable or nonrenewable resources are involved.

Before calling on Secretary Herter, I want to remind everyone that this is a Conference, not a convention. For that reason, no resolutions can be considered during the next three days of this meeting. Session chairmen have been asked not to accept resolutions or recommendations for action. It is hoped that everyone will take advantage of the discussion sessions. In this way, additional information and differing points of view can be brought before the Conference.

It now gives me great pleasure to turn the Conference over to the Chairman of this Opening Session, the Honorable Christian A. Herter, Jr., Deputy Assistant Secretary for Environmental and Population Affairs, U. S. State Department.

Remarks of the Chairman

Christian A. Herter, Jr.

Ladies and gentlemen, our session this morning moves away from the immediate problems facing all of you on the domestic scene. The subject we are to discuss at this morning's session, "International Pressures on Renewable Resources," is not a subject that comes up in every morning's headlines, as does perhaps the recession, unemployment, inflation, Cambodia, Vietnam or the Middle East. They are questions we hope are transitory in their nature, but the questions that we will be discussing—the capacity of the earth to carry man and his activities; the ability of our resources, in large part renewable, to support life as ever increasing numbers of people occupy more space and require food, shelter and clothing—are very serious. They are questions about what must be done if, in fact, the earth is approaching the limits of its carrying capacity. I am thinking in terms of self-imposed constraints, technological break-throughs, new social and political concepts for managing and redistricting our relatively meager resources. In short, there are some hard decisions that must be made if the quality of our lives, all of our lives, is to be tolerable or if we are to survive at all. These questions, ladies and gentlemen, at least in my judgment, are the ones that really matter insofar as the world is concerned today.

This morning we are privileged to have four speakers who, I am sure will cast light on the meaning of these questions, even if they may not be able to answer them in full. Our first speaker is Governor Russell W. Peterson, Chairman of the Council on Environmental Quality.

How the Damn Thing Works: Population, Resources, and Quality of Life

Russell W. Peterson
Chairman, Council on Environmental Quality
Washington, D.C.

You have probably all heard this story—but since I have the microphone, and cannot easily be interrupted, I will tell it anyhow: An unfortunate gentleman fell from his balcony on the 75th floor of a hotel. As he passed each floor on the way down, other guests heard him repeat to himself, "So far, so good."

It may seem a far reach from that humble tale to the theme of this conference: "Adjusting Consumptive Demands to Resource Capabilities." In fact, however, the falling gentleman's self-assurances seem to be at the heart of the problems we are here to analyze. His rationale could serve as a parable for man's obstinate rejection of reality—and for our continuing failures to make the hard decisions necessary to reconcile man's demands with global supply.

Traditionally, resource-managers have focused on the *supply* side of this equation. Resource-management has been the central theme of the 39 North American Conferences preceding this—and this emphasis has been productive. To select only one example from the entire spectrum of natural resource-and-wildlife issues that might be mentioned—from soils and waters to flora and fauna—your profession's management of game species has been a conspicuous success. In 1890, for instance, the total population of white-tailed deer was about 350,000. Today, though the number of hunters has increased, there are more than 12 million of these animals south of Canada.

Yet the potentially distinctive meaning of *this* Conference, I think, is that it addresses the other side of the equation: *demand*. In recent years, resource managers have recognized the changing patterns and character of demand on resources. Underlying all of these changes, and more important than any of them, is the size of the population making that demand. If this population exceeds carrying capacity, no amount of attention to resources will compensate for our failures to keep the supply-demand equation in balance.

The most conspicuous of these failures is man's refusal to check population growth. Sometime this year, the human population of the earth will reach 4 billion. If your mind works like mine, that figure will draw a blank. I can visualize a dozen of anything, such as eggs, socks, roses, or tanks; I have a reasonable sense for a hundred of many things, such as pennies, marbles, or books; and I have a less graphic but still keen appreciation for a thousand of some things—as in the sentence, "Your daughter's tuition for this quarter comes to exactly $1,000." But I am totally at sea when it comes to visualizing a billion of anything—whether amoeba, dollars or people. Hence, I've had to approach the notion of 4 billion people in a roundabout way.

The human population of the earth did not reach 1 billion until 1830 A.D. It took another hundred years, until 1930, for it to reach 2 billion. After that, it took 30 years, until 1960, for world population to reach 3 billion. And now, only 15 years later, we will have added a *fourth* billion. This chronology will not at all help you to visualize four billion. What it will do, I hope, is convey some sense for the gathering mathematics of man's growing demands on the world's carrying capacity. The period between additions of further billions is shrinking ominously—at an exponential, rather than an arithmetical, rate. At present rates of population growth, the earth will have *eight* billion people within 35 years.

As far as I know, nobody has a firm, scientifically demonstrable estimate of the maximum human population our ecosystem can support. But we do know that in some regions of the earth—notably in the Sahel, in Africa—local carrying capacity has been destroyed, perhaps irrevocably. We know that in other regions large numbers of people depend totally on international food aid for survival. And we know that last year, UNICEF—the United Nations Children's Fund—declared a state of emergency for 15 million children in the poorest nations. According to various estimates, between one-third and one-half of the world's people are chronically undernourished; more than 10,000 die of starvation *weekly*.

Even though we have no precise figure for the earth's human carrying capacity, we would surely be justified in concluding that we are approaching the limit. Considering the amount of human suffering that has already been caused by overpopulation in some areas, we might wonder how any sane person could contest the necessity for moderating population growth. And yet, some apparently sane people do—for good reasons, for bad reasons, and for cynical reasons. Other apparently sane people simply cannot work up to any sense of urgency about the problem. This latter attitude, I think, characterizes most Americans. Understanding why some people think as they do about population growth, and understanding why other people—such as ourselves—don't think much about it at all, requires a look backward.

Population growth seems an entirely natural, routine business: little boys and girls grow up, take a shine to each other, and have more little boys and girls. What could be more natural than that? In point of fact, the recent, exponential growth of human population is *not* natural. It is *un*natural. You can get some sense of the fertility revolution at work if you ponder how old the human kind is. A month ago, a team of anthropologists found the fossilized remains of a human female in Ethiopia. They estimate that she was 18 years old when she died. They estimate that she died 3 million years ago. Thus the human species has been thrashing around and reproducing for at least that long. Yet we did not add up to a billion until 1830 A.D. Why, if it took us that long to number *one* billion, will we add the *fourth* billion in only 15 years?

The reason is not high birth-rates, but low death-rates. In past centuries, the average birth-rate around the world was higher than it is now. But the death-rate of newborn infants and young children was also extremely high. In addition—owing to disease, malnutrition, famines, man's helplessness in the face of natural disaster, and the primitive state of his medicine—human life expectancy was low. In prehistoric times, it is estimated, man had a life-expectancy of only 13 years—and by the 15th century, it was only about 30 years. In consequence, even though human couples produced numbers of children that would astound us today, most of those children died before they could reproduce—and human population growth proceeded at a relatively low rate. Beginning about the time of the Industrial Revolution, however, improved public health practices in Europe and North America began reducing infant mortality and prolonging human life. More humans lived to adulthood and more, in consequence, had children. Because of the sudden disparity between birth-rates and death-rates, the stage was set for a population explosion.

But that did not happen—neither in Europe nor the United States. The reason is that, together with improved public health practices, the Industrial Revolution brought with it some major changes in attitudes toward children and human life. Prior to industrialization, children were valued as workers and as a form of future social security. The more children a family had, the more hands there were to cultivate land or pursue crafts—and the more adults there would be later on, to support mom and pop when their working lives were over. But as mechanization spread through agriculture and crafts, the value of human labor decreased. During one transitional, horrible period during the Industrial Revolution, children continued to represent economic value—but it did not take adult workers long to realize that, the more children there were available for work at slave-labor rates, the fewer jobs were available at decent rates for bread-winners. By and by, large families became an economic anachronism—many mouths to be fed, with a decreasing financial return. And as the 19th Century gave way to the 20th, the emergence of labor unions, improved wage scales, pensions, and finally the Social Security System, capped this process.

I am compressing a great deal of economic history into a few lines, and any such compression involves simplification. Nevertheless, the basic thesis holds true: rapid economic growth made children negligible as producers, but a handicap as consumers. For the first time in human history, the majority of mothers and fathers could think about children as valuable human beings in their own right, rather than as a potential labor supply. The result was that, following a few decades of social adjustment, the birth-rate began to decline in tandem with the death-rate. In the United States, for example—with the single exception of the "baby boom" following World War II—the birth-rate has declined steadily since 1825. At present, annual population-growth rates in the developed countries approximate five-tenths of one percent—about what they were *before* the Industrial Revolution. A few nations, including East Germany, West Germany, and Luxembourg, have actually achieved zero population growth.

In the developing nations, by contrast, birth-rates have *not* declined with the reduction in mortality rates brought about by public health improvements. Beginning in Latin America in the 1920's, and in the rest of the world from about 1940 to the present, new public health measures—particularly a massive U. N. effort to eliminate malaria—cut death-rates in half . . . from 35 per 1,000 population to about 18 per 1,000. Birth-rates, however, remained essentially unchanged. In consequence, population grew rapidly—from five-tenths of one percent to the current level of 2.5 to 3.5 percent. A population growing at 3 percent annually doubles every 23 years.

Three percent may sound modest. But if the population of the United States were to grow by three percent annually, in 100 years, it would be 19 times its present size . . . about 4 billion, equal to the present population of the entire world. The fact that such population-growth rates are being maintained in some nations without major famine is a tribute to their agriculture.

Now, however, it is clear that population-growth in some nations exceeds carrying capacity. Most developing nations retain their predominantly agricultural base; hence children continue to be valued as workers in agriculture or other labor-intensive occupations. In addition, because most developing nations lack any organized provision for the elderly, children are still regarded as social security—as a sort of insurance against deprivation in old age. Thus a destructive cycle is set up: developing nations find it difficult to generate a capital surplus because everything they produce is consumed by a rapidly growing population; lacking that capital surplus, they cannot purchase the technology—agricultural as well as industrial—to speed economic growth; lacking economic growth, they cannot establish mass-education systems that would develop their human potential, nor have their governments the funds to establish some form of social security; lacking any assurance of provision for old age, finally, people in the developing nations go on producing children at rates which guarantee continuing hunger, malnutrition, and—periodically—starvation.

This self-generating dilemma was captured well in a *New York Times* article entitled, "Why the Poorest Nations Have So Many Babies." The subject of the article was a widow in a Calcutta slum, who told the interviewer that she had two sons and three daughters, "and we're all half-starved." When the interviewer asked if she had ever wanted fewer children, she "shrugged and laughed, 'It's God's will', she said. 'Children come and children go.'" The article continued:

> It is evident now that in India and other nations, couples who have numerous children are unwilling to adhere to what seems like simple logic: more children in the family mean less food for everyone. Why, then, is the global population increasing at 2 percent per year?
>
> The answer seems rooted in illiteracy, a valid fear that parents will be left homeless and without support in old age unless they have several sons, the failure of governments to commit money and energy to birth-control measures, and the realization among poor people that some of their children will die, and that an extra mouth or two to feed will hardly alter the family's plight.

What we see, then, is a human variation on "The Tragedy of the Commons." A stock-owner grazing 100 sheep figures it can make no difference to the carrying-capacity of the public pasture if he grazes 10 more—and, of course, he is right. The trouble is that every stock-owner makes the same calculation—and instead of five extra sheep grazing, there are 50 or 100. Ultimately, these extra increments, each small in itself, destroy the capacity of the pasture to regenerate itself. Finally, it cannot support *any* sheep.

Yet, illiteracy, fear of old age, and lack of contraceptive devices are not the only factors that inhibit population control. Another is politics. At last year's Bucharest Conference on Population, for example, the head of the Chinese delegation declared that rapid population growth "is not at all a bad thing, but a very good thing." His reasoning was that "the large population of the Third World constitutes an important condition for strengthening the struggle against imperialism and . . . for accelerating social and economic development." The facts prove otherwise: the developed nations of the earth are those with the smallest growth-rates. Moreover, those nations which demonstrate the greatest interest in economic development are also taking strenuous steps to control population. In 1974, for the first time, Mexico and Brazil adopted government programs to provide family planning services. Considering the overwhelmingly Catholic population of both nations, these actions were nothing short of politically courageous. So far, 31 developing countries have adopted a reduction in population growth as national policy. It is ironic, in view of the Chinese delegate's remarks, that his own nation is one of the 31. In the People's Republic of China, 35 percent of the couples of child-bearing age now use contraceptives, and the annual growth-rate has been reduced to 1.9 percent—below the world average. In other developing countries, where annual growth averages 2.6 percent, only 12 percent of the couples practice contraception.

I have stressed the relation between low birth-rates and economic progress. But I have not at all mentioned a third factor that belongs in any discussion of adjusting consumptive demand to resource capabilities: quality of life. My emphasis on the economics of population control can convey a sense of selfishness—a purely pocketbook perspective of human life that might be stated, "The fewer there are to share the pie, the bigger the piece each of us can have." Cynical as it may sound, that formulation happens to hold true. But population control goes far beyond ensuring that there is enough food for everyone to eat. Just as the earth has a finite carrying capacity, so, too, does the individual family. We may think of its resources as time, money, and the physical, emotional, and mental health of its members. When any of these resources is excessively drawn upon, family life begins to degenerate.

Humans who plan and space the birth of their children have a better chance for happier lives—not only more comfortable ones, but qualitatively *better* ones. Fewer children, with a longer interval between births, means more of everything necessary to raise children well, and to sustain a strong love between parents: more money—for excellent health-care, first-rate education, and family security, as well as for family pleasures; more time for parents to devote to each child—and to each other; more freedom to select career and personal goals—rather than being forced to stick with an unpromising situation because a bread-winner cannot afford to leave it. Quality of life, in large part, boils down to a matter of preserving one's ability to plan and shape his future, rather than just letting it happen. At present, most of the world's societies, as well as their families, lack that ability.

Today, about 70 percent of the world's population lives in the developing countries. At present rates of growth, that proportion will, within 35 years, grow to 82 percent. That rate of expansion, if unchecked, threatens unpredictable danger for us all—not only incalculable human misery, but international conflagration: the India-Pakistan-Bangladesh conflict had its root in overpopulation. Considering the growing interdependence among the nations of the earth; the "new politics" of Third World nations which assert that our abundance has been achieved at the expense of their deprivation; and the proliferation of sophisticated weaponry around the world, *no* country—however far-sighted it may be in controlling its own population—can escape the consequences of the failure of others to moderate population growth.

That assertion, I think, is clear enough; what is not so clear is what developed countries can do to help other nations moderate population growth. The answer, I believe, has two parts:

First, for the long term, the developed nations must increase their investment in programs to restrict population growth. These programs must include comprehensive family services, not simply the furnishing of birth-control materials. Unless a family is assured, through the provision of health education and services, that at least two healthy children *will* survive, they will not voluntarily limit births. A related investment that must be increased is in fertility research. Present methods of contraception are too expensive for massive, widespread adoption by developing countries. We must help bring the price-tag down and—while these nations struggle for a sounder economic footing—the developed nations will probably have to pay most of the bill.

Second, for the short term, we must increase direct and indirect food aid: direct, in the form of foodstuffs for immediate consumption, to mitigate as far as possible the ravages of starvation and malnutrition. Indirect, in the form of fertilizers, seeds, and agricultural technology that the poorest nations cannot afford. Not only does sheer humanity require such action by affluent nations, but so does sheer pragmatism. Many Third World Nations—as evidenced by statements at the Bucharest Conference—believe that the affluent nations want to retard the population-growth of developing nations in our interest, not theirs. Only through continuing, substantial help can we convince them that our interest in their development is genuine.

We have right to emphasize, however, that the continuation of this sort of aid requires, on the part of the developing nations, a governmental commitment to reduction of population-growth. They have, I believe, every right to charge us with over-consumption—and it is clear, from such events as the oil price-increase, that if a sense of justice does not lead us to change our ways, economics will *force* us to do so. At this point, however, over-consumption by the affluent countries cannot be used as a pretext for inaction by the developing countries. Charges and counter-charges may satisfy the spirit—but they do not fill the stomach. *All nations must collaborate* to halt population growth.

Some people advance a third answer to the population crisis: food technology. There are valid reasons for hoping that we can produce more food than we do now—as witness, the "Green Revolution." A strain of wheat called Norin 10, developed by the Japanese in the 1930's and altered at Washington State University for tropical environments, has proven extraordinarily successful. Using new varieties developed from Norin 10, Mexican farmers have managed to raise their yield per acre from 11 bushels to 60. Food technology holds out hundreds of interesting possibilities, and all should be pursued. But none of these, no matter how successful, is an *answer* to excessive population growth. If any one should be an optimist about food technology, it should be Dr. Norman Borlaug, who won the Nobel Prize for his contribution to the "Green Revolution." Yet he is not. "The Green Revolution," he commented recently, "only delayed the world food crisis for another 30 years. If the world population continues to increase at the same rate, we will destroy the species."

And if anyone should be skeptical about technology's capacity to solve human problems, it should be the members of this audience. Your constant professional concern with the management of natural resources gave you an appreciation of the principles underlying ecology years before that word got into the headlines. You understood, before the rest of us did, that "Everything affects everything else"—that you cannot change one part of the ecosystem without affecting half-a-dozen others.

Perhaps the best-known, current example of this is the Aswan Dam. Because you are probably familiar with the consequences of that project, I will summarize them only briefly—principally in order to mention additional consequences, which have recently come to light. On the plus side, Aswan controlled the annual flooding of the Nile, permitted year-round irrigation that brought in four crops a year instead of one, and generated four billion kilowatt hours of power annually. On the minus side, it has eliminated siltation that formerly renewed the land, so that Egyptian farmers need larger and larger amounts of fertilizer; it has reduced fish harvests along the Nile; it has eroded the Egyptian coastline; it has interrupted the flow of nutrients into the Delta, with the consequent destruction of sardine fisheries; and it has produced phenomenal blooms of a weed which, ultimately, sustains a parasitic worm that causes disease in man. That disease is now epidemic in Egypt.

Now, courtesy of the February 22nd issue of *National Journal Reports*, comes the latest communique: the erosion may have been caused by wave-movements in the Mediterranean which have nothing to do with the Nile; most of the 140 million tons of silt formerly carried down the river were historically dumped into the sea anyhow; a rise in underground water levels, not Lake Nasser, is probably responsible for the disease-epidemic; and last but not least, the weed sucks industrial pollutants out of the water. When sealed in fermentation chambers, this weed produces a "bio-gas" that can be used for fuel. Commenting on the topsy-turvy history of Aswan, Richard Critchfield of *National Journal* writes: "The Aswan Dam, and the unforeseen problems it has brought in its wake, is an example of how adopting high technology can be as harmless as jumping off a cliff—providing one has a parachute and can figure out how the damn thing works."

The trouble with population-control as a national priority is that, while it's all about sex, it has no sex appeal. Americans prefer problems that can be attacked fast, and solved fast. We like to hit problems on the head with our doctorates and our dollars today, and see them crumple tomorrow. And it's awfully hard to keep us interested in a problem which is not only persistent, but seemingly far away. We wince in horror and sympathy at the pathetic photos of children with matchstick limbs and swollen bellies—but then we turn the page, or the TV screen erases our horror with a new image, a new sensation . . . and we forget about those kids, those parents, those human beings dying in distant lands with unfamiliar names.

We've got to stick with this problem, tiresome and distant and intransigent as it is. It's difficult for the U. S. today, for Canada today, for Mexico today, to squeeze an extra dollar or peso out of our national budgets. Modern economic, social, and political life is so complicated that government officials become understandably numb when presented with conflicting lists of priorities, every one of which has a lobby to assert its urgency. But I hope that you, as the continent's first practicing ecologists, will join me in continuing to push this issue to the top of our national agendas. Because you work with natural resources all the time, because you see the interplay between resources and growing or changing demands, you can appreciate the fallacy in a "So far, so good" philosophy that constantly invites disaster.

Which brings me back to my starting point: our gentleman who fell from the hotel balcony. The really troublesome element in his logic is that it was absolutely irrefutable for the first 74 floors. Only his arrival at the 75th floor, going in the wrong direction, betrayed a certain flaw in reasoning. Only then did he learn, as the old saw puts it, "It's not the fall that kills you, it's the sudden stop."

I don't know whether we have already passed the limits of the earth's human carrying capacity. I don't know whether technologies unknown or already in the works will permit a tripling or even a quadrupling of human population. I don't know whether the well-fed peoples of the earth will stop stuffing cattle with cereals, and divert them instead to human beings. But you and I *do* know that severe ecological damage often cannot be detected until it is irreversible—until the long tumble down comes to a sudden stop. And we *do* know that the ecosystem which supports man is the one and only life-support system we have; if we exceed its carrying capacity, we cannot buy another one.

"So far, so good," in sum, is suicidal logic—no excuse for delaying the hard decisions that all nations must make *soon* to avoid a common drop into oblivion. Even though we do not know the earth's maximum carrying capacity, we must assume *now* that we have reached it—for past population growth has built into future growth a momentum beyond our recall. Barring massive famine, nuclear warfare, continent-wide outbreaks of plague, or other such Malthusian "solutions" to excessive population growth, we cannot prevent world population from reaching at least 8 billion by the year 2025. We must hope that our one and only ecosystem can support that many people. But we cannot indefinitely expect nature to correct our errors, to subsidize our follies, or to tolerate our continuing political, economic, and social excuses for a failure to *act*. Like any parachute, like any life-support system, man's ecosystem has a finite ability to support human weight. And if the Aswan Dam and the St. Lawrence Seaway, DDT run-offs and the side-effects of a hundred well-intentioned interferences with nature have taught us anything, it is this: strong and resilient as our ecosystem is, we still have not completely figured out how the damn thing works. While we continue learning, we must not allow unlimited population growth to push man off his balcony. It's hard to change course when you're on the way down, and picking up speed.

Agricultural Production: Resource Needs and Limitations

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Overpopulation

As a result of overpopulation and environmental resource limitations the world is fast losing its agricultural capacity to feed itself. The world population today is 4 billion humans (NAS 1971). Based upon current growth rates, and even allowing for reasonable reductions in birth rates in several countries, the National Academy of Sciences Committee estimated that the world population will reach at least 7 billion by the year 2000 (Figure 1). The committee concluded there is no feasible means to stop this explosive increase short of some unwanted catastrophe (NAS 1971).

If we go back only about 2000 years, the records suggest that humans on earth numbered little more than 200 million (Coale 1974)—about the density of the population of the United States today. World population was about 500 million as recently as 1650. It was shortly after 1700 that the human population explosion occurred (Figure 1).

Note how the rapid growth in world population coincides with the exponential use of fossil fuels (Figure 1). Fossil energy was used for disease control operations and to improve agricultural production to feed the growing population. Both the effective control of human diseases and increased food production have contributed significantly to the current rapid population growth (NAS 1971). Of these two factors, the evidence suggests that reducing death rates with effective public health programs is the prime cause (Freedman and Berelson 1974). The eradication of malaria-carrying mosquitoes by DDT and other insecticides is a good example (note, substantial quantities of energy required for production and application). After spraying with DDT in Ceylon in 1946-47, the death rate fell in one year from 20 to 14 per 1,000 (PEP 1955). A similar dramatic reduction in death rates occurred after DDT was used in Mauritius where death rates fell from 27 to 15 per 1,000 in one year and population growth rates increased from about five to 35 per 1,000 (Figure 2).

Meanwhile in both Ceylon and Mauritius fertility rates did *not* decrease and an explosive increase in population numbers resulted. Recent history documents similar results in other nations where medical technology and medical supplies have significantly reduced death rates (Corsa and Oakley 1971). It is relatively easy to reduce death rates through public health measures, but birth rates are difficult to change. Birth rates are interwoven with social and religious systems of the people.

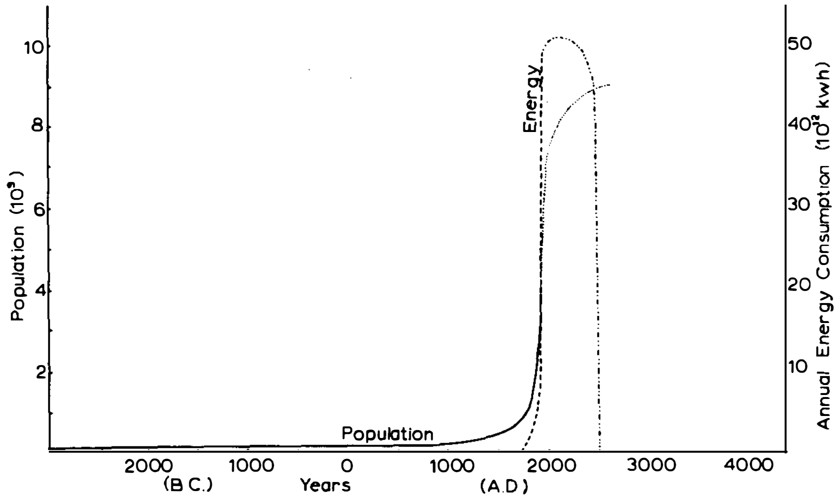

Figure 1. Estimated world population numbers (———) from 3000 B.C. to 1973 A.D. and projected numbers (•••••) to the year 2500 A.D. (NAS 1971). Estimated fossil fuel consumption (- - - -) from 1850 A.D. to 1973 A.D. and projected (-••-••) to the year 2500 (Hubbert, 1962).

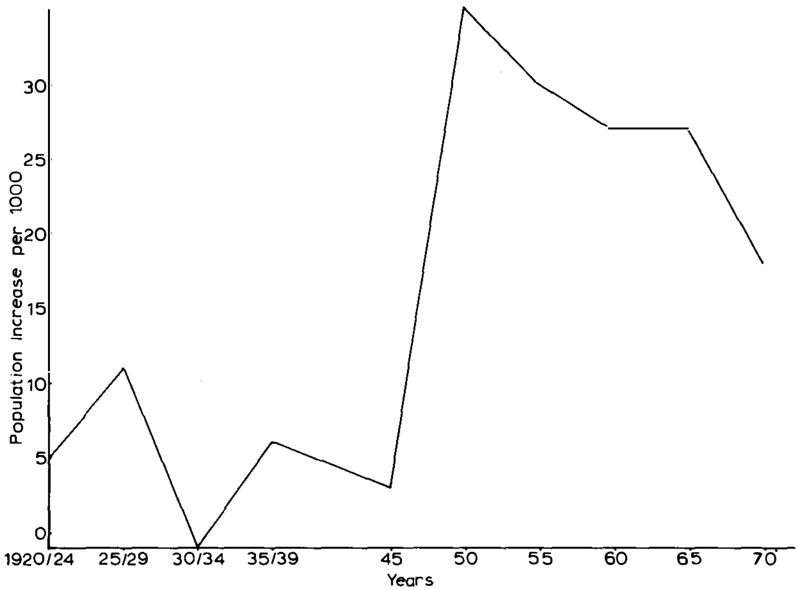

Figure 2. Population growth rate on Mauritius from 1920 to 1970. Note from 1920 to 1945 the growth rate was about five per 1000 whereas after malaria control in 1945 the growth rate exploded to about 35 per 1000 and has since very slowly declined (PEP 1955; UN 1957-1971). After 25 years the rate of increase is still nearly four-times the 1920-45 level.

Food and Agriculture

Man was first a hunter and gatherer. He obtained his food by killing mammals and birds, capturing fish, and gathering wild vegetables, fruits, and nuts. A small family system or tribal unit of 30 to 40 residents could effectively range over 311 to 414 km^2 to obtain their food (Lee 1969). This is about one person per 10 km^2. Lee estimated that it was energetically profitable to walk nearly 19 kilometers to obtain food from a good source. These data were obtained from the !Kung bushmen in Africa.

The American Indians in the Hudson Basin region of New York, previous to the arrival of the Europeans (ca. 1600), numbered about 65,000 (Lauer et al. 1974). This was the equivalent to about one person per two km^2. At this time the Indians were raising a little corn, beans, and squash and this density is considered high (Lauer et al. 1974). This high density per unit land area was supported in part by the availability of shellfish and other marine resources.

When human numbers increased in the world, many regions could no longer support a hunting-gathering economy. The shift had to be made to a more permanent type agriculture (Boserup 1965). "Slash and burn" or "cut and burn" agriculture was the first technology employed, i.e. cutting trees and brush and burning them on site. This practice killed weeds and added nutrients to the soil. Crop production was good for a couple of years before soil nutrients were depleted. After use, it then takes about 20 years for the forest to regrow and soil nutrients to be renewed.

Cut and burn crop technology required few tools (ax and hoe) and lots of manpower. For example, in a part of Mexico "slash and burn" corn culture was investigated and Lewis (1951) reported that a total of 1,144 hours of labor was required to raise a hectare of corn (Table 1). Other than manpower, the only inputs were the ax, hoe, and seeds. Similar data were obtained for corn production in Guatemala (Table 2).

The yield of 1,944 kg/ha in Mexico provided about 6,842,880 kcal. Allowing for 3,000 kcal of corn per person per day, this yield was suitable for more than six persons. Another way of looking at this is that only one-sixth of a hectare is necessary to feed a person per year with corn. The hours needed then would be about 190 hours per person per year or only about five weeks work.

Table 1. Energy inputs in corn production in Mexico using only manpower.

Input	Quantity/ha	kcal/ha
Labor[a]	1,144 hrs	622,622
Ax + Hoe[b]	16,500 kcal	16,500
Seeds[c]	10.4 kg	36,608
Total		675,730
Corn yield[a]	1,944 kg	6,842,880
Kcal return/kcal input		10.13

[a]Lewis (1951). See Table 4.
[b]Ax and hoe assumed to weigh 23 kg. See Table 3.
[c]10.4 kg x 3,520 kcal/kg = 36,608 kcal.

Table 2. Energy inputs in corn production in Guatemala using only manpower.

Input	Quantity/ha	kcal/ha
Labor[a]	1,415 hrs	770,114
Ax + Hoe[b]	16,500 kcal	16,500
Seeds[c]	10.4 kg	36,608
Total		823,222
Corn yield[d]	1,066 kg	3,752,320
Kcal return/kcal input		4.56

[a]Corn production in San Pedro Necta, Guatemala infertile Llano soil (Stadelman, 1940). See Table 4 for labor energy input.

[b]Ax and hoe assumed to weigh about 23 kg. See Table 3.

[c]10.4 kg x 3,520 kcal/kg = 36,608 kcal.

[d]Stadelman, 1940.

Other than using fossil fuels, this type of agriculture is the most productive per unit input and provides the society with the most leisure time. Boserup (1965) has pointed out that man values his leisure time. She documented cases where societies which had been forced to adopt "permanent type agriculture" reverted to "slash and burn" when the populations declined.

With a 20 year rotation required to employ "slash and burn" agriculture, of course, the land area required per family system is quite large. The use of permanent agricultural plots requires less land but a greater manpower input, because now organic matter (i.e., leaves and grasses) has to be collected from afar and carried to the plots to maintain soil fertility and productivity. To maintain soil fertility, about 16,000 kg of organic matter have to be added to the land per hectare. About 250 hours of hand labor would be necessary to collect, haul with a wheelbarrow and apply this material to a hectare of cropland if the distance were about 1.6 kilometers (Pimentel 1974).

When man started harnessing fossil fuel for crop production, agriculture became revolutionized. Great changes occurred in agricultural production and these are discussed later in the section dealing with "Energy and Food Production."

Land and Water Resources

Arable cropland is in short supply. Of the total of 13 billion hectares of land area in the world (FAO 1961), only an estimated seven to ten percent is suitable for cultivation (Hainsworth 1953, FAO 1961, Clawson et al. 1960, Pawley 1963, FAO 1969). As Paddock and Paddock (1964) point out, "a desert may have fine soil, but it has no rain; the Arctic has moisture but not the right temperature; mountains are too up and down. And so it goes." We are fortunate in the U.S., since about 22 percent of our land is suitable for cultivation (FAO 1961). However, South America has only six percent arable land for cultivation (FAO 1961), for approximately the same number of people. Furthermore, nearly all the arable land of the world is in cultivation (Paddock and Paddock 1964). By bringing the remaining arable hectares in the United States, Canada, and elsewhere in the world into production, only an estimated one percent might be added. An estimated 25 million hectares in the U. S., might be brought into production. Hence, even in the United States, which has the greatest amount of arable land of any nation, nearly all the land resources already have been put into use. To complete the picture on the use of land, mention should be made that about 22 percent of the land area of the world is used for livestock production and is in pastures, ranges, and meadows (FAO 1969). Another 30 percent of the land area is in forests (FAO 1969).

Although our land resources are vital to us for crop production, these lands are rapidly deteriorating. For example, annually in the U. S. about 3.6 billion metric tons of soil are washed into our streams and ponds, and into the oceans (Wadleigh 1970). This valuable topsoil is lost from our cropland, home building sites, and other areas where soil is left with insufficient plant cover. On bare soil, such as at construction sites, about 1120 metric tons of soil per hectare may be lost (Lauer et al. 1974). The average loss of topsoil per hectare of corn production is 44.1 metric tons (Miller 1936). In the corn-state of Iowa, the loss averages 36 metric tons annually and the aim is to reduce this loss to 11 metric tons annually (Shrader et al. 1963).

With wheat production, the loss of topsoil is significantly less than corn, averaging 22.6 metric tons per year (Miller 1936). For continuous bluegrass the annual loss is only 0.7 metric tons per hectare (Miller 1936). In a mature forest, I estimate the annual loss to be 0.7 metric tons or less per hectare.

We in the U. S. are literally mining our soils for crop cultivation. How long can we continue to abuse our valuable soils?

Water is another vital resource in crop production. This year, with the drought in the Mid-West, the importance of water was emphasized to us. Tremendous quantities of water are necessary to raise a crop. For instance, about 122 centimeters of water are needed to raise a hectare of corn in the subtropics. Translated into liters, this is about 12.2 million liters of water. Here in the Northeast U. S. our rainfall ranges between 89 and 102 centimeters which, with the lower temperatures, is adequate for corn and other crops. A small amount of irrigation is used, but most of this is insurance to protect crops during some critical period in its growth when adequate rain may not fall.

Only about 13 percent of the world's cultivated land is now irrigated (FAO 1969). The use of irrigation could significantly increase the arable cropland in the world (Kellogg 1967), but this type of alteration of the ecosystem requires energy. A liter of water is heavy and weighs 1.0 kilogram. To pump from a depth of a little over 90 meters and apply 122 centimeters of water to a crop hectare would require about 2060 liters of fuel (ca. 19.7 million kilocalories) (Smerdon 1974). Because of the high energy-demand of irrigation, it is doubtful that it will be used extensively to increase the arable land of the world (Addison 1961, Clark 1967).

Energy and Food Production

Earlier, I mentioned how man has utilized fossil energy resources to increase his population. In fact, the use of energy has been increasing faster than population. For example, while it took about 60 years for the U. S. population to double, the U. S. doubled its energy consumption during the past *20 years*. More alarming is the fact that while the world population doubled its numbers in about *30 years*, the world doubled its energy consumption within the past decade. Energy use in food production has been increasing faster than many other sectors of the world economy. For example, using corn as an average crop, Pimentel et al. (1973) documented that energy inputs in corn production more than *tripled* (Tables 3 & 4). Note that the quantity of energy used to produce nitrogen fertilizer during 1970 nearly equalled all the energy inputs for 1945. The other large inputs of energy come from machinery (420,000 kilocalories); fuel (797,000 kilocalories); drying (120,000 kilocalories), and electricity (310,000 kilocalories).

Drying corn was one of the factors that increased significantly from 1945 to 1970. This in part is related to one of the factors involved in increasing corn yields. Having corn with a longer growing season allows the corn to collect more light energy and convert this into corn grain. With a longer growing season the corn stands in the field later in the fall and does not have an opportunity to dry. Hence, the corn has to be dried before it is put into storage.

The total amount of fossil energy used to grow a hectare of corn in 1970 averaged about 742 liters of fuel (7.1 million kilocalories) (Pimentel et al. 1973). An estimated 134 million hectares were planted in crops in 1970 (excluding cotton and tobacco) (USDA, 1972a). With about 200 million people in the United States, in 1970, this averages about .7 hectares per capita; but since about 20 percent of our crops are exported, the estimated number of hectares per capita is about .56. Employing modern agricultural technology, this is the equivalent of 416 liters of fuel per person (742 ℓ per hectare x .56 per person = 416). If we include processing, distribution, and home cooking, the total inputs per person for the food system is estimated to be 1273 liters of fuel equivalents per person per year. Using U. S. agricultural technology to feed a world population of 4 billion on an average U. S. diet for one year would require the energy equivalents of 5092 billion liters of fuel.

To gain some idea about what the energy needs would be for different diets if U. S. agricultural technology were employed, an estimate is made of how long it would take to deplete the known and potential world reserves of petroleum. The known reserves have been estimated to be 86,912 billion liters (Jiler 1972). If we assume that 76 percent of raw petroleum can be converted into fuel (Jiler 1972), this would equal a usable reserve of 66,053 billion liters. If *petroleum* were the only source of energy and if we used *all* petroleum reserves solely to feed the world population, the 66,053-billion-liter reserve would last a mere *13 years* [(66,053 billion liters)/(5,092 billion liters) = 13 years].

Solar Energy in Crop Production

The 7.1 million kilocalories input of fossil fuel used to raise a hectare of corn (Table 3) represents a small portion of the energy input when compared with solar energy input. During the growing season, about 5,046 million kilocalories reaches a hectare of corn, about 1.26 percent of this is converted into corn and about 0.4 percent into corn grain (at 6,272 kg/ha) (Transeau 1926). The 1.26 percent represents about 63.6 million kilocalories. Hence, when solar energy input is included, the fossil fuel input of 7.1 million kilocalories represents about 11 percent of the total energy input in corn production. The good return for corn of 2.52 kilocalories in corn grain per input kcal of fossil fuel (Table 3) is due

Table 3. Average energy inputs in corn production during different years (all figures per hectare) (revised after Pimentel et al., 1973).

Inputs	1945	1950	1954	1959	1964	1970
Labor[a]	57	44	42	35	27	22
Machinery (kcal)[b]	444,600	617,500	741,000	864,500	1,037,400	1,037,400
Fuel (liters)[c]	140	159	178	187	197	206
Nitrogen (kg)[d]	8	17	30	46	65	125
Phosphorus (kg)[d]	8	11	13	18	20	35
Potassium (kg)[d]	6	11	20	34	46	67
Seeds for planting (kg)[e]	11	13	16	19	21	21
Irrigation (kcal)[f]	103,740	128,440	148,200	170,430	187,720	187,720
Insecticides (kg)[g]	0	.11	.34	.78	1.12	1.12
Herbicides (kg)[h]	0	.06	.11	.28	.43	1.12
Drying (kcal)[i]	9,880	34,580	74,100	163,020	247,000	296,400
Electricity (kcal)[j]	79,040	133,380	247,000	345,800	501,410	765,700
Transportation (kcal)[k]	49,400	74,100	111,150	148,200	172,900	172,900
Corn yields (kg/ha)[l]	2,132	2,383	2,572	3,387	4,265	5,080

[a]Mean hours of labor per crop hectare in United States (USDA, 1954 and 1972a). [b]An estimate of the energy inputs for the construction and repair of tractors, trucks, and other farm machinery was obtained from the data of Berry and Fels (1973), who calculated that about 31,968,000 kcal of energy was necessary to construct an average automobile weighing about 1,530 kg. In our calculations we assumed that 244,555,000 kcal (an equivalent of 11,700 kg of machinery) were used for the production of all machinery (tractors, trucks, and miscellaneous) to farm 25 hectares of corn. This machinery was assumed to function for 10 years. Repairs were assumed to be six percent of total machinery production or about 15,000,000 kcal. Hence, a conservative estimate for the production and repair of farm machinery per corn hectare per year for 1970 was 1,037,400 kcal. A high for the number of tractors and other farm machinery on farms was reached in 1964 and continues (USDA, 1953 and USBC, 1972). The number of tractors and other types of machinery in 1945 were about half what they are now. [c]DeGraff and Washbon (1943) reported that corn

production required about 140 liters of fuel per hectare for tractor use—intermediate between fruit and small grain production. Because corn appeared to be intermediate, the estimated mean fuel (liters) burned in farm machinery per harvested hectare was based on U. S. Department of Agriculture (1953 and 1964) and U. S. Bureau of the Census (1972) data. [d]Fertilizers (N, P, K) applied to corn are based on USDA (1954, 1957, 1967a, and 1971) estimates. [e]During 1970, relatively dense corn planting required about 21 kg of corn (61,750 kernels or 83,980 kcal) per hectare; the less dense plantings in 1945 were estimated to use about 10.5 kg of seed. Because hybrid seed has to be produced with special care, the input for 1970 was estimated to be 147,840 kcal. [f]Only about 3.8 percent of the corn grain hectares in the United States were irrigated in 1964 (USBC, 1968), and this is not expected to change much in the near future (Heady et al., 1972). Although a small percentage, irrigation is costly in terms of energy demand. On the basis of the data of Smerdon (1974), an estimated 4,921,166 kcal is required to irrigate a hectare of corn with 30.48 cm of water for one season. High energy costs for irrigation water are given by the *Report on the World Food Problem* (PSAC, 1967). Since only 3.8 percent of the corn hectares are irrigated (1964-1970), it was estimated that only 187,720 kcal were used per hectare for corn irrigation. The percentage of hectares irrigated in 1945 was based on trends in irrigated hectares in agriculture (USDA, 1970a and USBC, 1968.) [g]Estimates of insecticides applied per hectare of corn are based on the fact that little or no insecticide was used on corn in 1945, and this reached a high in 1964 (USDA, 1968 and 1970b). [h]Estimates of herbicides applied per hectare of corn are based on the fact that little or no herbicides were used on corn in 1945 and that this use continues to increase (USDA, 1968 and 1970b). [i]When it is dried for storage to reduce the moisture from about 26.5 percent to 13 percent, about 1,008,264 kcal are needed to dry 5,080 kg (CGG, 1968). About 30 percent of the corn was estimated to have been dried in 1970 as compared to an estimated 10 percent in 1945. [j]Agriculture consumed about 2.5 percent of all electricity produced in 1970 (CAHR, 1971) and an estimated 424.2 trillion British thermal units of fossil fuel were used to produce this power (USBC, 1971). On croplands this divides to 765,700 kcal per hectare for 1970 (USDA, 1968 and 1972a). The fuel used to produce the electrical energy for earlier periods was estimated from data reported in *Statistical Abstracts* (USBC, 1965). [k]Estimates of the number of calories burned to transport machinery and supplies to corn hectares and to transport corn to the site of use is based on data from U. S. Department of Commerce (1967), U. S. Bureau of Census (1968, 1971, and 1972), Interstate Commerce Commission (1968a, 1968b, and 1968c), and U. S. Department of Transportation (1970). For 1964 and 1970 this was estimated to be about 172,900 kcal per hectare; it was about 49,400 kcal per hectare in 1945. [l]Corn yield is expressed as a mean of three years, one year previous and one year past (USDA, 1967b, 1970a, and 1972b).

Table 4. Energy inputs in corn production (all figures in kcal) (revised after Pimentel et al., 1973).

Inputs	1945	1950	1954	1959	1964	1970
Labor[a]	31,022	23,947	22,859	19,049	14,695	11,974
Machinery[b]	444,600	617,500	741,000	864,500	1,037,400	1,037,400
Fuel[c]	1,339,800	1,521,630	1,703,460	1,789,590	1,885,290	1,971,420
Nitrogen[d]	140,800	299,200	528,000	809,600	1,144,000	2,200,000
Phosphorus[e]	25,520	35,090	41,470	57,420	63,800	111,650
Potassium[f]	13,200	24,200	44,000	74,800	101,200	147,400
Seeds for planting[g]	77,440	91,520	112,640	133,760	147,840	147,840
Irrigation[b]	103,740	128,440	148,200	170,430	187,720	187,720
Insecticides[h]	0	2,662	8,228	18,876	27,104	27,104
Herbicides[i]	0	1,452	2,662	6,776	10,406	27,104
Drying[b]	9,880	34,580	74,100	163,020	247,000	296,400
Electricity[b]	79,040	133,380	247,000	345,800	501,410	765,700
Transportation[b]	49,400	74,100	111,150	148,200	172,900	172,900
Total inputs	2,314,442	2,987,701	3,784,769	4,601,821	5,540,765	7,104,612
Corn yield (output)[j]	7,504,640	8,388,160	9,053,440	11,922,240	15,012,800	17,881,600
Kcal return/kcal input	3.24	2.81	2.39	2.59	2.71	2.52

[a]It is assumed that a farm laborer consumes 21,770 kcal per week and works a 40-hour week. For 1970: (22 hours/40 hours) x 21,770 kcal = 11,974 kcal. [b]See Table 3. [c]Fuel, 1 liter = 9,570 kcal (HCP, 1972). [d]Nitrogen, 1 kg = 17,600 kcal, including production and processing (Leach and Slesser, 1973). [e]Phosphorus, 1 kg = 3,190 kcal, including mining and processing (Leach and Slesser, 1973). [f]Potassium, 1 kg = 2,200 kcal, including mining and processing (Leach and Slesser, 1973). [g]Corn seed, 1 kg = 3,520 kcal (USDA, 1963). This energy input was doubled because of the effort employed in producing hybrid seed corn. [h]Insecticides, 1 kg = 24,200 kcal including production and processing (similar to herbicide; see [i]). [i]Herbicides, 1 kg = 24,200 kcal including production and processing (Pimentel et al., 1974). [j]Each kg of corn was assumed to contain 3,520 kcal (USDA, 1963).

in part to the high efficiency of corn to convert light energy (1.26 percent) into plant material (Transeau 1926). Most crop plants are far less efficient in capturing light energy. For example, the rice plant only converts about 0.8 percent of light energy into rice (Odum 1971) and vegetables generally convert only about 0.5 percent.

Providing a plant with a suitable environment will aid in increasing the amount of light energy captured and, hence, the efficiency of plants to capture light energy. However, according to the plant physiologists no great breakthrough appears to be on the horizon to improve the conversion of light energy via photosynthesis (DeWit 1967). Hence, man is currently limited in increasing the efficiency of plants to convert sunlight into food.

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Discussion

VICE CHAIRMAN CLEPPER: Ladies and gentlemen, at our first North American Wildlife Conference in 1936, which I had the honor to participate in, we established some ground rules for discussion. Those ground rules have served us well over the years and Chairman Herter wishes them to be enforced this morning. If any person in the audience wishes to ask our speakers a question, will that person please go to the microphone and give his name and affiliation before proceeding with his question or comment.

MR. RUEBEN JOHNSON [President, American Water Resources Association] : I would like to address this question to Mr. Peterson. He indicated that the developing nations' population will soon be 82 percent of the world's total, while we, in this country, have suddenly reduced our population and utilized our resources so that we can feed our population. The question I have, and this may sound very harsh, is: why do we wish to feed the rest of the world and utilize our own resources to do so? Can't we take our resources and use them for ourselves? I know this sounds selfish, but we are facing a very serious problem and I think we should be realistic.

GOVERNOR PETERSON: Let me correct two things. First of all, you have indicated we have been reducing our population. However, that is not true. We have actually been reducing the population growth rate. Today, for example, our population is 213 million. If the birth rate continues as it is today, the U. S. population will probably peak out at about 265 million in the early 21st Century. This is because of the momentun built in by large populations of young people who have not reached the child bearing age.

I think it is essential to the world stability and to the availability of resources for all countries that we do face up to helping the world to solve its population and resource problem. Even if we are only concerned about our selfish interests, we had better consider the need for our working with other peoples to provide them with some of their needs; however, if we are concerned with humanitarian interests as well, then we have a very strong incentive to participate.

We know today that in some of the developing countries there has been a tremendous change, a marked reduction in the birth rate coupled with a modest increase in economic well being. Those two things appear to have to go together. However, in all of these cases there has also been a strong push for the government to provide the knowledge and wherwithal so parents can exercise their basic human right of deciding on the size of their family and the spacing of their children. We do have demonstration projects in this area which have worked, and we need to spread such knowledge, and the wherewithal to use it, to other developing countries so that they can do likewise.

Unfortunately, some of them almost certainly are going to have some huge catastrophe before they participate in the approach I have just described.

CHAIRMAN HERTER: Governor Peterson, I suppose the question is really: what can we do in terms of halting this fast increasing population? At Bucharest we heard this from the developing countries: "There is nothing we can do about this until the state of our economy and standard of living begins to take care of the situation automatically." Is this really going to get at the heart of the problem in the near future or do we have to take more strenuous measures in this country or other countries to provide help?

GOVERNOR PETERSON: I think the facts in relation to the world indicate that, in developing countries, with only a modest improvement in economic well being but a definite trend toward a better tomorrow, the people have developed a hope that their quality of life will improve. As a result of this, they have been motivated to move toward smaller families. When the government provides them with knowledge and wherewithal to limit family size, they do so. They do not need to reach a standard of living such as we have in the U. S., but to show progress, from the very low level at which they are today, toward a better tomorrow. Of course, we in the developed world, as has already been demonstrated in relation to some countries, can be helpful in working with underdeveloped countries to try to help them raise their standard of living, however modestly. At the same time we can provide them with the knowledge and some of the funds with which to provide family planning.

At Bucharest, some 137 nations agreed by acclamation to further a population plan of action. Since that time, the Asian countries, whose problem is the most serious, without dissension, have developed a plan based on quantitative goals for reducing their population growth.

CHAIRMAN HERTER: I would also like to ask Professor Pimentel a question because I think this is a matter of great concern.

We get repercussions from all over the world, particularly from developing countries, to the effect that if we did not eat so much in this country—if we did not over-consume, if we were not so hooked on meat products—we really would have no problem about feeding the rest of the world; and that the problem of starvation is more a problem of overconsumption by the developed world than it is lack of production and distribution in the developing world. I wonder if you would comment on that basic assertion.

PROFESSOR PIMENTEL: Yes, Secretary Herter, there is no question but that we produce a great deal of food in these United States. The number that I recall is that the world population today is consuming 173 millimetric tons of protein a year. We in the United States produce only 31 millimetric tons of that protein. However, we feed to our livestock some 26 millimetric tons, while the total world feeds 51 millimetric tons to livestock. We could, if we so desired, go on a strict vegetarian diet. This protein is suitable for man's consumption, so that we could contribute roughly about 15 to 20 percent more food, if we wanted to exclude animal protein. Therefore, we can make a significant contribution. However, we are not *that* productive. While we have a percentage of the world's arable land, we do not have that much.

Pressures on Renewable Resources: A Canadian Perspective

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In its most simplistic conception, management of resources is a matter of achieving a balance between supply and demand. In this context, our consideration of the subject of this morning's general session, international pressures on renewable resources, must lead us to think of the global demand for renewable resources; and the implication of the Conference theme, "adjusting consumptive demands to resource capabilities", must, if we have any notion of social justice on a global scale, lead us to think of the dimension of the North American demand for renewable resources in relation to that arising from the needs and aspirations of the rest of the world. It is well known that the United States, Canada and some of the countries of western Europe consume an inordinate proportion of the world's resources. Recognition of that fact and its corollary, that a substantial proportion of the world's people live from day to day in dire need, has, over the past 30 years, given rise to a host of public and private programs of aid and development, and underlies the confrontational nature of political and economic manoeuvering that characterizes the world today. With the prospect of a continuing increase in global demand for goods, services and amenities, resulting from growing population and increasing per capita consumption, we can expect the pressures and the tensions to mount. What hope is there that they will not lead to major cataclysm?

Considerable hope, I would venture to suggest, and it is the intent of this paper to demonstrate that in the Canadian perspective such hope is warranted. Before attempting to substantiate that statement, let me make a few apologies. What I have to say will have rather little to do with wildlife as such, and will not be confined by a narrow definition of renewable resources. Since resources management is a matter of balancing supply and demand, I intend to address what I believe to be the key question: "Who manages resources and with what interests in mind?" I want to bring to your attention glimpses of the history of control over resources, and in doing so I shall refer to land, water, air, and wildlife. I shall say something about the exercise of control by the individual, the state and the community of nations and I will suggest that in a degree of control at the latter level lies the only hope of achieving and maintaining the security of mankind. In all respects my treatment must be a sketch rather than a comprehensive review of a very extensive and complex subject.

There is scant evidence to illuminate how, at the dim edge of history, the relationship between man and the resources he needed to survive became a matter of custom and, eventually, law. But we can speculate with some confidence, that as the prime locus of decision in human affairs moved from the family, to the clan, the tribe and the kingdom, so also the ultimate control over resources considered as property was exercised at a higher social level. We can easily imagine that in places and at times that small groups of people scattered themselves widely over the land, supplying themselves mainly by hunting and gathering, the concept of property was applied to only a very limited range of personal possessions. Resources, generally, were available for the use of the tribe, subject only to the limitations of territoriality worked out, one way or another, with neighboring tribes.

In places and at times that communities based upon cultivation, and later, trade, sprang up, the concept of property came to be much more widely applied. Land and its products, both natural and domestic, and, with some limitations, water came under the control of the individual and, ultimately, to greater or lesser degree, of the state.

Let me take a few moments to sketch the relationship between individual control and state control of certain resources as it has evolved, and is still evolving in Canada. The relationship between control at the provincial and at the federal level, reflecting a difference in the extent of the community served, is also of interest. With the exception of the Yukon and Northwest Territories and a limited extent of federal lands, ultimate control of land is the prerogative of the Crown (i.e. the public executive power) vested in the provinces. However, within the settled portion of the country most of the land has been granted to individuals. Limitations on the use of land in individual ownership have increased over the years, most notably in densely populated areas, and have taken the form of various sorts of restrictions on the use of land, not only in urban areas, but also in the countryside. Certain Crown lands are leased or allotted to individuals or corporations for specific purposes such as lumbering or recreation, and such disposition is usually conditional upon the observance of regulations relating to the use of resources and the environment. In certain parts of Canada there is growing concern about the loss of agricultural land to non-agricultural uses, and ways are being sought to bring this trend under control.

The actions just described have been undertaken mainly by the provinces. At the federal level, a first step was taken in 1961 when the Resources for Tomorrow Conference recommended the Canada Land Inventory. This joint federal-provincial program has provided detailed information on the suitability of land for agriculture, forestry, recreation and wildlife; on present land use and associated socio-economic factors; and it has enabled initiation of an agro-climatic classification of land. The inventory covers almost all of the inhabited regions of Canada, comprising more than 800,000 square miles. It omits important regions of Canada like the Arctic, and there are other gaps, for example the non-renewable resources.

Even if there is still a need for a more comprehensive approach to planning the use of resources, the inventory has led to a re-examination of the whole range of conservation issues and the spectrum of possible uses of Canada's renewable resources now and in the future. The inventory has made possible a first attempt at a national land use policy, now being developed, which involves consideration of the manner in which the individual, governmental or corporate owner should make use of the land in his or its possession.

Generally speaking, water cannot be owned in the same sense as land, but its use can be and is controlled. Custom and law providing for some control over the use of water must have arisen at a very early stage in human history, particularly in those semi-arid areas where civilization first began. Legal control over the uses of water relates to its consumptive use for domestic purposes, industrial requirements, irrigation and so forth; to its use for navigation, and as a dump for wastes; and to access to it. Partly because of the mobile nature of water, and the fact that watercourses cross both interprovincial and international boundaries, the federal government in Canada has jurisdiction over water in respect of navigation and fisheries. Control in respect of other uses of water is primarily a matter of provincial responsibility, and it is those governments that have generally had the greatest impact on water use. As recently as 1970, also as an outcome of the Resources for Tomorrow Conference, comprehensive federal legislation was passed to enable a co-operative approach to water management on the part of the two levels of government. Water pollution had come to be recognized as a serious threat to the health, welfare and prosperity of the nation. Moreover it was seen as imperative to acquire a greater knowledge of the water resource (its nature, expanse, distribution and requirements) and, at the same time, to undertake programs capable of "ensuring its optimum use for the benefit of all Canadians." This legislation, the Canada Water Act, has led to a number of federal-provincial agreements in the field of water management.

Control over the use of air, and the concept of property rights in air are such recent notions that "Free as the air" is a phrase that is still in the vocabulary of most of us. Only recently has air been considered in the perspective of a resource which is an integral part of the biosphere. Now, for more and more people, the quality of this commonly-owned resource is seen to be threatened.

In Canada, the regulation and control of sources of air pollution is divided between the federal and provincial governments. For some years, it was common practice for the provinces to delegate a good deal of their responsibility to the municipal level. But air pollution shares with water pollution the characteristics of a common-property resource and a mobile medium, and a rationale somewhat similar to that underlying the Canada Water Act led to the passage of the federal Clean Air Act in 1971. Because our knowledge of air is far from satisfactory, a primary responsibility of the Minister of the Environment, who administers the Clean Air Act, is related to "research, information and data collection," on the basis of which may be established "national ambient air quality objectives" in close co-operation with all the Provinces.

There is no need for me to review for this Conference the different degrees of control and varying proprietary rights that, through history, have been exercised in respect of wildlife. Suffice it to say, that in Canada, except for the case of migratory birds, it was only in 1973 that comprehensive federal legislation was passed in the wildlife field. Obviously, it took quite some time for Canadians to develop and express a national conscience about their wildlife heritage. Among the duties, powers and functions of the Minister of the Environment, the first relates to "the encouragement of public co-operation in wildlife conservation and interpretation." Without such public co-operation there may be no effective management, but it alone does not suffice: research programs, laboratories and other necessary facilities are needed. Finally, and most importantly in a federal state, there is the need to "co-ordinate and implement wildlife policies and programs in co-operation" with the Provincial Governments which have traditionally managed this resource.

What general conclusions can we draw from what has taken place in one country, Canada, with respect to the management and control of the environment and renewable resources? Underlying recent environmental initiatives, is the implicit conclusion that the social, economic and legal order of the past somehow failed properly to recognize environmental considerations in the development of the nation. Most often in the context of concern about pollution, the effects of public and private uses of water were increasingly questioned; rights to use water for various resource development schemes were more frequently weighed against the rights of the community to a better environment; and it became clear that there was a need to harmonize social and cultural goals with the economic and material considerations that had earlier seemed almost exclusively to prevail. The pre-eminence of individual rights and, in some cases, owner's rights is dwindling - *laissez-faire* is a thing of the past. While most proprietary rights to resources remain vested in the provinces, the broader national interest is increasingly reflected in federal legislation enabling co-operative programs aimed at better management of the environment and resources. Social, cultural and environmental considerations are becoming more significant in resource management decisions.

While we are witnessing the emergence of a greater social conscience about the use of renewable resources and a reexamination of the owners' relationship to them at the national level, there are indications of a comparable evolution, albeit less advanced, internationally. In the global context, the relationships between nations and resources, be they renewable or non-renewable, are characterized by dominion or "sovereignty." But at the same time as the concept of sovereignty over resources is being stated and re-stated, we increasingly hear references to a new global objective - to establish and maintain an equitable distribution of the world's wealth and thereby contribute to international peace based upon justice.

Let us look very briefly at some of the indications, as I see them, of a redefinition of sovereignty in relation to those renewable resources that we have discussed so far.

First, land, I should like to look at land primarily as a source of food. The first World Food Conference was held in Rome last November. It sought the means and methods to eliminate hunger, mankind's oldest and most persistent enemy. Together with the third Law of the Sea Conference and the World Population Conference, it is part of a process of re-examination of man's relationship to resources that is leading to a new consciousness of the global responsibilities carried by every nation and individual. Besides the "Universal Declaration on the Eradication of Hunger and Malnutrition," the Food Conference adopted some 22 resolutions ranging from the "Objectives and Strategies of Food Production" to the "Reduction of Military Expenditures for Increasing Food Production." I would like to draw attention to the three resolutions which may lead to a more searching consideration of the whole issue of man-land as well as state-land relationships, and ultimately to a more rational use of world resources.

Participants at the World Food Conference saw that food and agricultural research as well as the dissemination of research results played "a crucial role in providing new means of increasing food and agricultural production." They considered that scientific management of water resources, *inter alia* for the purposes of irrigation, drainage and flood control, was of the utmost urgency. Consequently, they recommended a series of actions, among them the undertaking of "exhaustive climatic, hydrological and irrigation potential, hydro-power potentials and desert creep surveys." While "noting that land resources are limited and that of the total land area of the world only a small percentage is currently used to feed the world population which is likely to double by the end of the century," they recommended that there be prepared "without delay, an assessment of the lands that can still be brought into cultivation, taking proper account of forestry for the protection of catchment areas of land required for alternative uses." Finally and most importantly, they urged the establishment of "a World Soil Charter which would be the basis for an international co-operation towards the most rational use of the world's land resources."

It is tempting to suggest a parallel between the results in Canada of the 1961 Resources for Tomorrow Conference, and the possible global results of the recommendations of the World Food Conference. The day when a world land policy will evolve may well be distant, but I believe its basic components are becoming evident.

Let us now look at water. It was only eight years ago that we saw the first major international conference on water - the "Water for Peace Conference," an initiative of the United States. In the same year, Ambassador Pardo of Malta proposed to the U. N. General Assembly that the areas of the seas and oceans which lie beyond the limits of national jurisdiction should be proclaimed and recognized as part of the common heritage of all mankind.

Today, Member States of the United Nations are preparing for the first U. N. Water Conference, to take place in Argentina in 1977. The preliminary agenda for this Conference reminds us of the growing concern about water resources and poses as its main theme the question: "Water: the Next Crisis?" The first session of the Third U. N. Conference on the Law of the Sea which I have already mentioned took place last year in Caracas. Its second session begins in Geneva this morning.

That is the background of recent and expected formal events related to water and ocean management at the global level. Now let me take a moment to look at more precise evidence of a re-examination of the sovereign status of states as it relates to the prevention and control of marine and inland water pollution.

With the notable exception of the Canada-U. S. Boundary Waters Treaty of 1909, which expressly provided that the "boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other," serious concern throughout the rest of the world for the protection of commonly shared water bodies against pollution really started during the second half of our century, that is some 25 years ago. For a State to agree not to pollute its waters because of the injury it might cause to others is a modification of its sovereign rights over such waters. Yet during the past 25 years, more than 35 treaties, conventions and agreements relating to the pollution of inland waters have been concluded between States, particularly in Europe. Transfrontier water pollution has become the object of almost daily consultation, discussion, negotiation and agreement between States.

The international approach to the control of marine pollution is a lengthy story in itself, which time precludes my telling now. Suffice it to say that the trend has been in the same direction as that of inland waters, although the pace has been slower. Developments that have so far taken place at the Law of the Sea Conference indicate both heightened awareness of the need for international agreement on the management of marine resources and the marine environment, and the counter reaction of certain states that perceive their traditional interests to be threatened.

The development of international agreements relating to air is less advanced than is the case as regards water and marine pollution prevention and control. Here again, there is a notable exception involving Canada and the United States - the 1935 Arbitration Convention that resulted, in 1941, in the well-known Trail Smelter Fumes Award. This, for the first time in international law, recognized that: "no State has the right to use or permit the use of its territory in such a manner as to cause injury *by fumes* in or to the territory of another or the properties or persons therein, . . ." There is a direct link between the principle enunciated in the Trial Smelter Award and Principle 21 of the 1972 Stockholm Declaration on the Human Environment, to which I will return in a moment.

International, bilateral and multilateral cooperation between States in relation to meteorology and climatology is well advanced, no doubt because control is not a feature of such activities. As regards air pollution prevention and control, and to a lesser extent weather modification, we are really just at the beginning. But it is safe to say that the seventies and eighties will witness a significant growth of international consciousness with respect to air as a global resource, just as the fifties and sixties did for water.

Now I should like to mention some of the international developments that have recently taken place with respect to wildlife and show how States have been brought to re-examine their past relationship to it. Again, I should note in passing the early recognition by Canada and the United States of the need for international agreement on the management of migratory birds. The Migratory Birds Convention was signed in 1916. Also, at a relatively early date, 1940, the Pan-American Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was concluded.

The Stockholm Declaration on the Human Environment referred to the responsibility of man to safeguard and manage the heritage of wildlife and its habitat. Since then, several initiatives further to implement this general principle have borne fruit, both regionally and globally.

States bordering the Arctic have recently concluded an agreement on the conservation of polar bears. They have agreed not only to a general prohibition of the taking of polar bears (Article I), except as provided in the Agreement, but also to "take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components . . . and . . . (to) manage polar bear populations in accordance with sound conservation practices based on the best available scientific data (Article II of the Agreement).

Two other conventions represent a meaningful effort to implement the Stockholm principles at the global level. The first is the 1972 Convention on Protection of the World Cultural and Natural Heritage, and the second, the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

What does the "international protection of the world cultural and natural heritage" mean with respect to groups of living creatures, to those areas which constitute the habitat of threatened species of animals and to those natural areas of outstanding value from the point of view of science, conservation or natural beauty? For the purpose of the 1972 Convention, it is understood "to mean *the establishment of a system of international co-operation and assistance* designed to support States Parties to (it) in their efforts *to conserve and identify* that heritage." (Article 7) In short, the 1972 Convention has laid down at the global level the basis of a system of co-operation and assistance whose primary objectives are to conserve and identify the World Cultural and Natural Heritage. Indeed, each State individually is called upon to play a determining role both in the identification of its heritage and determining the characteristics of conservation regimes provided by the Convention, although the role given to a 15-to-21 member committee, named the "World Heritage Committee" is essential in the realization of such global system. Far more important and constraining on the sovereignty of States are the obligations that a State, once a Party to the Convention, will have to meet in order "to ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory" (Article 5), more particularly as regards "the appropriate legal, scientific, technical, administrative, and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage." (Article 5 (d)).

However significant the conclusion of the World Cultural and Natural Heritage Convention may have been, wildlife conservation and protection is limited to items that are necessarily "of outstanding universal value." In fact, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, concluded in Washington in 1973, is perhaps more important in effectively protecting and conserving wildlife as a resource of all mankind. Its importance lies in the fact that it strikes at the roots of one of the fundamental problems of wildlife conservation: overexploitation through international trade. Furthermore, the Convention on International Trade in Endangered Species, through the establishment of several lists of species—those that are now threatened with extinction, those that may become so threatened unless their trade is subject to strict regulation, and those which any State Party identifies as being protected within its national boundaries—has laid the groundwork for a permanent universal inventory of a great number of wildlife species (more than 600), as well as a permanent world watch over their condition to ensure their protection and survival. These conventions are a step forward in the development of international consciousness of wildlife as a resource of all mankind.

The 1972 Stockholm Declaration on the Human Environment represents a crystallization to that time of the views of States on a number of important questions relating to resources and environment. The principles that it articulates, while not having the force of law, provide in the Canadian perspective, the basis upon which law and other consequential international activities should be built. Implementation of many of the more important principles will require a continuing accommodation of the traditional concept of sovereignty to the realities of the global requirement.

However, what I have said about the concept of sovereignty should not be considered a denial of its utility. The sovereignty of states is, in many ways, analogous to the citizenship of individuals. Just as a citizen has certain interrelated rights and responsibilities within the legal framework of his country, so, within the evolving legal framework of the global community, there is developing a more sophisticated relationship between the rights and responsibilities of the sovereign state. Each of our countries is seeking to perfect a system which facilitates good management of resources and the environment through the responsible actions of free individuals guided by appropriate laws. Recognizing also that that which belongs to everyone is the responsibility of no one, we are promoting, through developing law and custom, a system in which the principle of good stewardship is an essential element. In the Canadian view, we must follow the same course of evolution at the global level.

Principle 21 of the Stockholm Declaration begins "States have . . . the sovereign right to exploit their own resources pursuant to their own environmental plicies," but modifies that sovereign right as it goes on to say "and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." Other principles contained in the Stockholm Declaration relate to responsibilities or obligations, the discharge of which implies at least the exercise of sovereignty in a fashion compatible with the broader concept of global human well-being.

Principle 2 refers to the obligation to safeguard "for the benefit of present and future generations" the natural resources of the earth including the air, water, land, flora, fauna, etc.

Principle 3 calls upon States to maintain and, wherever practicable, restore or improve "the capacity of the earth to produce vital renewable resources."

Principle 4 enjoins States "to safeguard and wisely manage the heritage of wildlife and its habitat," in particular when "planning for economic development."

Principle 6 states that it is necessary "to ensure that serious or irreversible damage is not inflicted upon ecosystems" either through the discharge of toxic or other substances or the release of heat.

Principle 7 refers to the urgent need "to take all possible steps to prevent pollution of the seas . . .".

The development and trends that I have noted at the global level with respect to the sovereign relationship that has traditionally existed between States and the resources of land, water, air, and wildlife, may be summarized as follows:

1. The days when a nation could use or abuse its renewable resources such as land and water, without considering any responsibility to the other nations of the world, have come to an end.
2. Through accelerated and intensified international consultations and the conclusion of a number of international agreements and conventions, States have gradually come to accept a new concept of sovereignty—a concept that involves not only the exercise of rights, but also the discharge of responsibilities.
3. The growing consciousness of the interdependency of the nations of the world is slowly bringing States to recognize that land, water, air and wildlife are not only part of a nation's wealth but also elements of the common heritage of all mankind—to be managed by sovereign states with due regard for the interests of all mankind.

I spoke earlier of the rights and responsibilities associated with citizenship. Now I must go on to speak briefly of moral obligations pertinent to the theme of this Conference. Within our countries, and within many countries of the world, we have seen, for as long as we can recall, a moral obligation to alleviate the plight of the disadvantaged. We met this obligation in the first instance by personal generosity; later by organized but private charity; for some years by a variety of welfare and social insurance schemes; and, more recently, we have added programs of development aimed at enhancing the ability of the individual to look after himself. We call this the pursuit of social justice, and the developed countries have extended this endeavour to the global community. Again, as in respect of the management of resources and environment, our objectives are less clear and our mechanisms less well developed at the international than at the domestic level. To clarify and perfect these objectives and mechanisms is the primary challenge of the future.

On the scale of history, international consciousness has just begun to emerge. Progress to date at the global level is but a preamble to what is needed to achieve the just distribution of wealth among mankind. As Prime Minister Trudeau put it, speaking last May at Duke University, "The challenge, simply put, is to ensure that fairness is introduced as a reality, and not just as a theoretical concept, in the political and economic relations between developed and developing nations." So often we are served a doomsday look at tomorrow. So rarely do we notice that men and nations are progressing. We understand this year better than last how to achieve a more humane environment. If we can keep building and sustain a common will, we can look at the future relationship of men and nations to renewable resources in a mood of hopefulness.

Discussion

MISS CHARLOTTE STINGER [Cherry Hill, New Jersey]: I would merely like to address a comment to Dr. Munro and say that I can only express my extreme admiration to your country for its hopeful attitude and the fact that you have become so involved, whether in wildlife conservation, in the management or protection of endangered species, etc. I can only say, as I have already said, that you do have my extreme admiration and I can only hope for continued and growing cooperation between your country and mine.

DR. MUNRO: I am very grateful for those words. I also know there are a few Canadians in the audience and I am sure they were touched by them also.

On the other hand, I should say that I don't think that Americans should ever, in any sense, belittle themselves for their accomplishments in the general field of conservation or for their accomplishments in the larger field of contributing toward the greater development of the rest of the world. Your achievements in this country have been outstanding and I know they will continue to be.

A number of agreements have been reached in the past between our two countries. We look forward to building on that foundation. I think we have the opportunity to demonstrate better than any other pair of countries in the world that it is possible to submerge certain individual tendencies, certain concepts of self-interest, in the larger interest of maintaining a good healthy environment for the continent. This interest on your part has sustained us in our efforts.

MR. J. E. CAROTHERS [Louisiana Tech University, Ruston, Louisiana]: I would like to second the comment made by the young lady and ask Dr. Munro this question: does he see that through an organization such as ours, and conservationists in general, we might look forward to some kind of world government? I believe I saw that shining through your remarks and I would certainly like to see this come true, perhaps not in my lifetime, but sometime in the future.

DR. MUNRO: Well, you are asking me to look into a crystal ball that I left somewhere else. I really don't know how to answer your question, but let me say that I do think, if you will look back into history, ignoring the difficulties between groups of people and nations and look, instead, at the mechanisms of cooperation that have developed, that you can see that progress is being made. For example, I don't know what Bob Frosch is going to say when he comes up here, but let me add that he is sitting in a body that did not exist until just over two years ago. Of course, there may be times when we lack patience with certain of the activities that take place in certain of these international organizations, but at least now they exist and there is an exchange of views and some development of agreement taking place within them which simply was not happening a little over thirty years ago. Therefore, while some of these situations may be very gloomy at times, I think we have to feel that we have at least taken a step forward, but we also have many more ahead of us.

VICE CHAIRMAN CLEPPER: I believe we have time for one more question or compliment to Canada. Does anyone wish to speak?

MR. GEORGE REYNOLDS [Canada]: I just don't want anybody to get the idea that everything is light and roses in Canada. We do have a lot of problems. For example, the Canadian Water Act has been a disaster and we also have a language barrier at times.

CHAIRMAN HERTER: Well, I guess this is "Compliment Canada Day," and I would like to say that I have worked very closely with the Canadians in a great many different international governmental bodies, including one with Dave Munro himself, and the experience has been a very fruitful one.

Before we get to the next speaker, however, there is a question that I would like to ask Dr. Munro. It concerns the extent to which this concept of the sovereignity of natural resources with which we are faced and which we ourselves believe in, has become something used by every country in the world in connection with all resource and population affairs. It doesn't make any difference what the resource might be. However, with a world that is contracting, such as we have today, where there is a great degree of interdependence, and where many of these problems cross international boundaries, I believe there has to be some kind of policy adopted by a significant number of countries. In other words, is this statement of national sovereignty of resources really valid in this world today?

DR. MUNRO: I did try to point out that sovereignty has to exist in respect of the rights and responsibilities that are inherent in it. I think we have to accept, as one of my predecessors on the panel referred to it, the fact that where there is no responsibility, we likewise find that resources are wasted and misused, and I think that sovereignty remains, at least at this point, the most effective exercise in responsibility. What will happen as we, hopefully, progress through future decades, I am not sure; but I think that progress will be in the direction of negotiating modifications of sovereignty, which will provide a tremendous impetus toward the furthering of the interests of all people by insuring that there is not a continuing emphasis simply on the benefits that are conveyed to smaller groups. I think that sovereignty, obviously, cannot be overtaken rapidly. It remains a valid concept, but it is, as I have tried to point out, something that I am sure will be modified through an evolutionary process as the requirements of the globe are seen in clearer perspective.

CHAIRMAN HERTER: Thank you for your answer to that very difficult question.

We now come to the wind-up speaker for the morning, Dr. Robert Frosch, who is the Assistant Executive Director, United Nations Environment Programme, Nairobi. He was formerly an Assistant Secretary of the Navy for Research and he is here to give us a clearer notion of what a body such as the U. N. can do in relation to this difficult question we have been discussing this morning. As he is coming to the podium, however, I would like to ask him one question.

I happened to chair the meeting in Washington that took place two or three years ago to negotiate an endangered species convention. This was worked out successfully after about two or three weeks and I think we now have almost all the signatures necessary to put the convention in effect. At last count there were eight of the ten needed and we are expecting two or three more. But, interestingly enough, the prime stimulus for that convention, more than by any other country, was provided by Kenya, and they have not yet signed the convention. I would like to know why?

DR. ROBERT ALAN FROSCH: The answer is that I do not know. However, the Kenyan Government had an election and a major change in its parliamentary structure in the course of the past year and I expect they have been busy reorganizing things in that area, but I don't know when they will ratify.

Overview of Resources Issues in the United Nations

Robert A. Frosch
United Nations Environment Programme, Nairobi, Kenya

It will be clear that a short overview can touch only lightly on a number of issues without examining any of them very exhaustively. I shall concentrate on an exposition of issues, without attempting much analysis of them. There are five subjects that may usefully be covered in this talk.
First: what are the resources? Second: who owns the resources? Third: who can use resources and for what purpose? Fourth: How does the UN system deal with resource problems? and Fifth: The role of UNEP.

What Are the Resources?

The division of resources into renewable and nonrenewable is by now conventional. Yet it seems to me that this division by itself provides only the beginning of a taxonomy of resource characteristics. Indeed, the two terms have sometimes been used in a misleading way; as suggesting inexhaustibility for renewable resources and final consumption for the non-renewable resources. If we are to understand what resources are and how to manage them, it will be necessary to have a much more elaborate classification and understanding of the characteristics of various kinds of resources. Renewable resources may be divided into at least two classes: the destructible renewable resources and the indestructible renewable resources. Soil and grown resources may clearly be destroyed; soil for example by poisoning, salination, or erosion; living renewable resources by over-harvesting, unwise conversion of land use, excess pressure on the land, etc. In the category of indestructible renewable resources I would put the availability of solar and wind energy. While these are not infinite in availability, we use them without destroying them.

Within the category of non-renewable resources, I would make, first of all, a distinction between consumable and non-consumable resources. In the consumable category, of course, fall the fossil fuels. Using them consumes them by burning or other forms of chemical conversion. The category of non-consumable resources includes the metals. The number of atoms of copper available to us on the globe remains the same whether 'used' or not. Once the copper becomes available as purified metal, it remains so even though used as wire. In fact, we can regard the use of copper for electrical wiring purposes as a combination of use and storage in fully refined form. Should we desire to use that particular copper for some other purpose, it is relatively easily available. This view emphasizes the importance of maintaining the property of 'recyclability.'

However, even within the category of non-consumable, non-renewable resources, we need to distinguish between degrading and non-degrading uses. The use of copper as wire is non-degrading since the availability of the material for other purposes remains the same even though it is 'used.' Other ways of using non-consumable resources greatly decrease their real availability. One can convert metallic copper to copper sulphate and use it in some chemical process, disposing of the residual chemicals as waste. While the copper atoms are still present, they are not easily available for use without further reprocessing. They may be said to have become entropically unavailable.

I go to the trouble of producing this somewhat simplistic taxonomy because there has been a good deal of rather loose phrasemaking about resources, including careless conversation about the "consumption" of non-renewable resources, when in fact only some uses are "consuming," whereas other uses combine use with storage and leave the possibility of relatively easy re-use and re-cycling open. Proper care in design of industrial and manufacturing processes could increase the availability of the non-renewable, non-consumable resources.

There are two kinds of resources that have somewhat special places in this categorisation. The first are nuclear fuel resources. In the strict sense these are non-renewable, but it is not quite so simple to categorise them as consumable or non-consumable since there are important matters of time scale involved. If uranium is burnt directly in a fission reactor, then clearly it must be regarded as consumable. If, however, one uses breeder techniques in which more burnable fuel is being produced than is being burned, presumably one needs to consider this as a creation of a resource, in some sense super non-consumability. This is true, however, only over a limited period of time, since eventually one runs out of the basic uranium, thereby putting an absolute limit on the total amount of burnable fuel that can be created. In the long run it is thus all non-renewable and consumable.

The other peculiar material resource is water. In the absolute sense we are perhaps oversupplied with water, but most of it is entropically unavailable, or more precisely, not easily available, because of the salts in solution. (We are not short of water, we just have too much salt). However, it may be regarded, as not only a renewable resource, but one which is constantly renewed in some quantity by solar energy via the weather cycle. Because of the possibility of interference with the renewal cycle via interference with the climate, we could in effect make the supply of automatically purified water a non-renewable resource.

Beyond the simple traditional views of the nature of resources, UNEP, following the precedents of the Stockholm Conference has, in effect, been expanding the definition of natural resource. The traditional view principally included extractible or directly exploitable resources such as minerals, fuels, water, hydroelectric potential, fish, timber, etc. We would like now to also consider as natural resources a number of 'common heritage' properties of the planet: not only the fish in the sea, and the plants and animals of the land, but the productive capability of the sea and land; not only the stock of species of plants and animals that are used, but the genetic resources contained in those that are not now used; not only the lumber and land potentials of forests, but their role in maintaining global climate; the property of the ozone layer as an ultraviolet filter; the nature of the global climate itself. In effect, we have had to stretch the old meanings of resource to encompass the global properties that make our life possible. It must be noted that for some of these resources, in the broader sense, we simply do not know whether technology will make them renewable or not, but , certainly, now we must treat them as consumable non-renewable resources. We could force a change of state that we do not now know how to reverse, and which we would probably not have time or opportunity to reverse. Keeping these remarks on the nature of resources in mind let us proceed to the further questions.

Who Owns the Resources?

It seems clearly to be the current principle that all resources of any kind within the territory of a country are absolutely owned by the country under the doctrine of national sovereignty. The phrase now frequently appearing in UN General Assembly resolutions refers to "countries in the exercise of their permanent sovereignty over their natural resources." This appears to be true of all kinds of resources appearing anywhere in the taxonomy, and there appears to be no basic international argument over the ownership of any form of resource within the legal territory of a state. This legal doctrine, however, clearly does not dispose of all of the issues. For one thing, it leaves out issues dealing with the areas of commons which are considered not to be part of individual sovereign states.

The major such area, of course, is the oceans beyond the limits of national jurisdiction. It is generally agreed that there are some parts of the ocean and the sea bed which are outside of anyone's national sovereignty. In fact, the discussions at the Law of the Sea Conference may be said to centre in large measure on an attempt to define the boundaries and definitions of various kinds of limitations on national sovereignty. The discussions are attempting to define and delimit those regions that are entirely beyond any form of national sovereignty, and those in which certain sovereign states have limited rights, including special rights to exploit resources of various kinds. A second issue in this subject is the question whether these regions beyond national sovereignty, however defined, belong to no one or are the common property of all. The state of the current discussions seems to have put them quite firmly in the latter category, which raises a major issue of the mechanisms and rules for the management of this region of the commons.

Another portion of the globe which is clearly regarded as having common property characteristics, although not universally regarded as such, is the Antarctic. Its current status is covered by an international treaty which restricts activitites and actions that may be taken there, without finally, I believe, defining the status of that continent. There are claims to ownership, but it is treated as commonly used, if not commonly owned, property.

There has begun to grow up in the international community a shadow of an idea of common ownership, or perhaps it might better be called an idea of common responsibility for certain of global properties that I classified earlier as resources, and that must, I think, finally be viewed as commons. For example, the global climate is certainly a common property which transcends national boundaries and national sovereignty, and there is beginning to be some feeling that it must be treated as such. This is also true of certain other global properties such as the ultraviolet shielding capability of the ozone layer of the upper atmosphere, mentioned above.

It seems that an increasing concern with these global properties as common property to be tampered with only by general agreement will be inevitable, since the consequences of other attitudes would very likely be catastrophic for all. Thus, those properties of the globe that imply outer limits to the activities of man, lest we destroy certain common properties that make life possible, will have increasingly to be regarded as common property.

Finally, there is an increasing recognition that certain local resources may represent unique characteristics of the world that give a kind of common interest, if not common property right, in them. Wildlife is frequently regarded as such a piece of global heritage. Indeed, some of the countries that have wildlife of unique properties within their national sovereignty areas regard themselves, and are regarded as caretakers for the wider community. This is clearly the case in Kenya.

The issue is sometimes raised, however, as to whether the caretaker must bear the whole burden and/or the whole benefit of having this resource, or whether there is not an international responsibility to assist him in his caretaker status, or even to compensate him for loss of other economic potential, if that comes out because of the preservation of the unique resource. (It is not always clear to all parties whether the possession of such a resource is an economic asset or a liability, although we believe that it can generally be shown to be an asset.) This issue has been recognized so far principally by private action through wildlife and conservation organizations, but has become something of an item of broader international interest and concern as well.

Who Can Use Resources and for What Purpose?

I have separated this issue (or set of issues) from the issue of ownership, since the question of exploitation raises numerous international questions which are not settled by the fact of ownership. The simplest case in which this arises is the case of a natural resource which is shared by two or more States, each of which has or claims absolute national sovereignty over its portion of the resource. The classic case is the shared river basin, in which a view of ownership would have each country having absolute rights over the water of the river which is found within its territory. The counter view, which raises the international issue, points out that interference by one or the other state may change the properties of the river in a way which is in effect taking away part of the resource value from the other country. The form in which the international issue is now being discussed deals with the question of the obligations and rights of the states in question: is there an obligation on the part of a state that intends to exploit or change the nature of a resource which it shares with one or more neighbours to consult with these neighbours before doing so, or while doing so, or at all? If the neighbours object to the proposed action, what are the obligations of the various parties before taking actions?

While there have been legal cases which have led to judgements accepted by both parties in particular situations, and while there are numerous situations in which the parties agree at the very beginning to consult and to take collective action, there is no clear system of behaviour and obligation agreed even by most states, much less by all states, on how to behave in such situations.

An additional form of connection between countries owning resources has to do with another form of responsibility to the global commons. The relationship, for example, of renewable resources such as forests (which may only be renewable within certain bounds of exploitation) with questions of the effect of area of forests, for example, on global climate. If too much forest is cut down, then the action of a single nation might have an effect on all and thus, this individual sovereign action may in fact transcend national boundaries in a major way. Another example is the transfer of pollutants to the oceans beyond territiorial limits, or transfer of pollutants between countries via rivers or via the atmosphere (e.g. 'acid rain').

When one comes to questions of the less well-defined natural resources, the problems become even more complex. There has been some conversation, but certainly no real attack, on the issues that are raised by the possibility of weather modification. What is the right of a nation or a region to the potential rain water that goes across its territory in the atmosphere? Given various assumptions about possible weather modification capabilities, what is the status of the right to rain?

Much the same problem arises with regard to moving living resources. What are the relative rights of countries and the collectivity of countries in fish which spawn or have part of their life cycle clearly within the territorial waters of a particular country, but spend part of their lives in portions of the ocean which are common property or no one's property? The problem is especially complicated by the difficulty of knowing which fish came from where.

This problem is not confined to fish of course, but is true of migratory birds and migratory animals which cross borders in cyclic patterns, which are, however, not identical from year to year. In what sense does a country own its animals, if they move across borders? How is this situation complicated by the fact that one country may be putting an investment into the well-being of animals which pass out of its control for periods of time as part of the natural ecological situation of the region?

In spite of the strong adherence to national sovereignty and ownership of resources already referred to, there has arisen an important set of international issues that deal with the rights of all people to a proper share in the global resources that could feed and sustain them. In effect, this raises the view that while resources covered by national sovereignty are in effect absolutely owned, everyone has some rights in their consumption, and that distribution mechanisms for the fruits of resources should reflect this duality of facts.

The most commonly made assertion is that there is no absolute scarcity of resources, but that current mechanisms of distribution, particularly market mechanisms, are responsible for resource scarcity problems and that the consumption patterns of the developed countries are responsible for the inability of the developing countries to satisfy their resources needs. This is the basic set of feelings underlying the discussions in the UN General Assembly on the establishment of a New Economic Order and on the Economic Rights and Duties of States.

It is clear that these problems are bound together with the problem of population, thus constructing a constellation of problems which include questions of natural resources of all kinds, population and population densities, the nature of development in both the developing and developed countries, the nature and rights of people to basic goods and amenities, and the patterns of consumption and distribution that surround that set of problems, the outer limits to human action in the management of the globe, and all of the issues that have to do with the management of the environment which man lives.

While these issues of 'interdependence' are generally discussed in international fora in economic and trade terms, it is clear that those aspects of problems of interdependence are underlain by problems of common resources both in the sense that they are shared, and, as discussed above, in the sense that some of the common resources provide or are essential to the basic properties that make the planet inhabitable by us. The nature of this complex of problems involving resources, which must be somehow attacked by the international community, brings me to the next set of issues to be discussed.

How Does the UN System Deal with Resource Problems?

The first point that I would like to make is that the United Nations system evolved before this collection of issues that I have been describing came clearly to the fore. The system was constructed with a different and simpler set of problems in mind; in fact, it was not ever really constructed, but grew up out of a variety of needs and interests. The principal set of needs that gave rise to the current system include the basic issues of war and peace that gave rise to the United Nations itself, the issues of international health, food and agriculture, international science and education, international weather reporting and prediction, various aspects of international communications, and to a very large measure, and of increasing importance in the system over the past 15 or 20 years, the question of the economic development of the "underdeveloped," "lesser-developed" or "developing countries." These issues have been regarded as related to each other, but generally separable; the connections to be made in terms of common interests.

In the current system there is the United Nations itself, with a variety of internal and subsidiary, somewhat externalized, but totally connected, bodies with various responsibilities. For example, under the UN Secretariat directly, there is the Department of Economic and Social Affairs, with a certain responsibility, among others, for resources, for transport, for energy, and for science. It has a responsibility for human settlements and housing, for certain energy resources, notably geothermal energy, for certain matters of water and water resources, etc.

A second class of the UN organizations includes the United Nations Development Programme, the United Nations Environonment Programme, and the United Nations Conference on Trade and Development, which are a part of the United Nations directly, yet have their own governing bodies which report through the Economic and Social Council (in effect a committee of the General Assembly) to the General Assembly itself.

There are also organizations that are part of the United Nations system, but are not part of the United Nations itself: among others the World Meteorological Organization (WMO), the World Health Organization (WHO), the Food and Agriculture Organization (FAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Atomic Energy Agency

(IAEA), each of which is an independent intergovernmental organization, with its own statute, governing body, etc.

There are numerous aspects of this system and its mechanisms that I have not described, including the intergovernmental committees of the Economic and Social Council, the regional economic commissions of the United Nations, international organizations such as the International Bank for Reconstruction and Development (World Bank), and the Global Agreement on Tariffs and Trade (GATT), that are associated with the system but are considered to be technically outside of it (they are frequently described as members of the UN family instead of the UN system) but participate in the co-ordination activities. I have not tried to go into any details with regard to such matters as the resource related activities of UNICEF, nor have I even mentioned other aspects of UN organizations such as disaster relief co-ordination activities, etc.

One must also remember that outside of the UN family there are a number of other Intergovernmental Organizations, such as OECD, OAU, OAS, etc.; and the host of international non-governmental organizations. We are developing co-operative arrangements with a number of these, including the International Union for the Conservation of Nature (IUCN).

As an example (perhaps the most complicated example) of the complexity of the distribution of responsibilities among these organizations, we may note that the Department of Economic and Social Affairs has a responsibility for water as a resource and is, in fact, responsible for the United Nations Water Conference, which will be held in 1977. However, UNESCO has had a major responsibility for hydrology, although there is also a natural interest and programme in hydrology in the Food and Agriculture Organization because of their interest in water from the point of view of irrigation and agriculture. The World Health Organization has a major interest in water from the point of view of water supplies for drinking and domestic use, and the relationship of those problems of water supply to sewage and waste disposal. The WMO, of course, has an important interest in water from the point of view of weather and climate. This involves not only the matter of rain, directly as a result of weather patterns, but the effects of land use and ecology on local and regional weather or climate patterns, and thus on rain.

The complexity of issues raised by this complex international organizational system will be apparent. The independent organizations that are part of the UN system but not part of the UN, are related together with the United Nations through a system of agreements. They make serious attempts to co-ordinate their activities through the medium of the Administrative Committee on Co-ordination (which brings together the heads of various agencies under the Chairmanship of the Secretary-General of the United Nations), and its network of sub-committees. These sub-committees deal with various particular subjects such as water, arid lands, education and training, science, etc.

While the system has had many successes in development, and in dealing with particular issues, the complexity that arises when it attempts to attack the kind of constellation of interacting problems that I described earlier, has given rise to considerable difficulties. Recently there has been discussion regarding the possible reconstruction of this system in some way that will make it more capable of dealing with the current issues, which are more complex and interactive than those for which the component parts were originally set up. This discussion could lead to reorganization, or to attempts to construct tighter co-ordination and co-operation arrangements. Naturally, the component parts of the system generally take the view that good progress in co-ordination is being made, and no major changes are required. It should also be noted that the complexity of the system is not only on the international scale. In large measure the complexity is a reflection of the way in which most national governments are organized. There is usually a one-to-one relationship between the sectors in any national government and the sectors in the international organization system. This is only to say that the public health people are in rapport with WHO; Departments of Agriculture, Fisheries, and Forestry with FAO; science mechanisms with UNESCO, etc.

This outline of some of the problems of the United Nations system in dealing with natural resources in a comprehensive and co-ordinated way brings me to my final set of remarks.

The Role of UNEP

UNEP is set up to be a co-ordinating organization for environment internationally, and especially within the United Nations system. It is an organ of the United Nations with its own Governing Council of 58 nations reporting to the General Assembly through the Economic and Social Council. Administratively, the Executive Director, an elected official of the General Assembly, reports to the Secretary-General of the United Nations. Within the UN system there is an Environment Co-ordination Board which brings together the Executive Heads (Secretaries-General and Directors-General) of the components of the system, under the Chairmanship of the Executive Director of UNEP.

It is UNEP's task to try to promote co-ordination and proper balance and to initiate, where necessary, international activities in environment, especially within the United Nations system, and with special reference to those problems that are trans-national, regional and global. UNEP naturally has a deep concern with all of the resource issues that were mentioned in the earlier portions of my talk since they are really environment management issues, and all matters of resource use and the consequences of resource use are, in fact, environment matters.

We see ourselves as having a major role as "complexifiers," that is to say bringing forward to those who have sectoral and disciplinary responsibilities, the necessity to consider all of the complexities and interactions (some of which I described earlier), since it is in those complexities and connections that the nature of environment and environmental concerns lie. We view a concern for environment inseparable from the complex problems involving development, population, and the use of natural resources.

We have been particularly concerned about uses and approaches to natural resources that seem to lead to the non-sustainable solution or the self-defeating solution. Our interventions at the World Food Conference were designed around the theme, "Development without destruction—the maximization of the production of food without destroying the ecological basis to sustain production."

Finally, I would like just to touch on a few aspects of our programme which will be of particular interest to this audience. An important segment of the UNEP programme deals specifically with matters of conservation, management and control of land, water, and wildlife. As assigned by the Governing Council, we have a particular interest in arid and semi-arid lands. The approach to the desertization problem is essentially that of trying to learn to manage the ecosystem as such, taking into account factors of land, water, plants, animals, and the cultural habits of the people. As a second priority in this area, we will concentrate on tropical forests from the point of view of preservation and use without destruction. Both of these subjects will be pursued in co-operation with UNESCO and FAO. We are working with the Man and Biosphere (MAB) programme of UNESCO and with IUCN on biosphere reserves, and with IUCN in support of the Endangered Species Convention. We are developing a programme with FAO and UNESCO in the collection and preservation of genetic resources, with particular initial emphasis on crop genetic resources and with attention to the nitrogen-fixing micro-organisms, the rhyzobia. We are laying emphasis on means of pest and disease control other than pesticides. These will include both habitat and biological control means.

In the area of oceans, we have laid a special initial emphasis on the Mediterranean. At the end of January of this year, in Barcelona, we convened an Intergovernmental meeting of coastal states on the protection of the Mediterranean. The meeting adopted an action plan dealing with integrated planning of the development and management of the resources of the basin, with a co-ordinated programme for research and monitoring of the state of pollution and protection measures, and with the nature of a framework convention and related protocols for the protection of the Mediterranean environment. The meeting called for a plenipotentiary conference to sign conventions and protocols in February, 1976.

We are trying to find ways to use an environmental point of view to assist in development, not only to prevent its unwanted environmental side effects, but to show how proper concern for environmental values can improve the approach towards development. We view environment and development as inseparable. Our basic concern is to work within the environmental point of view to attack the complex of problems described previously in a way which will produce solutions to the problems of our managing our global environment which can be of long-term benefit to all.

Discussion

MR. STEWART DAVEY [Bureau of Outdoor Recreation, Washington] : I was wondering, with regard to the energy equation that was mentioned, is anyone working on models of any type that address the price rise and scarcity we face as well as the options for other energy developments? I address this question to Professor Pimentel.

PROFESSOR PIMENTEL: Thank you for your question. I have been accused by some of my economic colleagues of trying to establish a new monetary system based on kilocalaries instead of dollars. I can assure you I am not trying to do that. However, if we can understand the mechanisms and the energetics of not only agriculture but other systems, whether we are talking about food processing or constructing automobiles or what ever—knowing that price values change depending on supply and demand, then I think we will not have too much difficulty understanding this formula. For example, a kilocalorie of corn is equal to a kilocalorie of oil and these factors are not going to change, but the price values are. If we can understand these theories of the system, they will also help us to project the future and an economic understanding of the changes insofar as policy goes. Therefore, I see ecologists interested in energy really assisting the economist in making the decisions.

CHAIRMAN HERTER: If you will indulge us just a moment or two more, I would like to have Professor Pimentel discuss one factor in this whole problem of renewable resources—foods, population and the international community—that we have not touched on, and that is the question of climate. We are told, and I think perhaps a substantial portion of the scientific community agrees on this point, that since 1945, the world has started to get colder and this tendency has continued. Now, if this in fact does continue, it will be a climatic change in what is now the breadbasket of the world, North America, and also such areas as China and Russia, which have enormous populations, which, for the most part they are feeding, though not entirely. How much worse is the situation apt to become? What is your view with respect to the whole problem in relation to climate variation?

PROFESSOR PIMENTEL: I am very happy that you have raised that question, Chairman Herter, because I think it involves an extremely important problem and concern. Arable land is defined, of course, as land that has a suitable slope, appropriate temperature and moisture conditions to be suitable for agriculture. From the period of 1940, for about 20 years or so, we had an improving climatic condition in the world, which helped increase the productivity of our land. Since about 1945 or 1950, however, there has been a cooling trend—a decrease of about one-tenth of a degree centigrade per decade. Now, all that it takes is six-tenths of a degree centigrade decrease in the temperature to cause a shortening of the growing season by two weeks of crop production. One might say—"Well, two weeks isn't very much." However, it actually is a great deal and let me just use one example. In our corn belt in North America, it is calculated that if we delay the planting of corn one day after May 15th, for each day it means a decrease in corn yield of one bushel per acre. A two-week delay after May 15th would amount to roughly 15 bushels of corn per acre, which is significant.

CHAIRMAN HERTER: Thank you very much. As I understand it, the growing season in the United Kingdom is already down about 10 days. The same is true in Iceland and I think this is a factor in this whole discussion which it is wise to keep in mind because it may be a very real concern. Of course, we have also heard of the monsoon problem—the monsoons not getting up to South Asia—which may be part of the climate variation that is coming upon us.

I think we all owe a vote of thanks to the members of our Panel. You have heard this morning not only about the whole problem of renewable natural resources as they are affected by international pressures, from the point of view of population, of food, of the natural resource controls that have been instituted in Canada, and Canada's role in the United Nations system, but finally, about the UN system itself and how it is dealing with these problems. There may be many other points of view we ought to look at, but we have certainly had a rounded session this morning. Iwould personally like to thank our panelists for the very excellent papers and discussions that have been produced, and also thank all of you for participating in this session.

Living Marine Resources: Management Needs and Administrative Issues

Chairman:

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D. A. MacLEAN
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Law of the Sea

Howard W. Pollock

I am pleased to have this opportunity to give you a bird's-eye view of the Caracas session of the Law of the Sea Conference, with special reference to the living resources of the oceans. This issue is particularly timely, for today the representatives of approximately 140 nations begin deliberations in Geneva at the second substantive session of the Conference. The eight week session will build on progress made last summer in Caracas, as well as on discussions held in the interim period.

The United States has major interests at stake in the law of the sea negotiations. They include:

—Guaranteed access under reasonable conditions for U. S. firms to the mineral resources, especially manganese nodules, of the deep seabed beyond national jurisdiction.

—Coastal state rights over the resources, especially hydrocarbons, of the continental margin.

—Coastal state regulatory authority over coastal species of fish coupled with special treatment for salmon and tuna.

—Freedom of navigation beyond the territorial sea coupled with unimpeded transit of straits used for international navigation.

—Protection of the Marine environment.

—Maximum freedom of scientific research beyond the territorial sea.

The outcome of the Caracas session, more specifically its failure to produce a complete and final treaty, has elicited criticism from the press and elsewhere. I think that most of the delegates to the conference would acknowledge some measure of disappointment as well. But it should be kept in perspective. A final treaty was not expected to emerge from that first substantive session. In all recorded history of man's relation to man, never have so many nations convened to resolve so many complex and controversial issues of grave mutual concern. The issues confronted are momentous ones. As such, negotiation is difficult. The goal of the Conference, after all, is to seek consensus among nations of differing ideologies, economies, geographical and sociological circumstances on issues concerning all phases of ocean use and exploitation—and this at a time when control over natural resources, particularly food and fuel, is of such acute concern.

A most significant result of the session was the apparent agreement of the majority, not only that the interests of all will be best served by an acceptable and timely treaty, but that such a treaty can be achieved. The tone of the general debate as well as the informal discussions was serious and reflected considerable agreement on the broad outlines of a comprehensive general agreement. Perhaps the greatest progress in this regard was made within Committee II, which has been charged with responsibility over the economic zone, among other subjects. This committee produced a comprehensive set of working papers reflecting main trends on all issues.

As the main trends papers indicate, the major disagreement within Committee II did not concern the width of the territorial sea and the economic zone, which were all but formally agreed upon in Caracas. In fact, over 100 countries spoke in support of a 200-mile economic zone with coastal state sovereign right to, or exclusive rights over, the exploration and exploitation of living and non-living resources. At the Caracas session, the maritime nations, in particular the United Kingdom, the USSR, and the United States, made significant moves toward increased coastal states rights in the context of a zonal approach. Our previous position had been characterized as a fisheries species approach, whereby the coastal state would regulate and have preferential rights to coastal species of fish throughout their range.

The U. S. position, as outlined in our new draft articles, offers acceptance of the 200-mile economic zone approach, but contingent upon correlative coastal state duties and negotiation of a satisfactory overall package. It is on the details, the precise extent of coastal state rights and responsibilities, that reconciliation is needed.

Our articles differentiate coastal, anadromous and highly migratory species of fish. Coastal or resident species generally remain adjacent to the shore in waters above the continental shelf; anadromous species, such as salmon, are born in the fresh water streams and spend a major part of their life cycles in the open ocean before returning to their streams of origin to spawn; and the highly migratory fish, such as tuna, are pelagic species which migrate over vast areas of the oceans.

With regard to coastal fisheries, the U. S. draft articles would grant to the coastal state exclusive rights, subject to a responsibility for conservation and full utilization. A greater clarification of this latter concept was achieved at Caracas, although it remains a point of contention. The intention is for the coastal state to set an allowable catch on its coastal fishery stocks. This catch level would be dictated by biological considerations, as well as economic and environmental concerns. Once an allowable catch is set, based on these relevant concerns, the coastal state would be obligated to allow foreign access to the extent that domestic catches fall short of harvesting the total allowable catch.

The U. S. draft articles allow for collection of fees in return for foreign access. On the basis of this, the developing countries have maintained that economic reality would automatically dictate full utilization, and thus an obligation to ensure full utilization through such an access provision may well be unnecessary. Those nations want the right to determine the pattern of resource exploitation within their zone without outside interference. Thus, the questions of access and full utilization are of central importance to the accommodation of widely disparate interests and serve to point up the disagreement over rights and duties which underlies most LOS issues.

On the one hand, then, are the developing nations, some of whom have serious misgivings accepting the concept of coastal state duties of any sort. At the other extreme are those who seek to grant coastal states only limited preferential rights to living resources. This latter position is exemplified by Japan and the articles presented by eight Western European states, emphasizing the role of regional organizations.

In addition to rights and responsibilities of coastal states for conservation and management, the U. S. draft articles propose special treatment with regard to highly migratory and anadromous species. The articles require that the regulation of highly migratory species within the economic zone be accomplished by the coastal state, and beyond the economic zone by the state of nationality of the vessel, both in accordance with regulations established by appropriate international or regional fishing organizations. Participation in these organizations would be mandatory for all coastal states in the region and for all states whose flag vessels harvest relevant species. The mandate of the international or regional organizations would include the conservation of stocks, assurance of full utilizations, and the establishment of equitable allocations among member nations. The allocations, however, would take into account the special interests of the coastal states within whose economic zone the fish are caught. The coastal states would also receive reasonable fees for fish caught within their zones by foreign flag vessels. The rules pertaining to collection and payment of fees both within and outside the economic zone would be the responsibility of the regional organization. Such fees would be collected on a nondiscriminatory basis, and those not accruing to coastal nations would be used for administrative and scientific purposes of the organization.

These latter provisions on highly migratory species in the U. S. articles represent a conceptual and substantive shift, made in the hope of finding a reasonable accommodation on this issue. A number of developing country delegates have commented favorably on the U. S. move. However, there remains considerable disagreement on the extent of coastal state versus international control. Our previous position with regard to anadromous species provided for country-of-origin jurisdiction to follow the stocks beyond the economic zone wherever they might be found on the high seas. In response to conceptual problems by other countries with this approach, the new U. S. draft articles, in contrast, propose a ban on fishing for salmon beyond the territorial sea, except as authorized by the state-of-origin of the salmon for the purposes of ensuring full utilization. This issue is of direct concern to a relatively small number of nations, but the negotiations are of considerable significance to those involved.

Another fisheries issue of some importance concerns access provisions for landlocked nation-states. It is widely recognized that there should be special provisions for these geographically disadvantaged countries. In the U. S. articles, landlocked states access is presented as a coastal state duty to treat neighboring landlocked states on the basis of equality with their own nationals, with the prerogative on the part of coastal states to give special consideration to other neighboring states.

Among the specific problems raised by others with the U. S. approach was the conviction that our enforcement provisions were not sufficiently stringent to ensure effective coastal state fisheries management. The article in question allows the coastal state to inspect and arrest vessels within its zone of jurisdiction, but it must deliver the offenders to officials of the flag state for punishment, if that state has effective procedures for dealing with such offenses. The developing countries, in opposition, insist upon complete enforcement powers, including trial and punishment.

Throughout the Caracas session, many of us on the U. S. team participated in informal, private discussions with members of other delegations. These discussions were helpful in clarifying positions and revealing greater flexibility on the part of lesser-developed countries than their public statements had indicated. Despite these positive signs, further work is needed on the questions of access and full utilization. The Caracas session was characterized by a general unwillingness to negotiate on the truly substantive issues. This might have been due in part to the expectations of another session in 1975.

Despite the severe conflicts of interest and immense problems involved in these very difficult negotiations, the U. S. delegation remains dedicated to the pursuit of a widely acceptable international treaty. With particular reference to the living resources of the ocean, it seems to us most important that such an agreement be achieved. For many years the U. S. Government, the fishery industry, and the public have been gravely concerned about the intensive exploitation, and in some cases actual depletion, of North American fisheries resources. Massive fishing operations, conducted without regard to conservation requirements, have lead to resource damage and consequent economic and social disruption. We have been aware for some time of the need for constructive measures that will conserve stocks and provide management for the benefit of U. S. fishermen. The principal program, however, has been the absence of adequate jurisdiction for the purpose of effective management. We are, as is well known, a party to several bilateral and multilateral agreements concerned with fisheries resources off our coasts, and we have been moderately successful in negotiating some conservation arrangements. However, while most of these have provided some protection of stocks, none has been completely satisfactory, either from a conservation, or to a greater extent, from an economic standpoint.

The best solution to the problem in fisheries is broadly-based international agreement, providing coastal states with management jurisdiction over coastal and anadromous resources, and with highly migratory species managed by appropriate regional or international organizations. It is only through international agreement that such a radical change in oceans law can be accomplished efficiently and peaceably. For the first time in history, this is within our reach. We have succeeded at Caracas in providing an outline of agreement and the details of disagreements, and in raising to the attention of the highest political levels the issues of greatest concern. At Geneva, we should translate hard political decisions into treaty articles accommodating the interests of all.

Fisheries Regimes Under Extended Jurisdiction

Coastal Fisheries Resources Under Extended Jurisdiction

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Responsible and knowledgeable people no longer talk about whether we will have a 200-mile economic resource zone. They talk about when and how we will get it. This is not because the United States has decided that a 200-mile zone is a good course to choose. It is because almost all of the world has chosen this course, and the Executive Branch of the U. S. Government is—extremely reluctantly—turning to follow where other nations lead.

It's now painfully obvious that the world is not going to get a comprehensive Law of the Sea treaty from the Law of the Sea Conference session which begins today at the United Nations in Geneva. That many international lawyers are discussing and presenting papers on possible alternatives to a comprehensive LOS treaty is clear indication of this. Now, it appears that the most likely consequence of no treaty in Geneva would be general unilateral action on a 200-mile resource zone, action which does conform with the philosophies and established positions of over 100 of the nearly 140 nations negotiating at the Conference.

What will this 200-mile zone mean for United States coastal fishermen? As the time when we will have a 200-mile zone comes closer and closer, misunderstandings about what coastal fishermen would like to see in that zone multiply. Further, although most of the nations at the Conference have agreed on a 200-mile economic zone, the question is still far from settled about what the rights and responsibilites of the coastal nations in this zone will be. Some of the lesser developed countries' reactions to the U. S.'s conditional acceptance of the 200-mile zone last summer illustrate this. Far from being pleased about it, they have become more hostile than ever, charging that the U. S. makes a mockery of the term by saying "economic zone" and then gutting the concept of any meaningful advantages for developing coastal states. What they're referring to is that the U. S.'s major conditions are for the 200-mile zone through a widely-accepted multilateral treaty from the Conference and full utilization. That is, allowing foreign vessels to fish for those surplus stocks up to the optimum sustainable yield which the coastal fishermen do not plan to harvest.

Many U. S. coastal fishermen also oppose the full utilization concept because they've spent the last several years—off New England, it's been over a decade—watching the foreign vessels three, four times, sometimes larger, than their vessels wipe out fish on what traditonally have been among the U. S.'s richest fishing grounds. To them, 200 miles means—or should mean, they argue—no more foreigners! At all.

And just as the LDC's have different interpretations of what "economic zone" means, so do U. S. fishermen have different ideas about what "fisheries management" means—or should mean. Industry representatives feel that government bureaucrats are looking to use what could be a very useful and effective tool to shackle the industry with crippling and stifling regulations.

It's always risky to try to reach into the future and to say what will be there. So we present alternatives, put in a lot of "ifs," and generally hedge. But there are certain things I think are fairly likely in any future regime. Some of these are:

1. The U. S. and other nations, worldwide, will have extended fisheries jurisdiction as part of a 200-mile economic zone.
2. This extended jurisdiction will *not* be the result of a comprehensive Law of the Sea treaty arrived at during this Geneva session.
3. Although the nations of the world will have 200-mile resource zones, the regimes in this zone will vary widely throughout the world. These regimes will probably be the subjects of negotiation and controversy for several years while they work themselves out in bilateral, multilateral, and regional arrangements for managing fisheries and other resources, and for navigation and marine pollution control.
4. The U. S. will adopt a fairly comprehensive management scheme for fisheries soon. This will be a scheme which will include provisions for, among other things, if it becomes necessary, limiting entry into a fishery, and providing for allocations to foreigners to fish those surplus stocks up to optimum sustainable yield which the U. S. fishermen do not plan to harvest. I'll say more about foreign fishing later.

Within this framework, what are the necessary components of a U. S. management regime for coastal fisheries? I see at least five important and interlocking elements:

First, fishermen must have incentives to cooperate in proposed conservation and other management programs.

Second, these management plans must be evolved in cooperation with the lowest possible level of government—local, state, or multi-state region—concerned with the fishery or fisheries which need some form of management.

Third, it is neither necessary nor desirable for management plans to be instituted immediately for all regions and stocks. We should approach different fisheries gradually as their respective needs indicate.

Fourth, all management programs should have sensible, reasonable regulations; that is, regulations which are sensible and reasonable to the people being regulated. Obviously, the likelihood of this will be higher if the fishermen in the fishery are an essential part of the process promulgating regulations for that fishery. Reasonableness will help enforcement agencies enforce these regulations effectively, and enforcement is a vital part of any management program.

Fifth, the federal government will provide guidelines to assure management plans that local and state governments develop work in the overall best national interest and, when necessary, it will promulgate regulations to support these guidelines.

As regards management generally, a primary consideration for each management program must be to determine what the primary goal or goals are of managing that specific fishery, whether it be simply achieving full utilization of the maximum sustainable yield, achieving a balance among variable social, economic, and biologic elements; or maximizing one of these elements above the others. The role of the elements will vary from fishery to fishery, and, therefore, so should the goals of the management programs. It would be foolish to establish a single national goal and say that for all U. S. fisheries we will use the approach which always achieves this one national goal.

Some of us in industry are proposing a domestic management program as follows. The key to fisheries would be the three Regional Fisheries Commissions—Atlantic, Gulf, and Pacific. These Commissions could be modified through legislation and through policy decisions to strengthen and broaden their present roles. As it becomes necessary to manage a fishery, the local or state(s) government would have the authority and the responsibility to establish, under the appropriate Regional Commission's guidelines, a committee to draw up, on a Commission-established timetable, a management program for that fishery. The Committee would then present its plan to the Commission's Fisheries Management Board. This Board would either suggest modifications and approve the plan accordingly, or it would simply approve it and send it on to another strengthened and broadened body—the Marine Fisheries Advisory Council or the National Advisory Council for Oceans and Atmosphere, for example—for approval. Again, the plan would be modified and approved, or simply approved and sent to the appropriate agencies of government for implementation. These would be the same governments with which the industry representatives, and others concerned about the fishery, had worked on the original plan. Financing could come in part from, say, a second-sale tax on all seafood landed, as is the case, we understand, with the British Whitefish Authority.

Managing foreign fishing in the U. S.'s 200-mile zone will be considerably easier in many respects than trying to monitor foreign fishing off our coasts is now. After we determine what U. S. fishermen do not plan to harvest from the total amount that is available each year from a given stock, we can allocate national shares of this surplus to the foreigners.

When we license a foreign vessel to fish in U. S. waters, we will: license that vessel by name and number and require him to display both of these prominently on the vessel at all times; charge him a license fee that will cover all administrative costs of licensing; place aboard that vessel a U. S. enforcement agent as a vessel rider who will remain on board to monitor all fishing activites so long as the foreign vessel is in U. S. waters; and charge a per ton fee for target species and a much higher punitive fee for all vessels' non-target, incidentally-caught species.

The result of this arrangement could be a reduction of the present public treasury contributions to both the National Marine Fisheries Service for existing so-called management expenditures and to the Coast Guard for enforcement expenditures. Sound management need not require the astronomical increased expenditures that some bureaucrats have predicted.

We must think of management generally and of alternative kinds of management for different fisheries. Establishing management programs will be a time-consuming process, and right now we've no agency that could do the job that has to be done. We must begin to plan now to manage fisheries in our 12-mile territorial sea and our 200-mile resource zone.

Development of Fisheries Regimes Under Extended Fisheries Jurisdiction: Salmon Resources

Richard Roberts

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As we discuss here today the development of new fisheries regimes, the second substantive session of the Third U. N. Law of the Sea Conference is just beginning its deliberations in Geneva. While it would be inappropriate for me at this time to speculate what the Geneva session might achieve in terms of specific results, I think that we can confidently predict that within the near future economic zones extending far offshore will be a fact of life. The nature and extent of coastal state rights and obligations in these zones will be developed either by the Law of the Sea Conference or by trends that might emerge in unilateral action and regional multilateral negotiations.

New economic zones, however established, would not on the surface appear to make much difference to future management needs with respect to salmon resources. After all, most salmon fisheries are confined to areas well within limits being proposed for economic zones of coastal states, the only exception being the Japanese high seas fisheries for western Alaska and Kamchatka salmon which is currently being dealt with in bilateral or multilateral agreements between the countries concerned. At the Law of the Sea Conference, proposals are being made by salmon producing countries aimed at banning highseas fishing for salmon, or at least assuring that high-seas fishing is conducted with the consent, or under conditions which require the agreement, of states of origin. It is not possible to forecast at this time whether these efforts will be successful and what accomodations, if any, might be made with respect to the Japanese high seas fishery. However, if, on the surface, extended fisheries jurisdiction does not seem to make much difference, the actual implications will be much more profound and they fall into two broad but related categories: the solution to the "interception" problem, and the potential for salmon enhancement.

The Solution to the "Interception" Problem

Let us call "interceptions," salmon bound for the rivers of one country caught by the fishermen of another country. There are two broad categories of interceptions: 1) interceptions on the high seas beyond the economic zone, and 2) interceptions by neighboring states, either in areas of intermingling of stocks from the two countries, or in waters of one state as the salmon are on their homeward migration to the other (e.g. the Canada-U. S. Pacific coast situation or the West Greenland example).

In discussing interceptions it can be argued that principles of conservation and equity lead to the conclusion that catches by one country of salmon bound for another should be avoided or minimized. Interceptions should be avoided first of all in the interest of conservation, because management can be most effective when stocks are exploited close to their home streams and when the fish have reached their maximum size. Interceptions should also be avoided in the interest of equity, because the brunt of the fishery restrictions to assure spawning escapement, the costs of maintaining or improving conditions for reproduction, and the cost of the economy involved in refraining from other fresh water uses, are borne by the country where the salmon spawn. In addition there are other considerations. When interceptions are either non-existent or minimal, the country of origin has the necessary incentive to undertake programs to increase salmon stocks, either through habitat protection and improvement measures or by means of artificial enhancement techniques. Additionally, salmon fisheries dependent upon production in its own rivers provides a country the management flexibility needed to achieve social and economic goals without having to be concerned with domestic measures that might be taken by some other country.

In the light of these considerations let us examine each of these categories of interceptions separately and see how the economic zone will lead to minimizing the problems created by interceptions, or maximizing the benefits that might be created by taking advantage of salmon resource management opportunities.

Interceptions on the High Seas

One of the inhibiting factors facing government as they have made decisions in the past with respect to river development and salmon enhancement investments has been whether high seas fisheries for salmon would develop to take advantage of the salmon production of the state of origin. An economic zone extending out 200 miles, for instance, would not protect many Pacific North American salmon stocks from distant waters fishing nations operating outside the zone and this is why special LOS provisions are most desirable. However, in the event that no agreement can be reached in the Law of the Sea on a special provision to protect salmon, the economic zone may provide a bargaining lever, heretofore unavailable, to discourage high seas fisheries by distant water fishing nations. The lever will be the coastal state control over exploitation within its economic zone of the huge groundfish and pelagic resources in the northwest Atlantic and northeast Pacific.

Interceptions by Neighboring States

This is a much more difficult situation as evidenced by many years of complex negotiations between Canada and the United States to solve salmon problems of mutual concern on the Pacific coast. Quite apart from the biological and technical problems encountered in these negotiations, the existence on both sides of long established fisheries with a high interception content has made it extremely difficult to reach agreement.

But agreement must be reached, for the simple reason that neither side can benefit from its own salmon enhancement opportunities without one; and without greater investments in salmon enhancement, salmon producing rivers may be developed for other purposes. The key to a solution lies in developing mechanisms to limit interception in a mutually agreeable manner and this is the focus of the continuing negotiations between our two countries.

The Potential for Salmon Enhancement

Concurrent with the trends in world opinion towards extended jurisdiction has been the development of the technological foundation for a big push in increasing salmon stocks beyond current levels. While it is true that salmon culture projects have been tried for a long time—80 or 90 years—it is only recently that techniques have been developed and perfected to make these investments pay off.

Dealing specifically with the Pacific coast, in the forefront of salmon enhancement efforts in recent years is the work of the Federal and State agencies in the extensive development of chinook and coho salmon and steelhead hatchery and pond rearing facilities in the States of Washington and Oregon. Much of this work has been done as mitigation of the loss of natural spawning and rearing areas due to hydro-electric dam construction and damage done by industrial and agricultural environmental degradation. Currently, an impressive total of almost one hundred facilities are in operations, and total output is increasing at a remarkable rate. This might be expected to continue for some time, as old facilities are modernized and expanded, and new ones built.

In British Columbia, some 36 facilities—hatcheries, spawning channels, flow control works, and fishways—have been built by either the Federal Government or the International Pacific Salmon Fisheries Commission since 1945. However, this effort has barely scratched the surface of the potential increases in salmon output which might some day result from a large scale enhancement program. Such increases would come from a coordinated program to take advantage of the opportunities afforded by British Columbia's still largely unpolluted and unobstructed river systems.

The Alaskan potential for salmon production must be enormous. If Japanese high seas exploitation can be controlled, reduced, or eliminated, fisheries management techniques alone could rehabilitate many major stocks, while enhancement technology could contribute to realizing even greater returns.

The development of these techniques now allows fisheries agencies to embark on large scale salmon enhancement programs. While the establishment of economic zones will bring new challenges to fisheries managers concerned with the conduct of offshore groundfish fisheries, including solving stock exploitation, surveillance, enforcement and licensing problems, large scale enhancement programs will bring about the need for major innovations in salmon management. There will be a need to develop systems approaches to the enhancement of salmon stocks on major watersheds. In conjunction with this there will be a need to study exploitation patterns in order to choose those patterns which best harvest natural and enhanced stocks at appropriate rates so that we do not have a situation arise where natural stocks are overharvested in order to exploit more productive enhanced stocks. Additionally, new or restructured entry control programs will have to be developed so that fishing capacity reflects internationally agreed constraints and new enhancement outputs.

In the international context, of special concern will be the management of research to acquire the necessary information to plan the enhancement programs, to determine optimal exploitation patterns, and to assess the results. Looking in particular at the Canada-U. S. west coast situation and assuming that agreement on the interception problem may some day be reached and that

Canada and the U. S. expand their salmon enhancement programs, a great deal of attention will have to be paid to the machinery established to undertake the research necessary to support such programs. This not only is a matter between Canada and the U. S., the Province of British Columbia, with its interest in steelhead might also be involved and the State agencies in Alaska, Washington, and Oregon are already deeply involved in salmon enhancement activities.

Research programs related to these large scale enhancement programs would necessarily involve tagging and mark and recovery experiments, requiring properly designed sampling follow-up not only in the commercial and recreational catches, but also in natural and artificial spawning locations. Since many of the stocks that might be enhanced through artificial measures would be subject to interception by the other country, even though these numbers might be controlled under some agreement covering interceptions, the need for cooperation between the responsible agencies on both sides of the border is apparent.

Canadian authorities participated in the Columbia River and Puget Sound hatchery evaluation programs in the 1960's and some other coordinated research has been carried out in the aegis of what is known as the Informal Committee on Chinook and Coho. While these *ad hoc* and informal arrangements have been fairly satisfactory in the past, new arrangements should be more formal and better defined in the future. Since one of the objectives of any agreement on the interception problem will be to assure for the country of origin most, if not all, of the benefits of its salmon enhancement investments, provision should be made in an agreement for the obligations of each country to cooperate in research activity required by the other in the conduct of its enhancement programs. For example, if Canada were to build spawning channels to increase pink salmon production in the Skenna River and did extensive marking of fry output, it would be important in the assessment of the program that certain Alaskan fisheries were sampled at certain times at certain rates. The agreement should provide for a mechanism to sort out cost-sharing difficulties and to assure that the work done in one country, as part of an experiment benefiting principally the other country, be done on a mutually satisfactory basis. In the example cited above, the responsible agencies might well agree to a contract drawn up under principles laid down in a new interception agreement.

Conclusion

The extension of fisheries jurisdiction will have considerable impact on all North American fisheries. The impact on salmon fisheries is not obvious, but it might set the stage for removing the threat of high seas fishing for salmon of North American origin, leading to both Canada and the U. S. being able to realize the full benefits of their salmon enhancement opportunities. New or expanded salmon enhancement programs will require innovations in fisheries management mostly of a domestic nature. However, there is an international flavour to the research requirements associated with salmon enhancement programs and certain obligations and research coordination mechanisms must be built into any agreement designed to solve the salmon interception problem.

Problems Associated With the Exploitation and Management of Tunas and Billfishes

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The Third International Conference on the Law of the Sea was convened in Caracas in August 1974. Though nothing major was resolved during the first session, it is likely that significant changes in the concepts of jurisdiction over ocean resources will take place in future sessions. It is probable that the coastal states will be granted increased jurisdiction over the species which spend all or most of their lives within an extended coastal zone. These states would presumably also be responsible for the scientific study and management of these species. On the other hand, some of the highly-migratory pelagic fishes, such as the tunas and billfishes, spend part of their lives in waters which would be within the extended jurisdiction of the coastal states, and part in what would still be international waters. The problems of determining jurisdiction relative to harvesting and managing such species under a regime of extended coastal jurisdiction would be difficult, but it is necessary that such problems be resolved if the resources are to be properly managed.

It is the purpose of this paper to point out the unique qualities of the tunas and billfishes which set them apart from the coastal species, and to discuss the requirements for their proper management. The problems associated with the current arrangements for the scientific study, exploitation, and management of tuna resources will also be discussed, and suggestions for more workable arrangements will be presented.

The Fish and Fisheries

The tunas and billfishes are not closely related biologically, but because they are so commonly caught by the same vessels they are considered together in this paper. The "principal market species" of tunas, which make up about 75 percent of the world catch of tunas and billfishes, include yellowfin, *Thunnus albacares,* bigeye, *T. obesus*, albacore, *T. alalunga*, northern bluefin, *T.thynnus*, southern bluefin, *T. maccoyii,* and skipjack, *Katsuwonus pelamis*. The "secondary market species," which make up about 20 percent of the world catch, include the smaller and generally less exploited species such as bonito, *Sarda* spp., black skipjack, *Euthynnus* spp., and frigate mackerel, *Auxis* spp. The billfishes, which account for about five percent of the world catch, include the marlins and sailfish, Istiophoridae, and swordfish, Xiphiidae.

The tunas and billfishes are highly specialized, fast-growing, very mobile fish which spend their entire lives in the open ocean. They occur in all of the major temperate and tropical seas of the world, primarily between 35°N and 30°S. In the Pacific, tag return data have indicated that northern bluefin and albacore migrate between the coastal waters off North America and those off Japan and that skipjack migrate from the eastern to the central Pacific. In the Atlantic, transoceanic migrations of bluefin have been recorded, and it is likely that albacore and skipjack also travel great distances in the Atlantic, though such movements have not yet been documented. Southern bluefin migrate from spawning areas near Australia to the Pacific, Indian, and Atlantic Oceans. Yellowfin and bigeye appear to be somewhat less migratory, apparently usually remaining within a few thousand kilometers of where they were hatched. Information on the movements of the secondary market species is scanty, but they appear to be less migratory than those of the first group. Billfishes, on the other hand, are highly migratory, some readily moving distances of several thousand kilometers.

In Figure 1 are shown the catches of the three categories of tunas and billfishes for 1952 through 1972. These data were taken primarily from statistics published by the Food and Agriculture Organization of the United Nations (FAO), supplemented by additional information from a variety of sources. Prior to World War II, the catch of the six principal market species of tuna never exceeded 300 thousand metric tons per year. After the war the catches began to increase rapidly, and continued to do so until about 1967, when they reached approximately 1 million metric tons. Since then they have remained slightly above that level. The catches of the principal market species in each ocean are shown in Table 1. Nearly 85 percent of the catch of these species is taken by vessels of Japan (39 percent), the United States (20 percent), the Republic of China (9 percent), the Republic of Korea (7 percent), France (6 percent), and Spain (4 percent). The remaining 15 percent is taken by vessels of 34 other countries. The consumption of tuna has been increasing steadily since World War II, and in recent years has been limited only by production. This strong demand has kept the prices high, and at approximately the same level throughout the world, and has generated a great deal of interest in tuna fishery development on the part of many nations. The dockside value of the total catch at current market prices exceeds $700 million (U. S.).

The tunas and billfishes, like any other living resource of the sea, can support only a limited production. Most of the principal market species appear to be fully exploited, or nearly so (FAO, 1968 and 1969; Joseph, 1972a, 1972b, and 1973). The exception is apparently skipjack, which has produced increasing catches in recent years, but appears to be capable of supporting additional fishing. Due to lack of data, few attempts have been made to assess the potential of the secondary market species, but it is generally considered that at least some of them can sustain large increases in production (Gulland 1972). However, it is interesting to note that the development of fisheries for these species may be inhibited by laws which prohibit them from being labelled as tuna in many countries. Likewise, very little of the research necessary to assess the potential of the billfishes has been accomplished.

Current Tuna Research and Management

Before discussing in detail the problems of the tuna industry, it is of interest to examine briefly what is being done at present with respect to tuna research and management.

Table 1. Estimated catches of the principal market species of tunas in 1972 in thousands of metric tons.

Species	Pacific	Atlantic	Indian	Total
Skipjack	347	77	48	472
Yellowfin	251	96	40	387
Albacore	150	74	11	235
Bigeye	75	35	20	130
Southern bluefin	18	5	27	50
Northern bluefin	18	22	. . .	40
Total	859	309	146	1,314

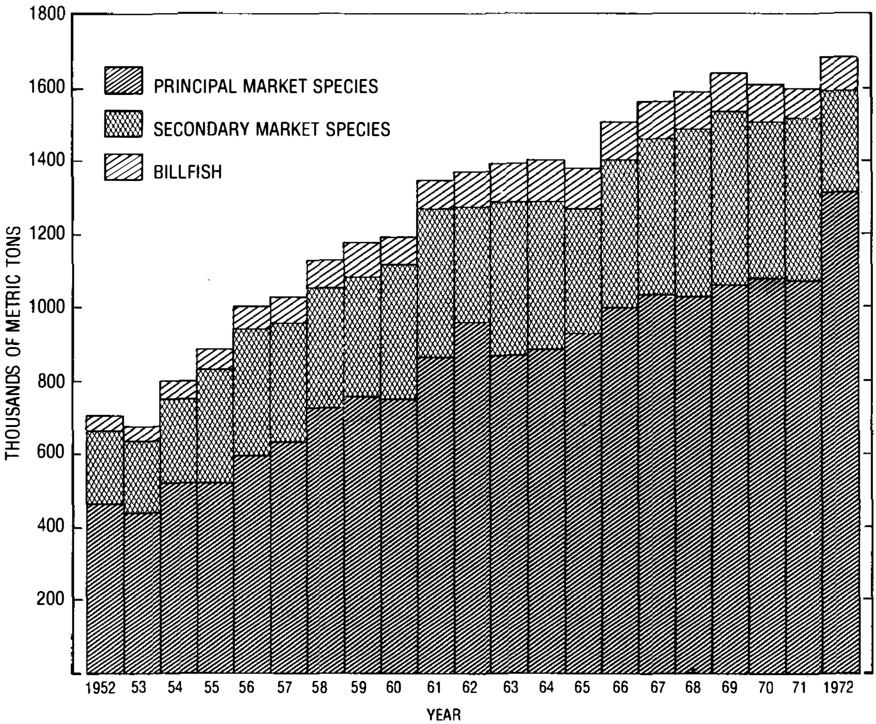

Figure 1. Total world catches of tunas and billfishes, 1952-1972.

Eastern Pacific Ocean

A major fishery for yellowfin and skipjack has operated in the eastern Pacific since the end of World War II. Because of concern over the resources of tuna and baitfishes, Costa Rica and the United States entered into an agreement in 1949 to establish the Inter–American Tropical Tuna Commission (IATTC), with its own, internationally-recruited scientific staff. The duties of the IATTC are to study the tropical tunas and other fish caught by tuna fishing vessels within its area of responsibility and to recommend management measures when necessary to maintain the stocks at levels which will produce the maximum yields on a sustained basis. These studies led to the establishment of a conservation program for yellowfin commencing in 1966 (Joseph 1970) in the form of an overall catch quota to be taken by vessels of all nations on a first-come, first-served basis, implying that the resources belong to whomever can first render them to his use.

In 1966 the carrying capacity of the international fleet fishing in the eastern Pacific was about 40 thousand tons, but since then it has increased to its present level of about 150 thousand tons, and by the end of 1976 it will reach nearly 200 thousand tons. Though the catch has increased substantially since 1966, it has not kept pace with the increase in the fleet. The production of tuna for this fleet has decreased from about five tons per ton of carrying capacity per year in 1966 to about 2.5 tons in 1974, in spite of the apparently healthy condition of the stocks of fish.

Atlantic Ocean

The fishery for tunas in the Atlantic, with a few minor exceptions, began much later than that in the eastern Pacific. It was dominated for many years by longliners, but in the late 1950's baitboats and purse seiners quickly became major participants in the fishery. The total catch increased rapidly, and by the mid-1960's concern over the long-term effect of exploitation on the stocks of tunas was expressed. In 1969 the International Commission for the Conservation of Atlantic Tunas (ICCAT) was formed, with responsibility for the scientific study and management of the tunas and billfishes in the Atlantic Ocean. Unlike the IATTC, the ICCAT was not provided with sufficient funding to conduct its own research. The collection of basic catch and effort data and studies of the biology of the various species of tunas are accomplished by the member governments. This lack of adequate funding for the Commission has inhibited the acquisition of data and timely formulation of management advice.

The intensity of fishing by the international fleet, principally off west Africa, is growing each year. This is due in part to substantial increases in the construction of new vessels, and in part to a large seasonal influx of vessels from the eastern Pacific after the closure of unrestricted fishing there. As in the eastern Pacific, the increase in production has not kept pace with the growth of the fleet. A great deal of concern over the condition of the stocks of yellowfin and northern bluefin has been expressed by some of the member governments of the Commission, but concensus has not been reached by all its members concerning the need for placing controls on the levels of harvest. Catch quotas have not yet been placed on the Atlantic fisheries, but a minimum size limit of 3.2 kilos has been adopted for yellowfin.

Indian and Western Pacific Oceans

Moderately large fisheries for skipjack and the secondary market species are prosecuted in the Indian Ocean by coastal fleets using drift gillnets and hook and line gear. The catches of the other principal market species are made by longliners of Japan, the Republic of China, and the Republic of Korea. The largest catches of skipjack in the world are taken in the western Pacific Ocean, principally by baitboats of Japan and other nations. There are also substantial longline fisheries for the other principal market species prosecuted by Japan, the Republic of China, and the Republic of Korea.

There are two international bodies concerned with all of the fisheries of the Indian and Western Pacific Oceans, including those for tunas and billfishes, both established within the framework of the FAO. These are the Indian Ocean Fishery Commission (IOFC) and Indo-Pacific Fisheries Council, (IPFC), neither of which has a research staff, or even a permanent secretariat. As a result, the work done by these two bodies is accomplished by working groups of scientists affiliated with other organizations. Not surprisingly, progress has been slow in assessing the impact of the fisheries on the stocks of fish and making recommendations for management.

As has been already noted, the principal market species other than skipjack are already exploited at about the maximum possible rate. It is generally considered that skipjack can support substantially greater catches than are presently taken, but some believe that the population in the western Pacific is currently being fully utilized. Research is badly needed; but, requisite to such research is adequate statistical data, which, is currently lacking, particularly for the Indian Ocean.

Research Requirements

The basic requirement for carrying out research on tunas for the purpose of management is the availability of catch statistics and of data on the effort which produced these catches. Also of prime importance are samples of the sizes of the fish in the catch and other data which provide information on the life histories of the fish and the effects of the fisheries and the environment upon them.

The present system of data collection, for the most part, does not work. The IOFC and the IPFC have no funds to collect the necessary data, and thus are ineffective in this respect. The ICCAT has only limited funds for such work, and as a result must serve only as a center for the summarization of statistics collected at the national level and transmitted to it. This has proved inadequate, and in recent years efforts have been made to increase the ICCAT staff to permit it to be more directly involved in data collection. The IATTC staff collects statistical and other data for its own use, and these have proved adequate for making recommendations for management in the eastern Pacific Ocean. From these experiences it is clear that the collection of statistical and other data must be carried out by one or more organizations which are given explicit mandates and provided with the necessary financial support to do so.

The fleets that fish for tunas are highly mobile, and one vessel may fish in three oceans in a single year. Likewise, the raw product may be handled in two or three countries in a matter of months. Thus it is far less efficient for a number of organizations to collect the data independently than for a single organization to do this job alone. Likewise, because collection of the data and their subsequent analysis are so closely interwoven, it would appear most practical that the same organization do both.

Management Requirements

It has already been noted that most of the tunas and billfishes are highly migratory, so the degree to which they are exploited in one area will affect the extent to which they will be available at later stages of their lives in other areas. Thus any management program for a stock of fish must apply wherever that stock occurs, whether it is on the high seas or in the territorial waters of coastal nations.

When management measures are implemented in one area the fleet, or a portion of it, is likely to move to another area where the measures are not in effect. For example, when the quota on yellowfin in the eastern Pacific is filled early in the year a large share of the fleet transfers its operations to the Atlantic. Since the Atlantic fleet appears to be larger than necessary to harvest the available fish in that area, this only serves to increase the problem there. This same situation will hold true for many of the major tuna fisheries of the world as management action is implemented.

One of the principal difficulties in implementing management controls is the fact that there are fundamental differences among the nations which fish for tunas or which wish to enter the fishery. The nations with well-developed fisheries now take most of the harvest, but other nations, many of which are adjacent to some of the most important fishing grounds, wish to enter the fisheries or to increase their shares of the catch. Since the resource is limited, the nations of the second group can, for the most part, hope to increase their shares only by decreasing the shares of the nations of the first group. The nations of the first group maintain that their shares should be kept large because they originally developed the fishery, while those of the second group insist that their shares should be larger due to their proximity to the resource.

If management is to be effective it is necessary that a workable system of enforcement be established. This would require the establishment of mechanisms of enforcement which would apply to all vessels. The two management programs now in effect for tuna are both troubled with problems of enforcement. In the eastern Pacific, where there is an overall quota in the catch of yellowfin, the regulations are not enforced for the vessels of some of the nations engaged in the fishery. This is primarily because enforcement is the responsibility of the individual nations, and some lack the technological capability or the political will to do so. This has not been a serious problem in the past because the fleets of such nations have taken only insignificant quantities of yellowfin, but as their fleets grow the problem will become more serious. In the Atlantic the ICCAT has established a minimum size limit of 3.2 kilos for yellowfin, but some of the nations participating in the fishery are not enforcing the law with respect to their fishermen.

Alternatives for Management

Before management of the tuna fisheries can be effective it will be necessary for the world community to decide where responsibility and authority for such management must rest. The current trend toward extended jurisdiction of coastal fishing zones has led many to believe that the sole responsibility and authority for management must lie with the coastal states. It is possible that this approach can work in cases where the species in question spends its entire life within waters under the jurisdiction of the coastal states, but, even then, international agreements are necessary if individuals of the species in question move parallel to the coast from the coastal waters of one nation to those of another. Some of the secondary market species may spend their entire lives within coastal waters, but the principal market species, and probably all of the billfishes, are highly migratory, moving between the coastal waters of various nations and the high seas with great frequency. It is therefore obvious that if the responsibility for tuna management lies solely with the coastal states, such management cannot be effective.

An alternative to assigning the responsibility for tuna management to the coastal states is to assign it to regional international bodies, which is the approach taken during recent years. In some cases this approach has been moderately successful, but in others it has not. For example, the geographical area of responsibility of the IOFC is broad enough to cover the range of most of the stocks under exploitation. However, this organization has not been given the necessary authority or funds to handle the problem of data collection and analysis. The IATTC, on the other hand, has been given the authority and funds, but its geographical area of responsibility is considerably less than the ranges of some of the stocks of tunas being exploited in the eastern Pacific Ocean.

Given the highly migratory nature of the tunas, the great mobility of the fleets that harvest them, the nature of the international market for the raw product, and the problems of collection and analysis of data, distribution of catch, and enforcement of regulations, it is obvious that a much broader approach to tuna research and management is necessary. There should be an international body with responsibility for collection of statistical and other data on the tuna fisheries of the world, assessment of the condition of the stocks supporting these fisheries, and subsequent recommendations for management. This concept is not new, having been discussed in detail by Kask (1969), Joseph (1972a and 1973), Gulland (1972), and Saila and Norton (1974). It also was one of the major agenda items at a recent meeting of the FAO Committee on Fisheries.

The most difficult problem facing any international body which might be created is that of distribution of the catch, due to the fundamental differences among many of the participants and potential participants. Those countries taking large shares of the world catch of tunas at present do not want to relinquish any part of their shares, while those wishing to increase their shares are not willing to accept constraints on development. There appear to be only two general directions in which events can move with regard to this problem.

First, tunas can continue to be harvested on a first-come, first-served basis, but this approach does not appear to be working well. As already pointed out, in the eastern Pacific a quota on the total catch of yellowfin has been effective in maintaining the resource at a level of abundance which supports large sustained yields. However, due to uncontrolled fleet growth, the catch per vessel has declined, some nations are not enforcing the conservation regulations, and each year pressure is increasing on the part of developing tuna fishing nations to allocate to them a larger share of the catch. To increase their shares of the catch, the coastal nations could enforce their claims of extended jurisdiction; while to maintain their shares, the non-coastal nations could fish without restriction on the high seas, which would almost certainly result in overexploitation and reduced catches for all. A similar situation is developing in the Atlantic, and when management is instituted on other species and in other areas similar problems will exist.

Second, provisions can be made for distribution of the catch. A workable system is not easily developed, however, due to the fundamental differences among the participants and potential participants in the fishery. The nations with well-developed fisheries would want past participation in the fishery to be the main criterion for allocation, while the coastal nations without well-developed fisheries would want coastal proximity to be the main criterion. A workable solution would presumably lie between these extremes. Also, provisions for new entrants and for control of fleet growth must be made. After the allocations were made, various countries would probably attempt to renegotiate larger allocations if unrestricted fleet growth was permitted, and as the pressures for new allocations increased, the probability of reaching agreement on management would decrease. Therefore, some mechanism for limiting the growth of the fleets to the level required to take the allocations would be needed.

Any institution which is to be created for the scientific study and management of the tunas must be able to deal with all of the problems discussed above—data collection and analysis, distribution of the catch, and enforcement of regulations. To be effective, however, the scientific function of such a body would have to be kept separate from the management and enforcement functions. Otherwise it would be difficult, if not impossible, to collect the data necessary to conduct the research required for assessing the stocks. Therefore such a body would require a council of representatives appointed by the member governments who would be responsible for administering the two arms of the organization.

The technical arm would consist of a scientific staff which would have responsibility for the collecting of statistical and biological data, analysing the data to assess the impact of fishing on the stocks, and providing advice to the council on the condition of the stocks for management purposes. The management and enforcement arm would consist of a technical staff of persons competent in these areas. This branch or arm would deal with the problem of distribution of the catch, enforcement of management regulations, and the economics of fishing, processing, and marketing.

The distribution of the catch might be accomplished by allocating part of the world catch among coastal states which have tuna fishing fleets, leaving the remainder to be taken on a first-come, first-served basis. User's fees could be paid by all participants in the fisheries, a portion of the proceeds going to the coastal states and a portion to finance the international body. Payment of this fee by a nation would permit its vessels to fish in the coastal waters of any member nation, according to the conservation regulations established by the global body. To prevent overbuilding of the fleet, which is becoming a major problem in the tuna fisheries of the world, the overall tonnage of the vessels that would be engaged in the fishery could be controlled. These controls could be placed on countries on the basis of their allocations and past and projected catch experiences. Any country desiring to begin tuna fishing for the first time or to increase its fleet capacity would have to negotiate for vessel permits with the participants already in the fishery. For such a management scheme, or for that matter any other scheme, to work would require that an effective system of enforcing regulations be implemented. This would require a system for monitoring positions of vessels at sea at all times and for inspecting the catches when the vessels return to port. This would be the responsibility of the management and enforcement arm, of course.

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The Recreational Viewpoint on a Fisheries Regime Under Extended Jurisdiction

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Establishing a management regime that will encompass the needs of the recreational fisherman under extended jurisdiction will present the most difficult of tasks in these overall fisheries changes. The recreational fishery in the marine resource is not fully developed at this time, has little or no management system now, and the participants, the recreational fishermen, are a fractured lot with no central voice for presenting ideas and desires.

At the present time the individual states undertake the existing management programs. Few states have any accurate or detailed data on the recreational harvest from their adjacent marine resources. Two states, Oregon and Washington, do have a mandatory punch card system to tabulate salmon catches, but any other harvest of bottom fish and tuna catches offshore for example are not statistically tabulated.

Excluding the recreational fishery for the anadromous specie salmon and the similar fishery for the pelagic tuna and billfish, the remaining recreational fishery in the marine resource is concentrated in the waters adjacent to the Northeastern United States and the Southeastern United States. Unfortunately it is here that the individual states present management seems weakest, in my opinion. On the other hand, it is a herculean management task for states at present, because enforcement would require expensive investment in vessels and equipment on a highly unorganized recreational fishery that regularly flows from one state's jurisdiction into another's. This area problem further clouds the ability of the states to sensibly manage.

Likewise, the consideration of additional management from the states does not stand up under a cost/benefit application because no sensible license system has evolved from any state that covers the cost of management and enforcement and satisfies the inter-state mix-up.

It should also be mentioned that included in the marine resource recreational fishery are such catches of fish or fish products, shrimp as an example, that question the very definition of a recreational caught fish. In fact, I would tend to classify them more in the category of a "commercial-sports" caught item. It is my opinion that the following facts now or soon will exist with respect to the marine resource recreational harvest:

1. The jurisdiction of the fisheries management will be extended probably to 200 miles.

[1]In the absence of the author, this paper was presented by Mr. William Luch, President, Trout Unlimited.

2. A complete management system must be developed with proper weight applied to the recreational potentials.
3. The states are not capable of handling this increased responsibility on an individual basis.

Accepting these facts, two alternative plans come to my mind to account for the above changes.

1. Complete Federal pre-emption of this responsibility.

An idea I immediately reject because it would require expensive duplicated effort, be unacceptable and alien to the states and in general show little regard for the democratic process as well as the enormous regional variations that occur simply due to the geographic differences in our country's coastline.

2. Creation of Regional Fisheries Commissions with full regulatory authority.

This alternative, in my opinion, offers the best potential for a management regime acceptable to all parties involved. Through creation of this commission, a federal-state partnership could be formed with representation of all levels of government. In addition, recreational and commercial interests could be represented in direct ratio to their importance so that this management regime would cover all forms of harvest applied to any particular fishery. A management regime and system that would recognize and deal with all forms of fishing that a specie or group is subjected to, would blend well with a resource oriented harvest yield, which I heartily support also.

In the past I have found little evidence of any management direction from industry or government, or anyone for that matter, that called for anything remotely representing restraint on the resource. Rather it has been overfished, overharvested and oversupplemented with government "boondoggle" funds resulting in an over-capitalized industry showing little if any return on investment, let alone a profit for the fisherman. To some degree, the industry, in my opinion, has been forced to overfish, just to keep financially afloat. However, recently the suggested change from a model of "Maximum Sustained Yield" to a model of "Optimum Sustained Yield" gives hope to the future maintenance of our marine resource stocks.

Enter now the recreational fisherman and one can immediately see where he has been relegated to a backseat position and treated as the perennial "bridesmaid." Creation of a regional marine commission with weighted representation from industry, recreation and conversation groups could begin to unwind all the years of strife and arguing that has gone on between these various factions for years. To me, it is inconceivable that this bickering goes on. It should stop once and for all. It has never been more apparent that these groups need to work together than it is now. Creation of a forum such as I have recommended above also would serve that purpose.

Funding of the regime I have recommended should be done in conjunction with the individual state's license sales. For the recreational area of this, I envision something similar to the Federal Duck Stamp Program that is now used to support waterfowl management.

The marine resource of our continent cries for management at this very moment. We can ill afford to wait any longer to implement long term schemes that will insure maintenance of these stocks. As an integral part of any management plan, whether it be my recommendation or some other, adequate and proper representation for the recreational interests must occur.

Discussion

CHAIRMAN POLLOCK: Now we have some time for discussion and I think that it is interesting to note that we have talked about the Law of the Sea, coastal fisheries resources, salmon resources, tuna resources and recreational fishing. Now, I believe we are ready to take any questions that you may have of any of the members of this panel.

MS. MAXINE McCLOSKEY [Sierra Club]: I would like to ask Mr. Joseph about a very important point that he did not cover in his discussion of the needs and problems of the commercial tuna fishery. It seems to me that one of the problems you must contend with is the continued kill of porpoises in the process of catching the yellow-fin tuna. This is done, as I am sure some of you know, during operations out on the high seas. It occurs to many of us that this certainly must be an administrative problem, and it also occurs to us it is a very important biological and ecological problem, yet I did not hear any comments made on this matter. Would you like to discuss this?

CHAIRMAN POLLOCK: Let me interrupt and say that I am sure there are many other subjects that each of us would have touched on had we had more time.

DR. JAMES JOSPEH: What the lady is referring to is the relationship between tuna and porpoises. For some reason they run together in some cases. We don't know whether the tuna or porpoise derives some advantage from this relationship.

We do know that the fishermen have set their tuna nets around schools of porpoise and if they should catch a porpoise school they are assured, most often, of catching the tuna that run in association with them. Their efficiency along this line has increased very rapidly. What happens, unfortunately, is that in this process a number of the porpoises are killed by drowning in the nets. They try to dive out of the net, they panic and they become entangled in the webbing. There are a number of estimates that the kill ranges from about 250,000 animals per year to, last year, in the neighborhood of 110,000 to 115,000 animals. Now, the United States Government has a major project at the Southwest Fisheries Center directed toward solving this problem. The Commission has not yet seen the direction to be taken or decided whether they should be involved in the study because the United States Government has a great deal more resources and expertise in this area. However, I agree with Miss McCloskey, and I think that any reasonable person agrees, that we should develop, as rapidly as possible, a mechanism for separating the tuna and the porpoise before they get into the net, or a proven method for separating them once they are in the net so that the mortality of these animals will be reduced.

In fact, there is a law, the Marine Mammals Protection Act, in which the onus is put on the fishermen to reduce mortality to a level approaching zero. In the early years of the fisheries there were no methodologies for separating the tuna from the porpoise or trying to save the porpoise. However, as a result of this law, and even before the law started, the fishermen instituted a program in which they attempted to develop methods for saving the porpoises. They have presently developed two methods that have proven effective to a degree, but the problem is by no means solved.

One of the methods is called a "back-down technique"—a type of fishing employing a very long net. It is closed up at the bottom like a purse and the fish and the porpoise are in there. What the fisherman has developed is a method for pulling the main net backward, so that when the porpoise and the tuna are in a certain position, the porpoise are enabled to get out over the net and away from the tuna. This has resulted in a great reduction in the porpoise mortality rate. However, a great many of them, as you can see by last year's figure of 115,000, were killed.

The other method that is used is called a "panel" method. The panel is placed at the end of the net where the back down occurs and it is put there so that, when the net is maneuvered into position, the porpoise can get on the panel and then out and over it. Both methods have been effective in reducing motality, but by no means completely effective because the porpoise are still being killed.

What is needed are more statistics. In other words, we need to know how many porpoise are being killed and what proportion this is of the total population. In sum, that is where the research is at present and also where it needs to go, at least in my opinion.

MR. DALE POTTER [Seattle, Washington]: I have a question for Mr. Luch. I believe you mentioned a very important problem and I would hope we can get a handle on some of the issues that you have brought up. I wonder if you would add to your list of problems the controversy, particularly in the Northwest, of the Indian Treaty Rights as they regard fishing. Perhaps you might explain briefly, for the benefit of the audience, what the controversy is about and also give us some notion of what you believe is the magnitude of the problem and the implications it has for the future—not only in the Northwest, but in other areas of the United States.

MR. LUCH: This whole situation with the United States and a couple of Indian tribes started when the Indians sued the State of Washington over the question of fishing by the Indians off of their reservations. It went to the Supreme Court and the court said, "Yes, you have a right to fish off the reservation." The state then moved in to regulate this fishing. This was followed by another decision regarding the regulation, the famous or infamous Boldt Decision. This said, in effect, that the state has no right to regulate this fishing. The judge involved in this case, Judge Boldt, appointed a fish manager and stated in his decision: " I will allow certain Indian tribes, once they have proven they can do so, to regulate themselves. Also, additionally, where I don't feel they are able to regulate themselves, I will regulate them." This removed the State of Washington from its ability to regulate.

We now go back into court, but this time to decide whether or not we are going to a single management jurisdiction, the state's right to regulate; or whether we are going to have legislative jurisdiction; or, on the other hand, whether we are going to have three management systems, the Indians, the judge and the State, on the same fish. The result is a big mish-mash and it is spilling outside of the question of fishing because Indian tribes all across the United States are now saying "We also have the right to hunt," and court decisions all the way to the Supreme Court say that, even on land that has been sold by the Indians, they still have the right to hunt without benefit of state management. This has happened twice now, both in Oregon and in Washington, where the Indians were told they could hunt without regulation on land owned by the State of Washington as a wildlife refuge.

Therefore, we come way beyond the fishing as it affects us in our dealings with Canada because now we cannot get a handle on how many fish are going to be taken in the Indian fishery. The reason I say that is because Judge Bolt has said that, before the Indians are given their share of fish, you must subtract those fish that are caught internationally. Therefore, we must subtract from the fishery catch the amount of fish taken internationally and then count. In addition, you must subtract those caught on the reservation, those caught for food, and those caught for ceremonial purposes. After you have kept subtracting, you find that pretty soon you are taking from zero.

The problem that is going on now with the United States versus the State of Washington is one concerning management of fisheries and wildlife by an agency of the state. Not only is this a problem to Washington, but it will affect every state that now has Indian tribes. Further, it is not a question of civil rights, because there is no one that can argue with the Indians' right to fish. That is not the question. The argument concerns how we manage the fishery. In other words, will we manage it by a single management unit or will we fractionalize it to the point of almost irreconcilable conflict? That is the real question.

I believe you also said something about the United States - Canada treaty negotiations. Let me say here that the major problem between the United States and Canada in our salmon management is caused by the United States, in my opinion. I am ashamed to say that, but it is true.

Insofar as the United States versus Washington and the Indian situation on fisheries is concerned, I don't believe there is a solution to this outside of the Supreme Court of the United States, and the case will go to the Supreme Court no matter who wins at the Ninth Circuit Court in San Francisco, where the case is right now.

CHAIRMAN POLLOCK: Are there other questions?

MS. MAXINE McCLOSKEY: I would like to thank Mr. Joseph for explaining some of the intricacies of the tuna and porpoise situation. I would like the people in the audience to know that, as he said, the Marine Mammal Protection Act requires reductions of porpoise mortality in the tuna fisheries to "insignificant levels approaching zero." They were given two years in which to find ways for doing this and the two years expired last October. As we read the law, that would seem to indicate that there should be no more porpoise mortality, yet the National Marine Fisheries Service issued a permit to the tuna industry to kill 85,000 porpoise during the present tuna fishing season. As an issue, we are advocating that the law be enforced. We are doing everything we can through administrative procedures and legal action to inform the commercial tuna operators and the United States government that we want the law enforced.

CHAIRMAN POLLOCK: Thank you for your comments. Are there further questions or comments? If not, I would like to make a comment to Bill Luch.

I believe there were two very interesting pieces of legislation before the House of Representatives—one introduced by Sullivan, the Chairman of the Marine and Fisheries Committee, and one by Dingell. Their designations are H. R. 1070 and H. R. 3412. I know that one of them has a very close alliance with what you are saying about getting regional involvement in at every level—government, sport fishermen, commercial fishermen, etc. I think you will find it interesting. The National Marine Fisheries Service, I know, is doing a great deal of study these days, in contemplation of an extended fisheries jurisdiction to 200 miles, in just this area, and, therefore, I found your comments to be very pertinent.

Are there other comments or questions?

MR. PAUL RICHARDS [Pittsburgh, Pennsylvania]: I would like to ask a question of Dick Dykstra. At the last meeting of the Atlantic Fisheries Biologists, discussion was devoted to underdeveloped resources on the New England Coast, and federal and state programs to develop them. I would like to ask him if any of these programs are being implemented, and what effect they are having on the fishing aspects in New England?

MR. JACOB DYKSTRA: In New England we have what is known as the New England Fisheries Development program. This is a Fisheries Service administered program but the industry is very closely involved in it. There is a task force of industry people who have been given a lot of leeway in what should be done. This program is aimed toward the underutilized species and I think is showing some results. We have had in my own port some developments that I think are directly attributable to this program, and I think very soon we will see some results from this. In other words, we are now working on a new plant, a larger plant, designed to deal with a lot of species.

The difficulty in relation to this program has been that when meat went so high, it stimulated the fish production around the world. As a result, a lot of fish production came in the direction of the United States. Then, when prices dropped, the pipeline was full of products and they just did not stop. This created a monumental jam in the warehouses pertaining to these products and is a condition which presently more or less reflects itself around the world. That means that a product such as squid, which is one of the products directed toward the overseas market because of the selling price, caused some difficulty. For example, the Italian economy went up and, as a result, we could not send any more there. Also, in relation to Spain, where the rest of it was going, we had the same type of situation and, consequently, it piled up there. Thus, the overseas market for squid is pretty well shot. What I am trying to indicate here, is that a lot of this came into the United States and jammed up the market for fish.

Crab is in the same type of condition, mostly the King Crab. I talked to some of the King Crab producers just last week and they said that it went as high as 84 cents last year, but is now down to about 40 cents. We were atempting to get on the ground with a couple of varieties of crabs in New England, but the market for this has been completely wiped out.

At the present time, in the United States, there is a glut of these traditional products, but I think that as soon as this situation clears up, and I think it will clear up with extended jurisdiction and so on, we will begin to really utilize these species.

Institutional Arrangements and Management Needs

Scientific and Economic Data Needs for Extended Fisheries Jurisdiction

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Extended fisheries jurisdiction represents the most important and significant change in fisheries since, or perhaps including, the development of the large high seas fishing fleets after World War II. The prospect of such an institutional change is exciting and sobering. It is exciting because a world-wide move toward extended jurisdiction, although having some shortcomings when contrasted with possible alternative schemes, can set the stage for efficient use and allocation of coastal fishery resources. It is sobering because with this change must come the responsibility for the U. S. and other coastal nations to assure that resources under their jurisdiction are used in a wise manner.

Extended jurisdiction contrasts with the historical situation in which the Federal Government has had little authority to control the exploitation of most fishery resources off U. S. coasts.[1] As a result there have been serious inefficiencies in the use of these resources. Some resources have declined in abundance and availability. Segments of the commercial fishing industry are overcapitalized. The rapidly growing saltwater gamefish recreation activities have been affronted with resource conflicts from commercial fishermen—domestic and foreign. These problems, exacerbated by rising worldwide demand for fish products and the resultant increases in fishing effort, are pervasive. Many of us have been waiting anxiously for an institutional change which will allow for overcoming these problems. Now, an important change appears to be near. The challenge to all involved is to assure that the potential benefits from this action will be attained for our society and for the world community.

Meeting this challenge will require a careful and well-planned strategy for decision making. Initial decisions should be made in a manner that maintains flexibility and options for the future. Decision making should be carried out under a well formulated policy, but on an incremental basis with the goal of closing out the fewest possible future desirable alternatives.

Sound decision making under this approach will require appropriate and timely data. Therefore, the data and information system must be consistent with the decision process. In particular, the decision process and information system

[1]Exceptions of course are those resources declared creatures of the continental shelf and those falling totally within the existing 3-12 mile fisheries zone.

must be integrated with an effective feedback mechanism so that adjustments and improvements can continually be made in the decisions and the information system.

Certainly, the adoption of extended fisheries jurisdiction will bring with it the need for additional data. It must be recognized, however, that the acquisition of large quantities of data—no matter how pertinent or reliable—is not an end in itself. Data are needed only if effective use is made of them. Effective use of data requires modeling, analyses, evaluation, interpretation, and timely dissemination of results. Possible actions under extended jurisdiction must be identified and the effects analyzed. Data collection alone will not accomplish this. Therefore, data needs, required analyses, and dissemination of results should be considered simultaneously with the decision strategy. We may each know of instances where data were collected, put on cards, magnetic tapes or simply in file cabinets, and never used in analyses or presented in published form. This is wasteful in time and money, and we must make sure that extended jurisdiction does not become merely the justification for more data.

Data needs, therefore, should be determined by the issues to be addressed, and the analytical or other methods selected to evaluate the effects of decisions related to these issues. In considering data needs, it is useful to identify issues that will likely arise as we move toward the reality of extended U. S. fisheries jurisdiction. For this reason the remainder of this paper is divided into three sections. First, a discussion is presented of possible objectives of fishery management under extended jurisdiction. Then, some of the issues implied by these objectives are identified. The final section of this paper addresses more directly the data needs implied by the identified issues. I have not, however, devoted a large portion of my remarks to specific data requirements. I believe it is more important here to deal with the mechanism of making available appropriate data and how this can be done most effectively. This is important because of the relatively short time in which some very important decisions must be made.

Objectives to be Attained Under Extended Jurisdiction

The bounds for data requirements depend upon the breadth of the issues to be addressed under extended jurisdiction. The breadth of the issues, in turn, is determined by the factors society desires to be included in its objectives for fishery management. It is not the intent here to identify a specific objective or set of objectives which society should adopt. This is more appropriately a function of the political decision making process in our society. What is important for our discussion is that we have some understanding of the general factors that will likely be included in the objectives upon which our society does settle.

There have been and probably will continue to be differing ideas on what should be the objectives of fisheries management. There has been growing recognition, however, that it is neither useful nor in fact possible to identify a single objective such as maximum average sustainable yield or maximum net economic yield for all fishery stocks (Alverson and Paulik 1973). This changing view is especially relevant because extended jurisdiction will affect both sport and commercial activities. Additionally, actions taken under extended jurisdiction will impact in different ways on local coastal communities throughout the nation.

The objectives society designates for fishery management should reflect the benefits that can accrue to the various user groups, present and future.

Alverson and Paulik (1973) state that objectives for fishery management may fall "... into three groups: (1) those concerned with maintenance of resources; (2) those which are of a socioeconomic character; and (3) those reflecting national and international political interests."

Emphasizing the importance of multiple objectives of fisheries management, Rothschild (1973) indicated that "... if management is to be developed from a rationale that includes *inter alia* biological, political, social and economic considerations, then management must appreciate biological, political, social and economic objectives."

Reflecting the trend of including many factors in the objectives of fishery management, a recent U. S. Senate legislative proposal included the concept of "Optimum Sustainable Yield (which) refers to the largest net economic return consistent with the biological capabilities of the stocks, as determined on the basis of all relevant economic, biological and environmental factors." The document goes on to indicate that "Most international agreements state as their basic objective maximizing sustainable yields from the stocks. ... However, many experts believe that use of the maximum sustainable biological yield objective in fisheries management may lead to substantial economic waste and may ignore important environmental relationships between stocks from which yields cannot be maximized simultaneously. It seems more desirable therefore to adopt the objective of optimum sustainable yield defined to include biological, economic, and environmental factors as the guideline for fishery management in an extended fishery zone and over anadromous species of fish."

Recognizing that this statement carries no official societal approval, it does, I believe, represent the evolution of thinking regarding the desired factors to be included in the objectives of fishery management. If we can accept this as a direction of public thinking, we can see that managing U. S. fishery resources under the extended jurisdiction will require consideration of a wide range of resources, economic and social factors.

Combining the usual constraints on funds available for acquisition of data and information with the tremendous demand for data and information implied by the above factors, surely leads to the conclusion that careful planning is called for. Effective planning, relative to data and information needs, requires an understanding of issues that may arise as resource, economic and social factors are considered in decisions affecting the use of fishery resources. Some of these issues are identified in the next section.

Issues Under Extended Jurisdiction

The issues related to extended jurisdiction are many and varied. Indeed, since we are dealing with a dynamic situation, these issues will only be fully set out over time and as a result of exchange and interaction within and among the scientists, fishery managers, and user groups involved with fishery resources. Therefore, the list of issues provided below, while extensive, is certainly not all inclusive.

Further, a listing of issues such as is provided in this section, while helpful for our purpose, is oversimplified and fails to capture the true dynamic and interrelated nature of these issues. Rothschild (1974) referred to the integrated nature of fishing activities by indicating that "... we need to view fisheries as a system or a collection of systems. These fishery systems usually constitute a resource problem or set of problems in that they involve linkages between a portion of the biota and man's use of it. These linkages involve biological questions, but they are not necessarily more important component linkages than the social, political and the economic questions."

Keeping in mind then, that these are interrelated, some of the important issues are:

—At what levels should the various stocks under U. S. jurisdiction be exploited?

—What are the implications of multi-species interactions on commercial and sport activities?

—Under what conditions could the U. S. exploit those resources within the U. S. fisheries zone?

—What are the alternatives for increasing domestic harvesting and processing capacity?

—What level of foreign effort should be allowed, and how much rent should be collected from foreign effort?

—Should a "rent" be collected from domestic sport and commercial fishermen to help pay for research, management and enforcement activities?

—How should existing and potential conflicts between sport and commercial activities be handled under this situation?

—What will be the effect of potential increases in the share of coastal fish resources on prices of fish available to U. S. consumers; the U. S. balance of payment; and general world fish trade patterns?

—How should regional, as compared to national, effects such as changes in the distribution of income and employment be weighed?

—What types of management regimes can be most effective in considering the above issues and in assuring the maximum benefits from sport and commercial activities within the U. S. zone?

If we accept that fisheries are a system of interactions, it follows that any decisions made with regard to a part of this system (i.e., any one of the above issues) will affect the entire system. Implied in each of these issues therefore is a myriad of resource, economic and social questions, all of which are interrelated. Useful data and information inputs relative to these issues must measure and trace the interaction and final implications of alternative actions on the resource, economic, and social factors of this system.

We must recognize that while decisions on some aspects of these issues are being made now or will have to be made in the near future, many of the data and analyses we would like to have simply are not available. Therefore, it is important that these decisions close out the fewest possible future alternatives. This implies the need for a strategy relative to decision making and relative to data and information acquisition required for these decisions. This is discussed in the next section.

Data and Information Needs

The data and information needs implied by the requirement of considering various resource, economic and social factors in the decisions regarding fishery management can be almost staggering. For example, information needs under these requirements are extensive even for a seemingly straightforward objective such as "maintenance of resources." Questions arise as to what is the appropriate level of maintenance: maximum average sustainable yield (MSY); a level that will simply prevent irreversible depletion (Ciriacy-Wantrup 1952); or some other level? When an appropriate level is decided upon, there is the equally important question of the means of accomplishing this objective. For each set of objectives, alternative means exist for meeting the objectives. If, for example, MSY is chosen as the objective, the economic and social implications of attaining MSY through the setting of an overall catch quota are greatly different from the implications of restricting effort to the MSY level through a controlled access (limited entry) scheme. The specific determination of these differences will require resource, economic and social data and analyses not generally available at this time.

The data needed to address the issues developed in the previous section can be classified into general categories such as oceanographic, ecological, resource, economic, and social. A partial listing of data needs under each category follows:

Oceanographic data related to: currents; salinity; temperature; areas of upwelling; etc.

Ecological data related to: food chains; identification of pathways of contaminant movement through the ecosystem; the basic implications of nonresidual pollutants on marine organisms; lethal and sublethal levels of pollutants such as DDT or heavy metals; the effects of dredging and offshore petroleum, mining and dumping activities; etc.

Resource data related to: physiological processes and requirements for reproduction, growth and survival; life histories and dynamics of individual components and populations; abundance and distribution of stocks; stock assessment and identification of separate stocks or populations to determine intermingling of stocks within and outside the fisheries zones; egg and larval information; commercial catch and amount and location of effort; sport fishing days and catch; composition of catches; etc.

Economic data related to: days at sea for fishing vessels; costs of vessels, fuel, equipment and labor; ex-vessel prices and landings; wholesale prices and quantities; retail prices and sales; capital costs; fleet capacities, availability of boat building facilities; quantity and type of port facilities; price and income elasticities; economic measures of sport fishing values; import quantities and prices; etc.

Social data related to: age, education, income levels of sport and commercial fishermen; population in coastal communities and the social values of living in these communities; attitudes toward fishing; the contribution of sport fishing as a leisure activity and to the well being of society; etc.

This partial listing probably raises in each of our minds questions such as: Will we spend more than the total value of all fishing resources on data collection; will we be overrun with data cards or magnetic tapes; and will any of these data be available in time to address the issues raised in the previous section? This, I believe, indicates that our primary concern here should not be trying to complete the above list of specific data needs. Rather, we should consider how an effective and efficient system can be developed to assure that the data collected will be appropriate and available on a timely basis.

Relative to this point, Christy (1973) specified the desirable characteristics of a data and information system for fisheries management. He indicated the system should provide sufficient data, and that the data should be timely, reliable, acceptable and available at a minimum cost. Alverson and Paulik (1973) states ". . . the scientific community has the responsibility to effectively communicate its findings, to evolve methods of providing quick and reasonably cheap diagnoses of the status of stocks, and to contribute to the development of the theory and application of the total systems approach to management of renewable resources."

As is implied by the above authors and as I am sure we will all agree, the acquisition of data and information is costly, I am concerned that unless carefully planned and coordinated activities are initiated we will see in the near future a profusion of data-gathering by various agencies and organizations which will result in redundancy and duplication. I am further concerned that the end result will be large expenditures for data, many of which will not be used because they are neither appropriate to fit the issues and the methods of analyses nor available on a timely basis.

The issues we face here are too important to allow for this type of inefficiency. We may argue that if initial decisions relative to the issues are inappropriate, they can be changed later. This is true; however, it is also true that the intial decisions will establish directions and begin to close out alternatives. Therefore, the strategy of decision making relative to all of the issues defined earlier should be one that involves initial decisions of a gross or preliminary nature. It should be made clear that these will be subject to revision and improvement over time as better and more refined information becomes available. This, as was mentioned earlier in this paper, will require a mechanism for feedback between the decision making process and the information system. This would allow for improvement in both decisions and information over time. Therefore, one approach to data and information acquisition would be to divide data and information needs into the following categories:

1) Short term—required for decisions being made now or within the next one to two years.
2) Intermediate term—required for decisions that will be made in the next five to six years, including adjustments in decisions made in the short term.
3) Long term—data and information required for "fine tuning" of previous decisions.

Under this strategy, data and information needs for extended jurisdiction could be handled in the following manner:

Short Term

Interdisciplinary task groups of scientists and others involved in sport and commercial fisheries could be established to address immediate data and information needs for decisions that are being made or will be made within one or two years. These groups would be made up of experts from federal and state fisheries organizations, universities and user groups. In some instances these groups might be organized on a species or combination of species basis. In other cases the groups could be organized on a geographic basis.

The activities of these groups should be coordinated and directed by a few individuals who could attend some deliberations of all groups. The groups would have responsibility for surveying existing data and information for decisions at hand. In some instances the groups could utilize available bio-economic models for analyzing the implications of alternative actions. These groups could be asked, for example, to use their accumulated knowledge and available data and models for identifying preliminary estimates of allowable catch levels and (where appropriate) the excess effort on the stocks included under U. S. extended jurisdiction. They could also make initial estimates of the capacity of the U. S. fleet.

These results could then be used by the managing agencies as a guide to their decisions and negotiations. The latter is important because it is probable that removing any foreign fishing will require negotiations with the foreign governments currently fishing in the U. S. extended jurisdiction zone. In some cases, task groups might address the issue of the initial license fees or rent to be requested from the foreign vessels.

The important point here is that the task groups would not be policy groups. Rather, they would simply be performing the tasks of data and information collection, analyses and dissemination. Tasks which an established information system would normally perform, but which will not be performed otherwise in view of the short time period available for the decision making. An extremely important role of these task groups would be to identify priority areas for the intermediate term data collection and analyses.

Intermediate Term

Information acquisition under this category would fall more into the "normal" areas of Federal and State agency and university data gathering and research. Efforts should, however, be directed toward information needed to improve upon decisions made in the short term.

One of the activities under this category would be the initiation of a monitoring system of foreign and domestic commercial catches and sport catches. This would imply the mandatory reporting by all allowed to fish within U. S. jurisdiction. This monitoring system, in combination with the models discussed below and other data, could identify the effects on the dynamics of the resource, economic, and social factors of initial decisions made in the short term.

The intermediate term activities should also include the development of new techniques such as multi-species dynamic models, integrated across the various resource-economic-social issues. Gulland and Boerema (1973) in discussing how a "correct" catch can be determined, stated that "at present there is not a single theoretical model for determining this (correct) catch that combines all the desirable features of (a) being readily understandable to decision makers, (b) describing and predicting in a realistic manner, and to an acceptable degree of precision the events in every fish stock to which it may need to be applied, and (c) capable of being applied to a specific fishery without great demands in data and analyses." Recognizing that it may not be possible to design a workable model that accomplishes all things implied in the statement by Gulland and Boerema, there are certainly improvements in and extensions of existing models that can and must be made. These improvements would allow for better measures of interactions among species and natural fluctuations in stocks. (See Strand 1974)

The Intermediate Term should also include considerable sensitivity testing through models in order to evaluate certain parameter estimates. For example, parameter estimates could be varied in order to determine the biological, economic and social implications of errors or mis-specifications in the estimates (See Gates and Norton 1974, for example). Such tests would represent an important guide to the data and information acquisition under the Long Term "fine tuning" phase.

Long Term

This category should include the systematic gathering of data to be used in refined models and analyses. The results of these analyses could be used for "fine tuning" of previous decisions. This could include, for example, adjusting domestic and/or foreign fishing effort and catch annually on the basis of predictions of abundance.

It is important to establish the activities under this category as soon as possible in order to develop effective time series of data. However, this should be done carefully in order to assure that proper data series are initiated. To a great extent, data and analyses needs in this long term category would have to be left open at this point and determined only as the short term and the intermediate term decisions are made and their effects analyzed.

Summary

Herfindahl (1969) indicated that just as the natural resources are considered as part of the "capital stock" of a nation, so should the information about the natural resources be considered as part of the capital stock of this nation. It is important, therefore, to develop and use this information in an efficient manner. This is certainly the case with scientific and data needs for extended jurisdiction.

Decisions on fishery management matters under extended jurisdiction will require a wide range of data and information. Many decisions, however, will have to be made before the results of new information systems can become effective. Therefore, it is important to develop a strategy of making decisions in a way that will allow future flexibility. The information system must be consistent with the decisions process. For this reason, I believe, the scientific and economic data needs should be categorized as short term, intermediate term and long term. The data and information in each of these categories can then be used to continually adjust and improve initial decisions relative to the use of fishery resources under extended jurisdiction.

This is one approach that could provide for an efficient and orderly manner of assuring that the best possible data and analyses are available at the time needed by decisions makers. Likewise, it could help to prevent duplication and waste in data generation that could easily develop as we move toward answers to the varied and important issues facing us under this new fisheries management arrangement.

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Enforcement and Surveillance Needs Under Extended Fisheries Jurisdiction

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Development of Fisheries Jurisdiction

Until 1964, the only Federal law of general applicability preventing foreign fishing in waters off the coast of the United States was the Nicholson Act.[2] That law limited fisheries within territorial waters (zero to three miles) to United States vessels. Other than a prohibition on the direct landing of fish by foreign flag vessels, the law was without penal sanctions. Enforcement upon foreign vessels fishing in United States waters was therefore limited to warning the offenders and escorting them beyond the three-mile limit.

In 1964, the so-called "Bartlett Act," sponsored by the late Senator from Alaska, made it unlawful for foreign nationals to fish in United States territorial waters.[3] It also provided the framework for similar prohibitions in an expanded United States fisheries zone and prohibited the taking by foreigners of any Continental Shelf fisheries resource, except as expressly provided by an international agreement with the United States. In 1966, the United States established a three to 12 mile contiguous fisheries zone.[4] Unauthorized foreign fishing in this zone was subject to the provisions of the Bartlett Act. In 1968, certain species were declared as constituting Continental Shelf fisheries resources which appertain to the United States.[5] Thus, it was not until the last decade that the United States achieved jurisdiction to (1) effectively prohibit foreign fishing within the territorial sea (zero to three miles), (2) control foreign fisheries within the contiguous fisheries zone (three to 12 miles), and (3) regulate foreign taking of selected sedentary fisheries resources from the adjacent Continental Shelf.

Obviously many of the marine fisheries resources of concern range far beyond the political boundaries of jurisdiction established by a coastal nation. In such cases, the United States has increasingly sought safeguards on the high seas through bilateral or multilateral agreements with other nations. The necessity for conservation of high seas fisheries resources has been long recognized and most of the existing multilateral agreements are the result of International Con-

[1] In the absence of the authors, this paper was presented by Dr. Robert F. Hutton, Associate Director for Resource Management, National Marine Fisheries Service.

[2] Act regarding Privileges of Vessels of the United States Employed in Fisheries (46 USC 251-252).

[3] Act Prohibiting Foreign Fishing Vessels in the Territorial Waters of the United States (16 USC 1081-1086).

[4] Act Establishing a Fisheries Zone Contiguous to the Territorial Sea of the United States (16 USC 1091-1094).

[5] Current list is Living Organisms of the Continental Shelf (50 CFR 295).

ventions far predating the Bartlett Act. One of the first, and possibly the most successful of these, was the North Pacific Fur Seal Convention signed in 1911 by Great Britain (for Canada), Japan, Russia, and the United States. The Fur Seal Act implemented the Convention on the part of the United States.[6] Other longstanding conventions signed and implemented by the United States included the Halibut Convention of 1923 with Canada, the Sockeye Salmon Fisheries Convention of 1930 with Canada, the Whaling Convention of 1937 with 16 other nations, the North Pacific Fisheries Convention of 1952 with Japan and Canada, the International Convention for Northwest Atlantic Fisheries of 1949 with 13 other nations, and the Convention for the Establishment of an Inter-American Tropical Tuna Commission, signed in 1949 in which the United States and six other nations now participate.[7]

In addition to the older international conventions, which are supported by enabling legislation in the United States there are presently 12 more recent bilateral agreements with other nations. They are in the form of executive agreements which do not require advice and consent of the Senate. Executive agreements in the fisheries field are relatively new, the first being initiated with the Soviet Union in 1964, governing certain aspects of their fisheries off Alaska. Since that time, agreements of this nature have been concluded with many of the nations fishing off United States shores and they establish some conservation measures on fisheries off the coast of the entire United States.

There are major constraints upon the extent of controls on the high seas that can be obtained by the United States through bilateral or multilateral agreements, since such measures must be negotiated and their acceptance is voluntary. Adherence to the resultant provisions of executive agreements is not required under law by United States fishermen since the agreements per se are not binding on United States fishermen. Adherence by foreign fishermen is often quite lax because all the executive agreements reserve for the flag government the prosecution of violators and most of the conventions have similar reservations regarding seizure of violators. The exercise of these exclusive enforcement obligations by the foreign nations is, as a general rule, inadequate in the view of the United States. Largely because of these inadequacies, the agreements have been ineffective in preventing foreign fishermen from severely depleting a number of fish stocks off the United States coast.

Enforcement and Surveillance

Program to Date

Federal fisheries enforcement, once the sole responsibility of the United States Revenue Marine Service (1790), is now a concurrent responsibility of its successor agency, the Coast Guard, and of the National Marine Fisheries Service

[6]Initial legislation enacted in 1912. Current legislation is Fur Seal Act of 1966 (16 USC 1151-1187).

[7]Current implementing legislation (as amended) are the North Pacific Halibut Act of 1937 (16 USC 772-772j), the Whaling Convention Act of 1949 (16 USC 916-916L, the North Pacific Fisheries Act of 1954 (16 Usc 1021-1032), the Northwest Atlantic Fisheries Act of 1950 (16 USC 981-991), and the Tuna Convention Act of 1950 (16 USC 951-961) respectively.

(NMFS). The modern era of fisheries enforcement and surveillance began in 1959, as foreign fisheries were expanded off the United States coast, mainly by the Soviet Union and Japan in the Pacific Ocean and by the Soviets off the Atlantic coast. Faced with the increasingly evident threat to offshore fisheries resources posed by foreign fishing fleets, the two United States enforcement agencies initiated a system of joint fisheries patrols. Patrol planning is done jointly at the national and regional levels and Coast Guard ships and aircraft on fisheries patrols are accompanied by NMFS enforcement specialists who provide fisheries expertise. To keep pace with the growing foreign fisheries and the obligations imposed by additional laws and agreements, the joint Coast Guard-NMFS patrols have been increased from a minor level in 1959 off Alaska and New England, to year-round patrols along the entire United States coast. In calendar year 1974, NMFS agents logged nearly 1,400 days, 250,000 miles at sea, and flew over 3,300 hours covering over half a million miles on joint NMFS-Coast Guard fisheries patrols. It is generally accepted that the joint enforcement efforts were insufficient for several years, but reached a point of reasonable effectiveness by 1972. (Fidell 1974).

Planning for the Future

Because of the depleted state of many of the fisheries resources off the coast of the United States, we can assume that rather drastic restrictions on fishing will be necessary in virtually all areas in order to stabilize or rebuild some of the populations that have been, and are being, overutilized. While some stocks can be considered depleted, the total harvestable biomass may preclude a total closure to fishing in certain areas. In most cases, coastal stocks will probably stand more fishing pressure than can be immediately exerted by the United States fishing fleet. The conclusion is that, under extended jurisdiction, some fishing by foreign nations would be permitted, but under strict regulation by the United States.

The complexity of the management plans, and the regulations adopted to implement them, will dictate the future enforcement and surveillance equipment and personnel needs of the Coast Guard and NMFS. For example, a quota or an allowable fishing effort on certain species could be enforced in more than one way. United States observers could be placed on foreign ships to keep a tally of species and amounts captured; or foreign ships could be required to check in to a United States port for inspection prior to fishing and to check out of a United States port before departing from the fishing area or transferring any fish to a carrier vessel. In the first example, trained observers would be necessary on a large number of foreign fishing vessels involved in the fisheries to ensure that the sampling was representative of the true catches. In the second, two or three trained persons probably could handle the entire inspection program for a given area. In both cases, continual surveillance of the fishing area would be required to ensure that vessels licensed for the fishery were in fact the only ones involved in the fishery. In any case, the enforcement schemes utilized will of necessity be a part of the overall management system.

The present Coast Guard-NMFS enforcement and surveillance program covers to a large extent all of the major coastal fishing areas off the United States. Implementation of a management plan covering coastal stocks on our adjacent

Continental Shelf would, however, undoubtedly require some increase in aerial patrol time and an increase in surface vessel time could be expected if more at-sea boardings and inspections by United States enforcement personnel were to be provided.

Anadromous species such as salmon that move in and out of a zone of extended jurisdiction, or perhaps spend much of their life well outside of any proposed extended jurisdiction scheme, present an entirely different problem. In such cases, the problems of enforcement and surveillance increase substantially. Many Pacific salmon spend a good share of their life cycle well over 200 miles from shore and are vulnerable to gillnet and hook and line fisheries 400-500 miles off shore. To adequately patrol these areas and prevent a significant fishery by a foreign nation could require a tremendous increase in both aerial and surface effort.

If Pacific and Atlantic anadromous species were to be managed as a multi-nation resource on the basis of a treaty similar to the North Pacific Fisheries Convention, patrol problems would still encompass the same geographic areas, but could be expected to be shared with those other nations involved in the convention, as we now share some salmon enforcement with Japan.

Highly migratory oceanic fishes such as the tunas present yet another problem. Obviously, no one nation can control or manage these resources, and if they are to be managed and fished in a rational manner it will be through an effective multi-nation agreement. A multi-national agreement that reserves enforcement on a particular nationality to the officials of that nation, however, is likely to be relatively ineffective. Such a situation is currently apparent in the difficulties which have arisen over non-enforcement of recommendations of the Inter-American Tropical Tuna Commission by certain member countries. At-sea patrol of a far-distant tuna fishery appears to be an almost impossible task. However, possible solutions involve mandatory position reporting schemes, perhaps coupled with automatic position signaling devices installed on all vessels licensed with the fishery, and mandatory inspection of vessels upon arrival in port or prior to trans-shipment to a cargo ship. The United States presently uses a system of radio reporting and triangulation for enforcing the provision of the regulations recommended by the Inter-American Tropical Tuna Commission and adopted by the United States on the United States yellowfin tuna fleet in the convention regulatory area.

The matter of recreational fisheries as it relates to extended jurisdiction is somewhat similar to that of commercial fisheries. This is in part due to the fact that some species (i.e., bluefish, cod, flounder, haddock, hake, mackerel, tuna, etc.) are fished by both commercial and recreational fishermen. Recreational fisheries problems relate not only to enforcement and surveillance, but also to allocation between commercial and recreational harvests and between different types of recreational harvests. The matter of recreational fisheries management will continue to be a major problem area for the manager. It will remain, for a while at least, a murky area difficult to assess.

Conclusions

To date, United States fisheries jurisdiction has been limited to 12 miles offshore and to certain secondary species on the adjacent Continental Shelf.

Safeguards or controls for species of concern on the high seas beyond United States jurisdictional limits have been sought through multilateral or bilateral agreements. That system of regulation has not been adequate to prevent depletion of a number of fish stocks off the United States coast. Strengthened management controls are expected to become available to the United States through some form of extended fisheries jurisdiction.

Until the final extent of extended jurisdiction is known and until a basic management plan with the requirements for regulation is formulated, an accurate appraisal of future needs for enforcement and surveillance is extremely difficult to make. Although a reporting and monitoring system will furnish information needed to supplement manned patrol efforts, an increase in the number of enforcement personnel will be necessary to assure the maintenance of an effective enforcement and surveillance capability.

For the bulk of the fisheries, which are those involving coastal resources, little increase in the geographic area patrolled will be required, although intensified surveillance, primarily by aircraft, will be desirable, and an increase in surface observers will be required. If at-sea boardings are to be a mainstay in the enforcement of a management plan, a considerable increase in surface vessel time will be required.

A requirement that the United States protect anadromous fishes of United States origin from interception throughout their vast range could necessitate a substantial increase in patrol effort. The cost effectiveness of such patrols would probably be the deciding factor in how much could be done. The amount of patrol required would also depend upon the amount of resistance or cooperation from countries taking anadromous species of United States origin.

Highly migratory oceanic fishes such as tuna will require an entirely different enforcement scheme, probably based on sophisticated positioning devices and rigid on-shore inspection of vessels by all of the nations involved in the fishery.

Finally, it should be noted that NMFS is appointing an internal Task Force headed by Dr. William F. Royce, to develop a program with which the United States can assume fisheries management responsibilities under extended jurisdiction. Planning for enforcement programs will be an integral part of the Task Force's job. This task is viewed by NMFS as, perhaps, the most important thing it will be doing during the next few years.

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Maximum Sustainable Yield: An Obsolete Management Concept

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The world's rapidly growing human population places ever-increasing demands on the world's living marine resources—for food, other animal products, and other values. The United Nations Environment Conference, the World Food and Population Conferences of 1974, and the fisheries aspects of the current Law of the Sea negotiations emphasize the growing international recognition of the problems. At the same time, it is clear that our past approaches to management of these resources have led to gross depletion of many of them rather than to sustained or improved yield of their values.

The world's whale populations are an archtypical example where one stock after another has been overharvested into commercial or biological extinction—to the point where all eight forms of the world's great whales are now on the U. S. Endangered Species list. Many individual stocks of finfishes have been grossly overfished. Even the total commercial fin fisheries illustrate the point. In 1950, about 21 million tons of fish were caught in the waters of the world. Rapidly growing fishing fleets with increasingly effective fishing technology raised the catch to 40 million tons by 1960 and to 70 million tons by 1970. Then the catch began to decline, and by 1973 had dropped to 65 million tons.

The two principal factors involved in management of any resource are the institutional arrangements for management and the scientific basis which the institutional arrangements are intended to implement. Institutional arrangements have been the subject of much of the previous discussion in this session and are being addressed in the Law of the Sea negotiations opening today in Geneva. I shall address the scientific basis.

The Concept of Maximum Sustained Yield (MSY) has been the basis for commercial and sport harvest of most living marine resources—fin fishes, marine mammals, and invertebrates. It is explicitly stated or is basic in many international agreements and treaties, and is at least implicit if not the explicit basis for local and national regulations. It has been rather uncritically accepted as established doctrine for decades by managers of these resources and policy makers, and is basic in the approach of many nations to fishery aspects of the current Law of the Sea negotiations. However, there is serious scientific question about the validity of the concept and its usefulness. There do not appear to be any examples of its successful long-term application to a resource, while there are examples of its failure and the consequent commercial loss of the species involved. The concept may have served a useful role in the evolution of fisheries management, but our knowledge has now passed beyond that point.

MSY is no longer appropriate or adequate, and it is long past the time when the world should have a better basis for management of marine resources.

It should be emphasized that I am not questioning the *generalized goal* of maximizing yields of the values of a resource on a sustained basis. My remarks are directed to the *specific formulation* of MSY as it has been developed and applied to management of many living marine resources. MSY, as I am using it, is the concept of management based on a simple S-shaped population curve, applied to a single species or stock without reference to other components of the ecosystem. It assumes that there is a well established, fixed relationship between a resource stock level and annual sustainable harvest or yield, and it seeks to achieve the highest annual harvest or yield, in numbers of weight, which theoretically can be sustained without reducing the reproductive capability of that stock. Management based on MSY seeks to manipulate numbers of the population to achieve and sustain the stock size at MSY level, i.e., the stock level at which the theoretical maximum harvestable recruitment to the population occurs. This level is determined from a simple, usually logistic model, based on the simple S-shaped population curve.

The MSY concept is based on the assumption that an unexploited population exists at an equilibrium density, maintained by density dependent factors—in terrestrial terms, it is at the carrying capacity. When the population is reduced and the density lowered, recruitment rates increase and exceed rates of loss. The difference between the recruitment and loss represents the number of animals which can be removed through exploitation, without reducing the population further, and if that number is removed annually it is assumed that the population will be stabilized at a new, artificially induced equilibrium density.

Under a strict, abstract logistic curve condition, the population density producing the greatest harvestable surplus—therefore the MSY level—is one-half the unexploited population density. In the real world, however, population dynamics of species do not appear generally to follow the straight line relationship, and the theoretical MSY level would range from roughly one-third to over two-thirds of the unexploited level. Consequently, because of that factor alone, MSY based on a simple logistic curve is not valid for most animal populations.

However, regardless of whether or not a logistic model is used, there are much more fundamental problems with the application of the concept. From an ecological point of view, the use of MSY on the basis of a simple model applied to a single species is almost certain to fail because it does not take into account the many factors affecting or operating on the species itself, nor the interrelationships between the species harvested and the other species and elements of the ecosystem.

The factors operating on the species itself—which MSY ignores—include: effects of altering the age or sex structure of the species; impacts on social and behavioral organization; and stochastic or cyclic changes in population level.

To illustrate with one example: MSY usually assumes a purely numerical model of a population system in which all individuals are treated as being equivalent. It usually does not make allowance for age and sex differences, nor the impact of exploitation on age and sex structure. In a population which requires several years to reach reproductive maturity, harvest usually truncates the age composition. Both random harvest, and harvest which selects for larger and therefore usually older individuals, skews the population structure, leaving a higher proportion of younger, non-reproducing age classes. This of course, lowers the potential recruitment. In theory, a heavily exploited population could have its age structure so skewed to young age classes that the reproductive rate could drop below maintenance levels.

The MSY models do not make any allowance for impact of exploitation on behavior, including factors such as the possible reduction in reproduction caused by disruption of social structure; nor the possible effect which the loss of group leaders, experienced in foraging or migration, may have on group survival. MSY further assumes stable population levels, affected only by human exploitation. Yet all population densities fluctuate to some degree, and there are very significant stochastic or cyclical changes in many species.

The ecosystem relationships ignored by MSY include: natural or induced changes in carrying capacity, such as through climate, pollution, or competition; responses within a trophic level, e.g., those of competitive species; responses between trophic levels, e.g., those of prey to carnivore reduction, or of carnivores to prey reduction; and impacts on symbiotic or commensal relationships. MSY only considers the effects of exploitation on an individual stock or species in isolation, and fails to provide any basis for predicting the first or second order effects on, or from, other components of the ecosystem. Where several species in the same trophic level are involved, harvest of one to a theoretical MSY level may result in other species "moving into the niche" of the harvested species and fully utilizing the resources—food, space or whatever—that were formerly utilized by those removed by harvesting. This has the effect of establishing a new carrying capacity for the exploited species, at the level originally calculated as MSY level. With the stock at carrying capacity, there will be no harvestable surplus, and if harvest is continued at the originally calculated MSY rate, the population will be rapidly further depleted.

This is only one example of the type of first order responses ignored by MSY. There will also be changes in more remote parts of the system as a result of first order impacts. No species exists in isolation, and effective management must take the ecological relationships into adequate account.

Effective management must also take into account the status of the data base. For most aquatic species the data are fragmentary at best, derived from catch figures and relying heavily on assumptions about population levels as well as population dynamics. P. A. Larkin (pp. 189 et seq. in Rothschild, B. (ed.) 1972, *World Fisheries Policy,* Univ. Washington Press) notes that:

"We must first acknowledge that, for the most part, our theories of fisheries management are essentially based on circumstantial evidence. . . . For example, for many of our fisheries the relation between stock and recuitment "remains obscure," by which we mean that it is the same relation that one would observe if there were no relation. In other instances it is difficult to estimate fishing efforts because of rapidly changing fishing technologies. The consequence of harvesting mixed species continues to haunt us like a can of many kinds of worms. Even on relatively basic matters such as the genetic consequences of harvesting we are much in the dark. . ."

He concludes that:

"In brief, our fisheries literature is largely unscientific in the strict sense of the word, and our fisheries management is unscientific in almost any sense of the word."

Larkin is an established voice within the marine resource profession. I have approached the problem from the standpoint of an originally terrestrial population ecologist who has become deeply involved with international fisheries matters. But my experience strongly corroborates his observations. Much of what I have seen of the allegedly scientific base for marine fisheries management consists of more or less sophisticated statistical calculations applied to a fragmentary and non-random data base, on the basis of gross and often ecologically unjustifiable assumptions.

Yet fisheries management appears to have had remarkably effective public relations. For the most part, policy makers here and abroad—and indeed, all too many of the managers themselves—treat it as an exact science, accept the MSY concept as gospel, and take the population figures and numerical quotas based on it as precise, established fact. Worse, there is real danger that MSY and the management problems—indeed obstacles—that it embodies, will become set in concrete as international law through the current Law of the Sea negotiations. The original U. S. position defined "full utilization" of fisheries and conservation in terms of MSY. We have amended this slightly, but our negotiators in Geneva today still adhere to MSY because it is "accepted," "understood," "it is simple," and "the biologists support it."

In my view, biologists have a responsibility to do their part to set this record straight. To help accomplish this, we have organized a program of consultations and workshops, bringing together many of those involved in the management of and research into living marine resources, to critically examine the concept of MSY and to develop recommendations for a more appropriate management base. This effort is sponsored by the Council on Environmental Quality, The Ecological Society of America, the International Union for Conservation of Nature and Natural Resources, The Smithsonian Institution, and the U. S. Appeal of the World Wildlife Fund. Although the program is not yet completed, several preliminary conclusions can be made:

1. MSY is not an appropriate or scientifically justifiable sole basis for management. Indeed, no simple formula or simplistic slogan can be.

2. Any effective management must take into account not only the species or stock involved, but also the ecosystem, and should assure that: the positive values of the resource, commercial and otherwise, are maximized on a continuing basis; the health of the ecosystem is maintained in the sense that risks of irreversible change or long-term adverse effects are minimized; a variety of present and future options should be maintained; management decisions should be conservative to allow for a margin of error, likely to result from inadequate data and imperfect institutions; and the privilege of exploitation of a living marine resource carries with it the responsibility and obligation to assure that data on the effects of exploitation are gathered, analyzed, and made public.

Rational management of living marine resources will require an approach along these lines. In view of the significance of these resources it would be inexcusable to perpetuate an unsound management regime. Yet until we recognize the inadequacies of MSY and develop and accept a more suitable basis for management, we will simply perpetuate the mistakes of the past.

Discussion

MR. BUD BODDY [Alaska] : I do not have a particular question but I should like to make a few comments if I may.

I am particularly pleased with the last speaker's approach and observations regarding the present policies to determine what amount we should be taking on a safe basis. We should all take this seriously and give every effort towards solving this problem and coming up with better approaches than we presently have.

With regard to the paper as presented by Dr. Hutton, I would like to emphasize what the authors have said and add perhaps a little more. Certainly one of our problems and one of our great needs in dealing with this problem of international fisheries and local fisheries is the matter of surveillance. This has been very obvious, as you know, for many, many years, and it hasn't gone unobserved by the Alaskan people who are representing the various agencies of Alaska. However, only recently have we gotten any show of determination to do something about it.

One thing that I have noticed is the Coast Guard have brought in their high endurance cutters, which have the capability of moving in this hostile environment—not only moving in it but being able to keep up and maintain a surveillance—and the capability of catching offenders. This has been one of our big problems because these foreign fishing vessels, insofar as speed is concerned, have far outstripped anything that we have had in the past. Therefore, the use of these new, up-to-date cutters has been of tremendous advantage to us. The only other observation I would like to make is that we need more of them and we also need more airplanes.

I think, in relation to Alaska, that most of us realize here that we are not dealing in a normal environment—we are dealing in a very hostile environment and, therefore, you have to have specialized equipment and trained individuals and crews that are capable of operating under the same conditions that these foreign vessels are, even on a year-round basis.

I don't know what the numbers of vessels are in the North Pacific at this time, but I would venture to say it is better than 300 and will run as high as seven to eight hundred under more favorable weather conditions and during periods of high opportunity for taking some of these marine resources.

There is also one other thing I would like to make an observation on, and that is the decline of our inland resource, the halibut. When we think of the halibut and try to keep up with this matter of harvest, perhaps a reduced season will take care of it, but then there was an inner dependency here that eventually caught up to us. We do have a bad situation in this case and let's attempt to do something about it.

CHAIRMAN POLLOCK: Thank you very much, Bud. Your comments were appreciated.

As an Alaskan, I was thinking that just in that one enormous state we have something like 43,000 miles of coastline, and when you talk in terms of going out to an extended jurisdiction of 200 miles, we have, I understand, something like 2 million square nautical miles of additional area for the Coast Guard to survey and enforce. It is an enormous job. I think the Coast Guard has done a terrific job with the resources they have had over a period of years. I also think this extended jurisdiction is going to create some new and really enormous problems in relation with doing an adequate job on our supply lanes.

DR. JOSEPH: I wanted to comment on the concept of maximum sustainable yield. I wanted to clarify that this doesn't apply to logistic models as yet—it applies to a whole array of models, including simulation models. What it implies is that we, over the long term, want to get the most protein out of our animal population. I agree with what you have said, Dr. Talbot, but I also think what we need to do is look at the populations of fish in the units in which they occur, the associated animal populations, and the oceanography associated with these animals. But what concerns me is that if we begin knocking maximum sustained yield as an obsolete concept, we do not have presently available to us any other tools with which to manage the fisheries of the world.

Now, we have often heard of economic rent from a resource. Well, what level of harvest do we need in order to keep a population? Insofar as I know, there is no population of animals we are presently exploiting on a large scale in which we can differentiate the level of the harvest at the maximum sustained yield, whatever people think that to be. Then we have these maximum economic yields, and what concerns me is that when we get involved in saying that we need new systems, new biological concepts for management, what we are going to do is merely provide another fence for scientists and administrators to get behind so that they do not have to manage any resources.

DR. TALBOT: A point very well taken. It is clear we need to have better systems and that we simply must not take a negative point of view and tear something down without having something better to replace it with.

New Requirements and Approaches for Fish and Wildlife Planning

Chairman:
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Discussion Leader:
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Planning for Wildlife in Canada

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I propose to disobey all the instructions given to speakers in this Technical Session, apart from adhering to the time limit. The Program Committee saw a need to look for, and at, new requirements and approaches for fish and wildlife planning; to advance new knowledge, stress potentials for wise utilization of renewable natural resources and stimulate constructive follow-up actions. They sought a thorough revision of overall planning requirements, specific criteria used to generate a satisfactory plan and examples of acceptable plans of different types. I shall not seek to answer any of those calls, except in oblique and devious ways.

The title I put on the preliminary abstract of this paper was "Wildlife planning for Canadians." The title assigned on the printed programme is "Planning for Wildlife in Canada." Why the change was made I do not know, but it has the merit of encouraging me to concentrate on saying what I believe to be true, rather than trying without conviction to be useful.[1] For me, geese are the most important animals in the world. I shall try to speak for them, recognizing that they in turn represent only a small part of the full spectrum of wildlife.

We see human beings above all as meddlers, trying continually and on an ever-increasing scale to mess up the biosphere. Often, in fact, benefiting some of us, though usually by inadvertence. Often, also, imprudent predators, with needless and heedless blood on their hands. (We acknowledge that hunters formed until recently the most important lobby for the preservation of some kinds of wildlife.)

[1]My use of the first person should make clear that I am not necessarily presenting the official views or policies of the agency by which I am employed. 'I' refers to me, 'we' to geese.

As geese, what we (just like you) always want to know is "What's in it for us?" We are on the whole very much abler than you in selecting where we can live most comfortably and successfully, because our perceptions of our needs are more sharply focused than yours and uncluttered by economics and other irrelevant abstractions. We make our choices on the basis of what we see and hear, constrained as you are by innate ethological programming and helped or hindered, as you are, by some traditional wisdom transmitted through the agency of strongly-bonded families and other larger and looser social groupings.

As we look around North America at what man has done to the country, much of what we see is good. For geese there has probably never been a better time to be alive, at least if merit is to be measured by quantity, in the North American way. Agricultural man, and especially the mid-20th century version of him, has been kind to us. High-yielding grasslands and cereal crops, heavily fertilized and harvested mechanically, provide us vast supplies of food. We have still not multiplied sufficiently to outgrow these in the human way, but most groups of geese here and in Europe would have to assent to the politically unfortunate claim of Mr. Harold Macmillan (then British Prime Minister) in 1963 that "You've never had it so good."

Of course some of our wildlife colleagues, who like trees and cover and complexity of landscape, find less to enjoy in the broad swath of agricultural advance. But you can't please everybody and, in the democratic way, it is the big battalions that count the most.

Of course, too, there are sad blots on the landscape even for geese. Many of them are man-made and most of these have grand official titles, such as National Waterfowl Refuge or Federal Migratory Bird Sanctuary or National Wildlife Area. These are odd places, both for what they offer to geese and for what they show us about the confusions of the people in the bureaucratic backwater of wildlife management. These sites were set up for and have been managed to improve the welfare of the geese and other wildlife they were designed to hold and attract. In practice they have often led to such dubious benefits as introducing us to the qualities of crowded urban living and welfare handouts or to the consequences of the firing line, a dense ring of hunters around the perimeter of a sanctuary.

You, as administrators, have gradually come to see that the great spectacles produced by concentrations of waterfowl at refuges are of interest to far larger numbers of people than those who want, or could safely be let loose, to hunt the birds in the vicinity. This realization, coupled with the recognition that large masses of waterfowl create problems by their size, such as increasing the risks of serious damage to crops in the neighborhood, is leading to extensive revision of management plans. What so often seems to be lacking in your plans is the appreciation of the nature of the interactions between people, the land and wildlife. You assert that sets of objectives and goals can be defined for an organization and its management units and that to select and then to achieve a target of x goose days of refuge use or y man-days of recreation in a hunting management zone is the right way to run the country, or at least the bit you are responsible for.

Geese don't believe in management by objectives any more than in flyways or national or provincial boundaries. We are opportunists for whom the weather and the climate are still the most influential factors (in the short and long-term respectively), in determining how many of us can be where, and when. Because we make no pretensions to being able to affect the weather, our strategy is always to ride with the punches, rather than to attempt to impose arbitrary rules on the world in which we live without the capacity to secure compliance. Wildlife and other land-use managers can of course impose rules upon people, but you cannot ensure our compliance with your plans, if only because most of the decisive events occur beyond your range. Those geese nesting in the Canadian Arctic have had a rough time from the weather in the last 15 years, with late-lying snow and several miserable summers often making nesting difficult or impossible and the rearing of goslings harder. Yet we have triumphed over the difficulities, thanks in part to American bounty in providing plenty of winter food, but in greater part to our individual physiological adaptability and our demographic and social structures. Your own individual lives and social organizations have such adaptations too, of course. The point is that wildlife managers who wish to play god are hopelessly outclassed and outgunned by the forces of nature. That is just as well, for if we had to rely on your skill and judgement to ensure our survival we would all be rare and endangered species by now.

That might in turn bring you wildlife managers back successfully into business. When a species is recognized as endangered, that implies that the animals are at some exceptional disadvantage with respect to their environment. It may then be comparatively easy to detect what is wrong and to do something to put it right in a small way, if the cause of the trouble is itself due to man, as is most often so. It is harder to do right by those of us in middling plenty — the silent majority, perhaps — while the very abundant usually incur your wrath, as pests, when we start to compete effectively with you for resources that you covet or have worked to produce.

If there is one notion that geese cannot abide, it is that of the sustained yield. You will recall "Behold the fowls of the air: for they sow not, neither do they reap, nor gather into barns (St. Matthew, vi. 26)." As migratory birds we are perpetual fugitives. All of us die, as do all of you. Most of us die before reproducing ourselves (as has been true of man until very recently). It can be argued that the presence in our population structure of "non-breeding" stocks as a cushion against adversity can provide you with what you call a "harvestable surplus." What we will not concede is that you have any right to rely on us to yield such a surplus, or to determine what size it should be. In the present state of your ignorance you have no way of telling, for more than a very few migratory populations (and rather more sedentary ones), what surplus is available or how it can be utilized without waste or harm to the perpetuation of the stock. Your techniques of population measurement are crude, your control and measurement of the kill is cruder still. You tinker annually with hunting regulations yet, characteristically, you spend little effort on seeing just what the effects of your tinkering have really been.

To sum up with respect to the guidelines for this session put forward by the Program Committee, geese see no need for — because they anticipate no benefit from — national or continental long-range wildlife and outdoor recreation plans, or the formulation of wildlife program and project plans required to meet goals under management by objectives. Plans for threatened and endangered species may have a place, if they are based on adequate ecological understanding and include ways around or through the bureaucratic and legislative mazes which tend to prevent wrongs being righted.

Geese are not unappreciative of human efforts on their behalf, but planners occupy only minor places in their pantheon. They need sympathizers and enthusiasts. Sympathizers are those scientists and artists willing to look hard at how geese use the fluctuating and scattered resources open to them and to use their intellects and imaginations on what they and others have observed. Observation and thinking and creative writing and painting being activities that are hard enough to make most people uncomfortable, we can be sure that there will never be many good sympathizers. Enthusiasts for geese will always be scarce too, because ardent zealots are also a minority and there are so many causes amongst which their energies have to be shared. Enthusiasts are, of course, an abomination to bureaucrats; trouble-stirring and time-wasting. But as human achievement is powered by the irrational, if wild animals are to flourish in Canada in this generation and beyond, they must hope that reasoned human planning will not prevail.

The role of wildlife biologists in planning, if they wish to help wildlife more than themselves, is to go underground, to infiltrate those occupations, industries and agencies that have major effects on land use. It is of course comically incongruous to envisage the archetypal wildlife biologist, with his attachment to hunting, fishing and other demonstrably virile occupations, allying himself with or imitating the disciples of non-violence. But in these enlightened days, when the missionary position is obsolete and no bedfellows are too strange, why ever not?

I have been trying to say that in many cases, direct actions, such as acquiring and managing wildlife refuges, often turn out as examples of being kind in order to be cruel (to invert a familiar phrase). There are two more themes I want to promote. The first is the obverse of the one just stated: it will be rare for wild animals to provide spectacular responses to management actions, unless wildlife managers grow very adept in anticipating trends amongst those animals and their environments. If managers are clever they will only try to do what the animals were going to do anyway, and hope that no one will notice that this makes their own activities redundant.

More seriously, I want to take issue with a part of one of the most succinctly informative accounts of the role of planning for wildlife in the larger context of land use planning that I have ever heard, given by J. W. Maxwell (1972) to the 35th Federal-Provincial Wildlife Conference in Toronto, in July 1971. Perhaps I liked his paper best of all where it agreed with my own thinking in saying that the clients of wildlife specialists are "the nation's fauna." But for the moment, I want to focus on the classification of land-use determinants that Maxwell used. Having illustrated a wide variety of factors that help to establish what kind of use will be applied to a given piece of land, he argued that it is convenient to group them into three classes: physical, economic and social.

"The physical determinants of land use include those characteristics of land that are determined by *physical location*, for example, climate and geology. The characteristics of land that are based on these fundamental relationships are, for the most part, fixed and inscrutable in terms of man's planning horizon. It is they that largely determine the life systems and basic ecological characteristics of any given area. They present both opportunities and constraints to man's land-using activities." Maxwell went on to say "Unlike the physical land-use determinants, the economic factors are very dynamic." (Maxwell 1972, p. 36).

He is wrong. The physical determinants are very dynamic too. In a country such as Canada, climate is a perpetually changing and very powerful determinant. In the next few years we are going to see a fascinating struggle in the prairie provinces, with farmers trying to produce more food using relatively less imported energy (in the form of fuel and artificial fertilizers) in a temporarily less favourable climate. The course and outcome of that battle will have great effects on migratory waterfowl and other wildlife. Wildlife agencies will need to be very astute to get the best deal for their clients without being labelled enemies of the people. Futher north, in the large part of the country still sparsely settled or used by man, wildlife will be struggling hard against the effects of climatic deterioration. Amongst migratory birds, particularly geese, the results of that struggle will greatly affect, and be affected by, events here in the United States. In some cases the supply of geese flying south is determined as much by the condition in which the birds leave your country on the way north in the spring as by what they encounter in Canada in summer.

Wildlife planners and managers need to think geographically, on a very large scale, and to bring into local planning the effects of actions often at great distances. A few weeks ago I was discussing with two of my western colleagues some of our recent studies in the High Arctic Islands. I had been expounding with enthusiasm on the way in which Canadian brant-marking had been helping Irish ornithologists unravel some puzzles about the changing numbers and distribution of brant in the estuaries of Northern Ireland and the Republic. My opposite number remarked that in Edmonton a proposal to continue a project just to help a bunch of Irish bird-watchers would go over like a lead balloon. I'm sure he was right.

He was also wrong, because in this case the Irish bird-watchers include some senior professional land-use planners who are very well aware of the ecological importance of estuaries and the need to ensure their protection from the hazards of deep-water oil-terminals, such as the one in Bantry Bay that leaks far too often, and other development proposals funded with North American capital. The least we should be doing is to help offset the environmentally detrimental effects of reverse colonialism.

To return finally to the starting point provided by the Program Committee, I see the chief new requirement for wildlife planning to be its abolition. Wildlife are better off without it. Wildlife planners are better dispersed through the whole broad apparatus of land use planning, rather than concentrated in a minor special interest group of their own. The same is *not* true of wildlife *scientists*, who are needed to search for and increase new knowledge. If "wise utilization of renewable natural resources" means killing for sport, I see no need for that either; the subsistence hunting of northern peoples can indeed represent wise use, though it by no means always does so.

The essential requirement for planners who are seriously interested in the conservation of wildlife is humility. In Canada, at least, it is still true that the forces of nature far outweigh the efforts of man in keeping the country fit for animals to live in. Long may this be so.

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Discussion

DISCUSSION LEADER BROWN: Thank you , Hugh. That certainly should evoke some discussion from a group that is assembled to hear about planning.

One ground rule that I would like to establish here, if I may, is that I would like to request we avoid that age old argument of whether or not people can truly be empathetic with wildlife species. Usually after a lengthy and heated exchange, it turns out to be a semantic discussion rather than a real one. People do relate to wildlife in terms of the aesthetics and subject uses and it is our job to recognize all of the uses.

I think that planning is nothing more than one of the tools to cross some of the disciplinary lines that Hugh thinks are impossible to cross. With that I would like to encourage any of you to go to the microphone, identify yourself and present your question.

MR. BOSSENMAIER [Manitoba, Canada]: I am a planner. I work for a Department of Wildlife that endorses hunting and I know I am not a target of Hugh, at least I hope I am not, because we are good friends. What I have to say is not staged either, but some thoughts that I have on the planning area.

I would like to propose that a fundamental new requirement be to examine our basic philosophies and goals toward usefulness of wildlife to man. Some think this will be obvious—such as income derived from trapping etc., but there are other values less obvious to society. It is in this category that I place sport hunting. But unless we understand the value that accrues to individuals in society from sport hunting, and when I say "we," I am referring to our own fish and wildlife agencies, the front line agencies, we may do sport hunting and society a disservice.

As I said earlier, I am a wildlife ecologist and in the wildlife planning role I have to look at this thing pretty seriously and, to put it simply, I contend sport hunting should be something beautiful, not debasing to either the hunter or the hunted. The primary goal of sport hunting should be to establish a bond between the hunter and the hunted and the earth. As designers for sport hunting programs we got sidetracked in the 1920's when we aimed our program down recreational trails. Now, we have the Canvasback and the geese mixed up with tobogganing, skiing and outdoor recreation. This can lead to nothing but degradation of hunting and its ultimate demise. We see this happening all around us. For man's good, I contend we must maintain sport hunting, but even more importantly, right now we must change the goals of our hunting programs from outdoor recreation to education and ecological awareness.

This is not a new philosophy. I think many of you are familiar with it. Leopold was promoting it back in the 1940's and it seems to be even more appropriate in the 1970's.

MR. DALE JONES [New Mexico]: It seems to me that wildlife has kind of taken it on the chin in the few areas where we have not had land use planning, perhaps not so much from the fact you are going to put wildlife on a specific parcel of land to manage it alone there or not; but, and I think it can be improved with land use planning, a lot of resource activities that go on that land under a good planning procedure and under good constraints can certainly be beneficial to wildlife. I wonder if you would comment on that?

MR. BOYD: I think this is really what one of my central themes was about. One of the difficulties I have is seeing how, if I don't believe in wildlife planners being gathered together and functioning in the special interests of wildlife, the new knowledge that I think the scientists should be acquiring should be disseminated through the planning community at large. I don't, as a matter of fact, see a simple answer to this.

We are in fact demonstrating, involuntarily, an answer to it in the Canadian Wildlife Service, in which, for example, our better biologists are being drained away by higher salaries and higher positions in planning departments. This may be one way of ensuring we accomplish the kind of spread that we want, but, of course, it is always a mistake to pay them more money because they will then do less work.

Comprehensive Planning for Improved Management of Wildlife and Non-Wildlife Outdoor Recreational Resources in Montana—A Director's Viewpoint

Wesley R. Woodgerd,
Director, Montana Department of Fish and Game, Helena

As director of a state fish and game department that has undertaken development of comprehensive planning under the Federal Aid options (Public Law 91-503, 1970), I will discuss our rationale for embarking upon this ambitious effort and highlight some of the benefits, challenges and tasks we see ahead in achieving full implementation.

The need to apply the planning process in the management of natural resources has been voiced here before (King 1972). Current events are certainly emphasizing that point throughout the world. In Montana, we have a mandate for better planning in our State's Environmental Policy Act (Section 4b), plus ample incentive induced by the Utilities Siting Act, Water Use Act, Forest Practices Act, and other issues here or just over the horizon. Further impetus for planning is provided by the President's announced energy policy—Project Independence. The race to establish priorities for use of our natural resources could be finished while we are still in the starting blocks.

Montana is a large, primarily agricultural state with some of the finest wildlife and non-wildlife outdoor recreation resources in the nation. Nearly three of five Montanans (ages 15-65) purchase hunting or fishing licenses and many others include wildlife (and non-wildlife) oriented outdoor recreation as an important part of their life style. Almost a third of our large State is Federal land; we have and will continue to share the benefits of our wildlife assets and other outdoor recreation opportunities with others.

The Montana Department of Fish and Game has been a leader in striving for better stewardship of the land in our State. This is part of our assigned responsibility to protect, maintain, enhance and promote the wise use of the State's natural and cultural resources that provide outdoor recreation or are of aesthetic, scenic, historic or archaeological significance. The history of more developed regions of the United States and current problems of advanced environmental degradation illustrate how the process of economic growth has largely been one of substituting manmade goods for natural amenities (Barkley and Seckler 1972).

Our State is at the crossroads of potentially massive physical and socioeconomic changes. The burgeoning growth of this affluent nation (and lack of planning for energy resources) has rapidly focused attention on Montana (and other western States) for coal as well as for living space, timber and agricultural products, and outdoor recreation resources. The history of use of the nonrenewable natural resources of Montana has been one primarily of an extractive nature. Recent State legislation reflects the current attitudes of many of our State's citizens. There is strong concern that environmental quality not merely be subservient to the State's economic development, but rather that it be an integral and realistic part of planning for our future.

Perhaps it is axiomatic that many of the wildlife agencies seeking more effective and efficient ways to operate their organizations are in western States. We understand that Colorado Division of Wildlife's intensive comprehensive planning effort is now advancing from the strategic to operational phases (Prenzlow, pers. comm.) and Oregon is currently completing the strategic phases (Stein, pers. comm.) Several other states follow us here today to discuss their experiences with comprehensive planning.

The comprehensive planning process appears to be our best option to prepare for the challenges ahead. It will be necessary to improve our ability to fulfill our obligations to produce outdoor recreation (consistent with the capabilities of the resources) for the people today, tomorrow, and 5, 10 and 15 years into the future. It is a dynamic means to establish needed and attainable program objectives and then to budget, direct and evaluate the work effort toward accomplishing those objectives. It is essential that we develop means of directing our organization in a way that is in tune with the rapidly changing relationship of resource supply and demand, and that it is defendable to public scrutiny in relation to making optimum allocation of their money to produce the desired benefits. Comprehensive planning can be an effective tool in improving the decision making process—it does not prevent "bad" decisions but should surface them as such and make them difficult to defend. If you really want to evaluate what you are presently doing in relation to the projected demands of the future, and if you want to replace crisis action with pre-crisis action, then pursue planning with total commitment. Plant both feet on controversial issues by describing what it means in terms of wildlife values to the public, and how you intend to use it over the next 10 years; then conflicting resource users must move you and our referee, the public, will call the foul on them.

Getting Started

To get moving from "ground-zero," we initially had to rely upon faith in the chosen planning staff. They were provided with adequate funds, quarters, our general support and several months of orientation. Conferences with planners in other states, Federal Aid planning specialists and various university disciplines were encouraged.

We reviewed our laws, policies and Constitution and made the determination that our entire effort was linked to the production of outdoor recreation for the public. It then became necessary to write a statement describing the *ultimate goal* of the overall Department of Fish and Game. Candidate statements were reviewed with our top management staff and one chosen after a vigorous discussion. For those of you who haven's tried this exercise, it will elucidate the degree to which you are "divisionally" oriented or otherwise compartmentalized within your organization—particularly when your responsibilities extend far beyond "fish and game" in the traditional sense.

Once this central goal of the entire department was established, it was less difficult to determine what recreational products or programs each division was responsible for in the process of producing outdoor recreational opportunities.

Some Necessary Attitudes

Top management must have a realistic awareness of the limitations and strengths of past and current ways of doing business *relative to the task ahead,* and regardless of relative success or progress in the past. There has to be an *attitude for improvement;* standing still in this stressful era is really falling behind! Certain questions need to be asked: Are we ready to meet the future expanding needs of society from a decreasing resource base? Are we cognizant of the degree that our current agency structures are a product of past political and unplanned expediencies? To what degree can our current annual budgets be taken as reliable guides to satisfy future public needs? Nobe (1973) stated that "if past management has led to an efficient use of agency budgets or to an optimization of social net benefits from wildlife, it surely has been by accident rather than by design." Most wildlife agencies are crisis oriented on a biennial basis. The easy way out is to add or subtract a percentage of each division's budget depending on the total expected revenue.

Setting the Course—A Plan for A Plan

The next requirement of the planners was to generate sufficient information to show the sequence of necessary tasks ahead—from the strategic plan to the operational plans based on program budgeting. The PERT chart developed by the Colorado Division of Wildlife has been most useful in preparing a logical "plan for a plan." The Director must understand the planning process sufficiently to provide the strong commitment necessary, and to decide where his direction, guidance and encouragement are needed. This requires continual liaison of the planning leader with the Director and his staff. Sufficient faith in the planning system being developed is necessary in order to provide unwaivering support far beyond "lip service." All personnel in the department must give requested information a very high priority to avoid time lags and obsolescence of gathered data.

Sorting Things Out

Program selection (or categorizing the major sources of wildlife and non-wildlife oriented outdoor recreation products) required considerable planning time and staff review. In Montana, wildlife-oriented recreation has been structured into categories by species; non-wildlife oriented recreation into site-oriented, dispersed use, urban recreation and historic and cultural sites. Department personnel are now reporting their daily activities in relation to these program categories. This is to determine a baseline of ongoing expenditures of personnel time by programs and to acquaint personnel with program planning concepts.

Gaining Momentum

The statewide inventory of wildlife resources is well underway. It is a formidable task, considering the many species in our 93 million acre study area! This process shifts the emphasis of planners' time to middle management and regional personnel and requires sacrifices of their time from the old comfortable routine. This is serving several purposes: collection of necessary planning data, communication between planners and all personnel, and providing a continuous testing of the planning process as it develops. A certain degree of the adversary process is healthy and continually tests the credibility of the developing planning system. A professional, objective approach is essential by all personnel involved. Decisive action is necessary from the top to keep the process moving to meet scheduled deadlines.

The Road Ahead

As Director, I foresee some complex but *possible* tasks ahead, such as: changes in data collection and storage-retrieval systems; interpreting "demand;" attaining internal and public understanding of the benefits of comprehensive planning; and converting focus of a divisionally oriented department toward unified program objectives. Implementing program-budgeting and meshing new systems with ongoing ones will require great patience and decisive action in the face of constant opposition from many directions, both internal and external. Keeping the system dynamic will require constant guidance, adequate funding, unwaivering support and patience.

You can expect your planning team will be handicapped by bureaucratic resistance from within your department, partly from fear that their status or supervisory control may be usurped, or that pet projects, duplications or inconsistencies may be uncovered. Also, present budgeting methods that may in some way benefit certain divisions or geographic units would be favored over any new budgeting system. If there is a gleam in the eye of any of your top administrators that indicates planning may not be good for your department, you can be sure it will be further exploited by related field positions. However, I feel strongly that the ultimate benefits of comprehensive planning justify the effort and the risks. If your department resembles ours, you have added personnel and their associated costs by jurisdictional units intuitively, or by mutual compromise among members of your staff; a comparison of realistic cost-benefit ratios is usually neglected in either case. We feel the opportunity still exists in Montana, dependent upon proper planning, cooperation and dedicated action, to maintain and enhance our wildlife and other outdoor recreational resources despite the immense challenges of the future.

We have gained considerably by contact with other state wildlife agencies and Fish and Wildlife Service planning specialists before and during the undertaking of comprehensive planning. We hope that this interchange can continue. Even though each state will have its unique problems, we all can use all the help we can get to make effective planning an integral part of natural resource management. Any comprehensive planning system must be constantly aware of all other governmental planning efforts to achieve adequate coordination.

To be sure that the planning organization matures into the tool that is needed requires a great deal of a Director's personal attention during its formative months. He must guide, protect, defend, fund, coordinate, discipline, communicate and demand cooperation, if his planning staff is going to produce a plan he can publish with pride. Over-indulgence is a risk, but it is rarely possible because of the voluminous demands of a Director's job. Delegation of authority to guide and supervise the planning process may be his alternative. Be careful! Something is always lost or added in interpretation when anyone delegates his duties to others; it will be his plan instead of the Director's.

I hope I have been able to provide some insight into the progress, problems and possibilities of our comprehensive planning effort. I believe it will, if properly exercised, lead the way to better resource management.

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Discussion

MR. PAUL EASTMAN [Interstate Commission on the Potomac River Basin]: My question has to do with the first speaker's remarks, about what I think he said—namely that wildlife planners should not be engaging in wildlife planning, but should be engaging in land use planning.

The Federal Water Pollution Control Act in the United States was passed in 1972 and it set as its purpose restoration and maintenance of the physical, chemical and biological integrity of the Nation's surface water. It also set three enforceable requirements—that all waters of the United States shall be maintained so as to support fish, other aquatic life, and wildlife. I would like to know what wildlife planners are doing in the United States with regard to meeting that enforceable requirement and, further, for our Canadian friend on the podium, inasmuch as he is not responsible in any way for meeting those three goals, perhaps what he thinks should be done.

DISCUSSION LEADER BROWN: Does anybody care to comment on that? I cannot seem to envoke any response out of anybody here on that statement.

MR. EASTMAN: Perhaps you can take it up with the panel, but I think this, in and of itself, is an answer. Apparently the lack of comment indicates that pretty well nothing is being done.

CHAIRMAN BRAY: You are asking the State people to answer a question at the Federal level and, unfortunately we do not have a Federal representative on this panel. I can be an eternal optimist and say, for example, that we will solve it by 1983.

MR. EASTMAN: On the contrary, it isn't just a Federal problem—it is also a State problem because states are supposed to be planning to meet the 1983 requirement.

MR. ED PRENZLOW [Colorado]: I cannot say anything about the National Environmental Protection Act or national land use, but I can speak from what Colorado has done on land use. I know that a lot of the systems that the planning section conceived, which were implemented by the field section, contributed greatly to the information that we could use in relation to our land use act, House Bill Number 1041. It has provided for and, hopefully, it will allow better management decisions. That is all I can say. I don't know anything about the national situation.

CHAIRMAN BRAY: I think that is all planning is intended to do. I think all it has to do is identify where the problem is and at least provide alternatives which decision makers can choose from. I believe that is all we will ever be able to do.

MR. HERBERT DOIG [Fish and Wildlife Service, New York]: Perhaps you are getting to the nub of the answer to the question as to what planners are doing to solve the problems that have been identified and which should be solved by 1983. In that connection, I would hope to say that the answer would be "nothing." I would hope planners are not going to solve the problems, but help guide the thought processes that will, and perhaps that is why the panel had difficulty addressing the question.

Comprehensive Planning in West Virginia

James W. Rawson, Robert H. Dayfield, and William M. Santonas
West Virginia Wildlife Resources Division Operations Center, Elkins

A basic need to identify goals and establish continuity in management and research programs precipitated planning in West Virginia. A federally-funded comprehensive wildlife planning and coordination effort began in 1969. Fiscal restrictions and a lack of trained wildlife planners necessitated staffing of the planning section from within the Division. A wildlife planning and coordination section consisting of a supervisor, a fisheries biologist and a game biologist was organized. Responsibilities included comprehensive and water resource planning and coordination of projects involving various federal and state agencies such as the U. S. Forest Service, Soil Conservation Service, and West Virginia Department of Highways.

The main obstacle to comprehensive wildlife planning was the absence of tested methodology. Personnel of the Division of Federal Aid of the Bureau of Sport Fisheries and Wildlife advocated planning, but could offer only limited technical assistance. The California Department of Fish and Game was the only State agency that has exhibited significant progress in comprehensive planning. A training session with appropriate personnel from that agency was held to establish procedures. Although California's planning method proved to be inadequate for West Virginia's needs, it was a starting point.

We have placed considerable emphasis on support data in the belief that better decisions are made with better information. West Virginia had very little of the basic data required to initiate planning. Hunter and fisherman use and harvest data was available only in fragmentary form and landowner attitudes were unknown. Much data was provided by Division biologists, who have conducted investigations in West Virginia's lands and streams. Streams were inventoried with regard to size, species composition, productivity, pollution level and type, and other parameters. Various biologists were assigned from one to five species and/or topics upon which they developed detailed status and recommendation reports. Their input was also required to develop lists of the State's fishes, mammals, birds, reptiles, and amphibians. Basic data such as population levels and trends, harvest data, habitat trends, management area objectives and needs, and other information were provided. This effort obviously required time and often curtailment of regular activities normally conducted by field personnel.

Facilities to efficiently record, store, and analyze planning information were lacking and no system of cost accounting was available. To remedy these deficiencies a biometrics unit was organized at the Elkins Operations Center. A remote terminal was installed to transmit and receive data from the computer center at West Virginia University, allowing the Division to utilize the operational and storage capabilities of a large computer complex. Programming, sample selections, keypunching, verifying and other such duties are conducted in Elkins. The Biometrics Unit conducted mail questionnaire surveys to determine hunter and fisherman use and distribution and landowner attitudes relating to such use. A work report system incorporating cost accounting was implemented, and West Virginia joined nine other states and two agencies in the Southeast Economic Survey (Horvath 1974) to provide information on economic values.

The design of future programs must be based on anticipated needs. The need for demand analysis was evident, but the method was not. Studies revealed parameters such as latent demand that we could not identify. The decision was made to use projected use rather than actual demand. The Biometrics Unit developed equations to estimate per capita hunting and fishing license sales to project use based on equations developed elsewhere (Davis and Seneca 1972). The equations estimate future license sales on a county basis.

No definite system or format was developed during the initial states of planning for the operational plan, although the need for such was recognized. As the Division of Federal Aid became more involved, its consultant group (BASYS) provided some important guidelines for general planning and particularly, operational planning.

Basically, the BASYS system promotes planning on a program basis. Programs are based on a species, a group of species, or habitat unit; *e. g.* trout, deer, farm game, reservoirs, and small impoundments. All existing and future Division activities are included in one or more programs.

The system insisted on quantifying predicted outputs for each program. We found that this could be done in some cases and not in others. When outputs cannot be quantified numerically, a narrative discussion should relate the activity to the program objective.

The system required a goal, objectives, problems, and strategies in each program. The goal is a general statement of purpose stating what we wish to do for whom. Goals are utilized only in the long-range (strategic) plan. Program objectives quantify the goal; *e. g.* if the goal states that we wish to increase wild turkey hunter use opportunity, the objective states by how many days we wish to increase it.

Program problems are a list of stumbling blocks in the way of accomplishing goals and objectives. Strategies are actions that will resolve problems in order to accomplish goals and objectives. Obviously, not every problem can be solved.

The basic outline for West Virginia's plan is as follows:

Volume I - *Inventory of Land and Water Resources*

This volume includes discussions of physiography and climate; a statewide inventory of major game and furbearers, fishery resources, amphibians, reptiles, and mollusks; checklists of mannals, bırds, fishes, *etc.*; a discussion of the State's various habitat types; individual discussions of each amount and type of terrestrial habitat in each county, game and nongame populations, type and extent of mining, and other items; summaries of stream inventories; existing farm ponds and reservoirs; and much more.

Volume II - *Effects of Major Industries - Habitat and Use Projections*

This volume includes discussions of effects of various major industries, *e. g.* forestry, agriculture, mining, highways; analysis of posting and access;

projections of future land use trends; hunter and fisherman use projections; projections of future human populations, and other items.

Volume III - *Species Status and Recommendations*

This volume provides in-depth discussions of all game, fish, and nongame (as a group) species with respect to habitat, population status and dynamics, numbers, use, problems, and probably most important, management recommendations.

Volume IV - *Strategic Plan*

This volume contains all the Division's programs. Each program has a section on status, present and future use, and anticipated habitat trends. Each program's goal, objectives, problems, and strategies are presented. The volume also contains a discussion of major problems facing the Division. This is a very important document because it sets the Division's long range direction.

Volume V - *Operational Plan*

This is a working document containing a compilation of activities that are needed to accomplish program goals and objectives. The exact format of this document is not presently known, but it will probably be composed of district management plans dovetailed together for each program. Each district, depending on various factors, will be responsible for accomplishing a portion of each of the program's objectives.

Our basic procedure will be to develop the implementation or operational plan to conform to the goals and objectives of the strategic plan. This will be the acid test of the strategic plans, goals and objectives; *i. e.* are they attainable.

The Division's Game and Fish Management Sections have primary responsibility to produce outputs. Other sections, *e.g.* research, administration, and planning, are service sections to assist management in attaining these outputs.

Planning Problems

Several definite problems arose during the course of West Virginia's planning effort:

a) Comprehensive planning progress was hampered because planners had other responsibilities. Several highly environmentally significant projects required attention by the planning unit. Ideally, planning should be the planners only responsibility.
b) Much of West Virginia's early efforts resulted in trial and error situations. This requires administrative patience. West Virginia has enjoyed support from top level administrators.
c) Planning requires considerable input by biologists and other field personnel. In some cases this causes curtailment of regular activities. We encountered considerable resentment in some cases, and found that planning was a difficult product to sell.
d) Planning also requires involvement by top management throughout the planning program. Decisions must be made as the plan progresses.

e) As priorities became apparent, certain projects did not meet the Division's needs and were terminated. This often causes conflicts if "pet" projects are involved.

f) Most planning systems call for quantifications of outputs. Field biologists are reluctant to accept what they consider to be unreliable estimates of use and demand which are needed to formulate a plan. Their scientific training is probably responsible for this reluctance.

Suggestions

We feel that planning should be phased into Division operations rather than being a process of stopping everything and starting anew. We found that as new ideas and methods arise, they should be implemented.

We do not anticipate that the format of any part of the plan will remain static. As we see better ways to do things we will change. We feel that our first operational plan will be far less complex than future ones. For example, the first operational plan will utilize very little, if any, cost accounting, We hope to gradually incorporate this procedure as our data base increases. Initially, a relatively simple operational plan will be more widely accepted by field personnel and refinements will be gradually incorporated.

One of the most important aspects of planning is the process itself. A good plan is never completed. Everything in West Virginia's documents is subject to revision upon receipt of better data or changes in conditions. Planners should be permanent fixtures in a state wildlife organization. The implementation, or operational plan, should be updated annually, since actual accomplishments will vary from planned accomplishments. The strategic, or 15-year plan, should be revised or reviewed every three years. An inventory must be updated to provide current information and detect habitat changes and project future habitat conditions.

Although the plan is not complete, it is essentially in effect. Many new ideas and decisions have been incorporated as they became apparent, and older, less beneficial projects were phased out. The planning process has benefited West Virginia's operations in many ways. some of the questions planners ask are: Why are you doing this activity? Whom does it benefit? What are the benefits? How many does it benefit? If an activity isn't directed toward one of our goals, why are we doing it?

Such questions raise both problems and eyebrows. Because of this, the planning unit reviews all proposed projects and all progress reports.

Planning forces us to think ahead and evaluate today's activities with tomorrow's needs. For instance, many biologists had not thought about how many bucks they wished to harvest by 1985 or how many acres of muskie habitat will be needed to satisfy future fisherman requirements. Planning promotes thinking.

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State Experiences with Comprehensive Planning: Idaho's Problems and Progress

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Reasons for Planning

There are, as I see it, two basic reasons for a fish and wildlife agency to develop a planning program. These are, stated very simply, first, to improve internal operating efficiency and secondly, to secure input into external planning efforts. External planning, as referred to in this paper, is defined as planning conducted by entities other than fish and wildlife agencies which has an effect on fish and wildlife resources.

Improvement of agency efficiency has, of course, been a continuing process over many years and has taken many different forms. At the present time, however, with the complexities of modern fish and wildlife management and the many different factors affecting management programs, a clear, workable plan is almost a necessity if a high-level of operating efficiency is to be maintained. Measurable and quantifiable goals and objectives and evaluation of progress in meeting them are essential if the most is to be obtained from available dollars and manpower, both of which seem to be in chronic short supply.

A great deal of external land and water use planning, which directly and indirectly affect fish and wildlife resources, is currently underway. Federal and state agencies, counties and other local governments and various combinations of all of these are actively developing comprehensive land and water use plans. If consideration of the fish and wildlife resource is not incorporated into these various plans, that particular resource will simply fall by the wayside in many instances.

In a state like Idaho where about 70 percent of the land area and an even greater percentage of remaining fish and wildlife habitat is owned or administered by federal and state land management agencies, it is absolutely imperative that our Department have input into plans currently being developed by these agencies. Another example of where fish and wildlife input is imperative is in the development of a state water plan.

It is a fact of life, at least in many of the Western states, that any truly significant wildlife habitat preservation or enhancement accomplished will have to be accomplished through cooperation of the land management agencies which control the bulk of the habitat. The best and simplest way to secure this cooperation is to have an established fish and wildlife plan that can take its place in competition, if you will, with other land and water use interests involved in comprehensive plans being developed. From the number and type of requests our Department receives for plan input, I am completely convinced of the soundness of this approach, both from the standpoint of internal efficiency in meeting the requests for input and the weight this input will carry.

Planning Components

Fish and wildlife planning components are basically the same as for many other planning efforts—namely an inventory of existing and projected resources; determination of the use opportunity these resources will supply; a projection of use demands; and the development of means for best fitting use demand to use opportunity. The latter three components are fairly straightforward even though approaches to them will vary considerably depending on the total resources and uses involved. The inventory component seems straightforward but has some inherent, potential problems that are worth pointing out.

Design of the inventory is normally the first step in a fish and wildlife planning effort. If the resource is of any great magnitude it is most desirable, from a storage, retrieval and updating standpoint, to put inventory data in a computer program. It is possible for a planning effort to seriously flounder at this point.

There is a tendency to try, indiscriminately, to gather all available data and develop new data in minute detail to be placed in the program. Under normal fiscal and manpower constraints, this approach is infeasible. It is also likely that a great portion of such data will never be used. There is a very fine balance that must be achieved between fiscal, manpower and time limitations on one hand and necessary and adequate inventory data on the other.

Two steps taken prior to inventory design can help in achieving this balance. A fish and wildlife plan format can be drafted and data that will be actually needed to justify and present the plan determined. If the type of data needed to make meaningful input into external plans can also be determined, an inventory which will meet all minimum requirements can be designed. The inventory can then be expanded as other needs, and fiscal and manpower limitations dictate.

Fitting Fish and Wildlife Planning into External Planning Efforts

A basic mechanical difficulty is encountered in meshing fish and wildlife planning with other planning programs. External planning is normally based on geographic units of one type or another. Fish and wildlife planning is normally based on species, none of which have respect for geographical boundaries.

This problem cannot be entirely overcome but can be alleviated in many instances if, insofar as possible, it is taken into account in fish and wildlife plan development. It is possible to develop some species plans by various geographical units. The controlling constraint being, of course, that the species distribution and requirements determine the geographical unit, not arbitrary boundaries. While geographical units determined by species distribution and needs seldom conform with external plan units, if they have some common base they can often be adjusted to fit external plan needs.

Plan Implementation and Control

It has been said many times that a plan gathering dust on the bookshelves represents only a lot of wasted effort. Plans must be implemented, but just as importantly, they must be adhered to once implemented.

We have not implemented any formal plans as yet and so do not have actual experience with maintaining direction toward goals and objectives contained in these types of plans. We have, however, undertaken an exercise which is most helpful in designing plans that lend themselves to program control.

A few representative, theoretical or model species plans can be developed complete with policies, goals and objectives for both statewide and supporting local operating plans. These theoretical plans can then be tested against agency operating procedures to determine whether progress toward meeting various types of goals and objectives can actually be directed, measured and evaluated and whether overall program control can be maintained. Such a procedure can result in two alternatives to be considered—tailoring goals and objectives to fit into existing operating procedures or changing existing operating procedures to accommodate independently established goals and objectives.

Problems With Planning

External

The major external problem with a fish and wildlife plan, once developed, would appear to be coordination involved in getting the plan considered in external plans. I personally don't believe this will be as great a problem as it appears.

There is a basic difference between fish and wildlife plans and most external plans. External plans are normally "comprehensive" or, in other words, are essentially dealing with and allocating multiple uses. Fish and wildlife plans, while comprehensive in the sense they coordinate planning for many species, are essentially single use when viewed in the context of other competing resource uses and can be submitted in a straightforward manner as just that.

Due to various legal requirements and the existing social climate, most major multiple use agencies are eager to include fish and wildlife considerations in their comprehensive planning efforts. The extent to which these considerations will actually result in adequate plans to meet fish and wildlife needs is obviously another question.

One-half of whatever portion of this battle is going to be won, however, is already won if a fish and wildlife plan is available for official input. Such a plan carries more political weight and has greater public support than bits and pieces of data and fragmented position statements. It also serves as a firm negotiating base in the compromises that are usually involved in multiple use planning.

Internal

There are also internal problems with fish and wildlife planning. Some have occurred in our Department and some obvious potential ones we have escaped.

A major potential problem, probably an insurmountable one, would be a lack of committment and strong action from top administration. We, fortunately, do not have this problem. Quite the opposite in fact.

We have had problems with other levels of the Department, however, particularly with field staff. Formalized fish and wildlife planning is a relatively new concept. Like all new concepts, it has met with a certain amount of resistance simply because it is a change from the old way of doing business.

The most difficult task, to date, has been impressing upon field staff the necessity and value of statewide policy planning. Policy plans require a great deal of background data from the field, yet are not directly related to localized management efforts. Conflicts in work priorities inevitably arise and can result in some prejudice against statewide planning work. As an example, there could be resistance from a person deeply involved with four or five local deer herds against taking time from the management of these herds to prepare data that are of value in statewide planning but of little value in local management.

This is the old story of the broad picture versus the local picture which has always been somewhat of a problem in the administration of fish and wildlife resources. Many of the field staff readily grasp the value of policy planning. We have devoted considerable time and effort to training sessions, seminars and regional meetings in attempting to convince the remainder and believe we now have at least general acceptance of the principles and values involved. As the planning program progresses from policy planning to localized operating plans, I believe this acceptance and interest will grow even stronger.

Summary of Idaho's Progress

Necessary preliminary work involved in setting up a planning program has been completed. A planning program consistent with our fiscal and manpower resources has been designed and appears to be workable.

A wildlife resource inventory including habitat classification, land ownership, land use and species distribution and relative abundance by season is essentially complete. Computer programs for storage and retrieval of these data have been designed and approximately two-thirds of the data are now in the system. Similar fishery inventory data is available. Program design to accommodate this data is now in progress.

Enough background data and information have been compiled in usable form to permit the drafting of statewide fish and wildlife policy plans. Formats for these plans have been developed and policy plan drafting is now in process.

Thanks, in great part, to shared experiences with other fish and wildlife agencies, we have, to date, avoided any major stumbling blocks. A high priority has been assigned to planning work and hopefully we will have a draft, comprehensive, statewide fish and wildlife policy plan completed within the year.

Conclusion

This has been a very brief resume of some of the factors involved in fish and wildlife planning as our Department sees them. It is based both on experience to date and considerable study and evaluation of factors yet to be encountered. I hope it will be of some value to others initiating similar programs.

Wisconsin's Promises and Performances

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I am reminded of a talk Dr. Karl Lagler gave some years ago at a Midwest Wildlife Conference. After talking briefly about the failures of fish stocking as a panacea, he then talked about a new bandwagon called habitat improvement. He indicated that everyone was jumping aboard, even though some of the parts of the new bandwagon were being built in the dark.

The latest bandwagon to come along seems to be planning. I am not so sure this is new; I can't conceive of any major conservation agency conducting even one year's program without some kind of plan. But the formalization of planning, the use of a planning process in making budgetary allocations and major shifts in policy—these seem to be relatively new.

Wisconsin's Department of Natural Resources, and its predecessor, the Wisconsin Conservation Department, have had a recognizable planning effort since the early 1960's. Prior to that there had been planning within the various programs, obviously, but no attempt to "put it all together" in any kind of single package. The first efforts consisted of one man, "the planner," plus whatever assistance or attention he could manage to siphon off from the rest of the Department. At various stages in its development thereafter, planning was in the Bureau of Research and Planning, the Bureau of Planning and Aid Programs, and finally, in 1971, in a separate Bureau of Planning. This last Bureau is attached directly to the Secretary's office, giving it a certain degree of recognition and useful clout when needed.

I would like to make some general observations based on my experiences in planning over the last 10 or more years. Most of these are fairly obvious, but still they bear repeating. The success of planning, as measured by its degree of implementation, varies with a number of factors. I trust, before discussing these, that all of you agree that implementation is the best single measure of successful planning. The world is full of bookshelves loaded with very learned (or at least weighty) but very dead plans.

What are some of these factors? One, how complex is the subject? There is far more success on simple subjects. We are currently trying to develop a long range natural resources plan for Wisconsin. In terms of implementation, I personally doubt that it will be very effective. It's probably necessary to provide certain guideposts for other, more detailed plans on smaller and presumably simpler elements, but I doubt if many changes will occur solely as a result of this plan. Relatively less effort spent on broad, framework type plans, and much more on the specific elements, will pay better dividends.

Second, how far into the future are we trying to plan? Obviously, the farther we try to look, the dimmer the view, and the less likely we are to succeed in developing a plan that has any meaning at the end of its theoretically useful life. There have been some serious discussions among planners that long range planning, i.e., 20 or 30 years ahead, is frequently only a delusion, or at best a meaningless exercise for planners. There are also warnings being sounded by certain demographers, who point out that recent drastic changes in the projected age composition of this country's population may make some fairly recent planning efforts look like rather poor guessing by the time the projection dates arrive. What this is really saying to us is something all planners profess but don't always practice. Planning is a process and plans must be flexible and able to accommodate change, or they will soon be discarded. This sounds like a tired cliche, but cliche or not, it's true.

Third, are the planners in contact with the rest of the department, and the real world? I'm not trying to suggest that most DNR's aren't part of the real world. Rather, I suggest that the planners must be part of a management team, responsive and responsible to top level administration. They must also enjoy a reasonable level of contact and mutual respect for each other's problems and capabilities with the field organization. Where this would occur in any particular agency would vary with the size and responsibilities of the agency. Under our decentralized organization in Wisconsin, this contact occurs, at a minimum, with the six district directors' offices.

One of the ways to get attention, and develop some of the essential contact, is to get into budgeting. Whenever you start affecting the future dollars for someone's program, you attract immediate attention. The most notable example in Wisconsin has been in outdoor recreation planning. Although the initial impetus was provided by federal Bureau of Outdoor Recreation planning requirements, Wisconsin has gone one step farther. Even local governments, by state law, must have recreation plans to obtain state and/or federal aids. Interestingly, the plans that have resulted have usually gone well beyond the project of immediate concern. Indeed, there is some evidence that this requirement has sparked an interest in more general planning in some communities.

Within the Department, the Bureau of Planning has spent many man-hours working on the next biennial budget, trying to tie money to program plans, goals and objectives. Although the participation was not always cheerfully given, it *was* given, and in reasonably good measure. This was the Bureau's first foray into budgeting, and produced the usual number of birth pains, miscellaneous crises, and errors which we hopefully won't repeat. Nevertheless, it really served to increase the internal awareness of planning, and, more importantly, to point out to some of our program bureaus how little planning has been done in many areas, and how poorly defined their goals and objectives really were. I will return to this point a little later.

Finally, the most successful planning is that done for brand new programs. There apparently is something to the old adage that you can't teach an old dog new tricks. I think that, without exception, fish and game programs have been around since the beginning, and for anyone to suggest that they're not perfect, borders on heresy. And yet, if planning doesn't result in any changes at all, then it apparently wasn't really needed or wasn't a very good planning effort. Planning has had far more influence on our new lake rehabilitation program, and some of our water quality programs, than it has on pheasant stocking, for example. The only real lesson here is that considerably more effort and much broader involvement will be required in planning for established programs such as fish and game.

With these five generalities out of the way, let's take a closer look at how planning has been functioning in Wisconsin. For planning to deliver a significant portion of its promise requires a total commitment at all levels of the organization. Wisconsin's commitment, while it may not be total (and whose is?) is certainly substantial. Wisconsin statutes direct that "The Department shall establish long-range plans, projects and priorities for conservation," and to formulate ".... a long-range, comprehensive state water resources plan..." There are numerous other statutory references to planning.

The Natural Resources Board's Policy on Planning states that, "All Department of Natural Resources action programs will be based upon long-range plans. Emergency actions, requiring new programs, will be incorporated into existing plans as soon as possible. To this end the Department will engage in a continuous planning effort." I don't believe anyone can argue that we lack a strong commitment to planning by the Board.

The Secretary of the Department has implemented this policy in numerous ways. One of the most recent was his strong support for comprehensive fish and wildlife planning. This is based not so much on the possibility of block grants under the Pittman-Robertson and Dingell-Johnson Acts; Wisconsin has had no real problem with the present method of obtaining funds. Rather, it is a recognition of need. In the absence of adequate analysis, who knows if our present allocations of scarce fish and game dollars are as effective as they might be? As inflation continues to shrink these dollars, the question becomes critical.

The answer lies, in part, in an adequate fish and wildlife plan. Wisconsin has recently launched such a planning effort, and put together a planning team. The team consists of one man (about half time) from the Bureau of Planning, one man from fisheries management and another from game, and approximately half-time each from the game and fish research section chiefs. I should note that the planning man has a wildlife background, and that both of the fish and game staff men have a broad understanding and many years of experience in their respective programs. In addition, overall responsibility lies on my doorstep, and as a retreaded game manager I feel fairly comfortable in this assignment. The fish and game staff men are in effect on "detached service." They remain on the fish and game roster, but are to work solely on planning matters. Herein lies one of the stumbling blocks.

It is not easy for an administrator to voluntarily relinquish two experienced staff members. The temptation is to continue to route various assignments to these people. In addition, some of the previous assignments of these staffers were "fun" and not easy to give up. Some partial solutions to these problems have been developed.

First, we physically moved these people to a different floor, making it more difficult for things to be dropped off on their desks. Second, we had the Secretary send out a memo indicating that any assignments for these men that were not planning related had to be cleared through the Bureau of Planning. Third, by assigning enough tasks with realistic but fairly short deadlines, we've kept them too busy to stay involved in all their past activities. Fourth, we've attempted to budget for this kind of program planning in the various Bureaus in the next biennial budget. With the budget crunch, this may not succeed. The problem hasn't totally disappeared, but it seems to be at a level we can live with.

Our progress to date has been slow but satisfactory. A program design to get the job done has been developed. A broad Department goal (the motherhood type) has been written, although not yet formally approved. Strategic goals and program goals are now being addressed. It is amazing how difficult it is to get at these program goals. You will recall what I mentioned earlier in connection with budgeting and the lack of clearly defined goals. If you find this hard to understand, try the following sorts of questions on some program of your own.

Is your program goal to provide one million man-days of big game hunting? Fine! But what success level constitutes a satisfactory day of hunting? Suppose the potential demand doubles? Can you say that the hunters will be satisfied with half the current success level, or will you have to double the harvestable surplus, or is the answer in between, or what? And you can't consider the goal in a vacuum. Is it even feasible to double the crop, just from the habitat or land use standpoint? Presumably this might cost something; precisely what are the total costs, as well as benefits, and who pays what? These are tough questions, which make the development of goals a very difficult task. But the fact that these are the kinds of questions that should be answered is what makes the promise of planning so attractive. The need to find the most cost-effective solution to our fish and game problems was never more critical. Pressures on all of our resources are increasing; at the same time the effective dollars for management to meet these pressures are decreasing. What current programs can be curtailed, which ones should be emphasized, what brand new efforts are needed? Hopefully, our fish and wildlife planning will provide information leading to good answers to these questions.

I think I should point out that not all of these questions can be answered by retreaded fish and game biologists. During the years that I've been involved in planning, it has become increasingly obvious that expertise from many other fields is required. Whether you put economists, political scientists, rural sociologists and others on the planning team directly or not is immaterial, but their knowledge had better be available in some manner during the planning process. We hope to acquire a few people with at least some of these skills within the next few years. They will obviously be expected to assist in many areas beyond fish and game planning, such as evaluations for environmental impact statements, weighing of alternatives in master planning of Department properties, and in the attempt to develop cost/benefits of designating state properties in the various categories of our wild resources system. I am sure we will keep them usefully busy for a long time.

As is so often the case, our planning comes a little late. The very real financial difficulties we're facing in Wisconsin will almost certainly require cuts in programs. It would be nice to have a completed fish and wildlife plan that would tell us what the relative effects of cutting program "A" versus program "B" or "C" would be. While we don't have this, we have assembled a team with considerable and varied experience, and a penchant for asking "Why?" that should be very useful in analyzing alternative cuts, and in justifying no cuts in some areas. It will be interesting to see how much attention is paid to the extensive efforts that went into the preparation of the budget document.

This matter of attention (or the lack of it) paid to plans, planners and the planning process is a perennial problem. I have a few ideas that seem to have helped, at least in Wisconsin. There is a general tendency, in my experience, to regard planning as the repository for all the odd jobs that don't seem to fit anywhere else. This isn't all bad. The secret is to accept (to the extent you have any choice) those where you know you can deliver a good job, and then follow through. Examples of the kind of thing I'm talking about have included the development of a cooperative land management plan for one of the largest and wildest storage reservoirs in Wisconsin, the leadership of quite a number of feasibility studies on proposals for new land acquisition areas, and the development of new policies to deal with recreation conflicts on various public lands. There have been many others. I recognize first that you can't always pick and choose, and that second, this detracts from the "real" planning effort. However, as planning's credibility and acceptance increases, the effectiveness of the planning that's left improves. This sort of thing can be overdone of course, and this is a constant danger. Nevertheless, I think some participation in departmental affairs outside of pure planning is good for both the planners and the department.

Another obvious idea, and one that is preached in all the planning literature, is participation. It's usually easier to talk about than to achieve. This is one of the reasons why I have made a big effort to develop planning capabilities in the various program bureaus, rather than develop a big empire in the Bureau of Planning. Public involvement in planning is also necessary. For most agencies this is even more difficult to achieve than a diffuse planning capability. I don't really find too much input obtained from general public sessions. The Wisconsin Department of Natural Resources has relied on citizens' advisory councils to provide some of this public feedback. We may have overdone the council thing a bit; at last count we had 19 councils, covering everything from forest pests to natural beauty to ski touring. But the idea is sound. Many of these councils have provided excellent suggestions; and we attract talent on a voluntary basis that we could never afford to hire.

At the moment we don't have an advisory council for fish and game. We do have a Conservation Congress, consisting of representatives of each county, elected at annual meetings in each county. This Congress considers proposed fish and game regulations and makes recommendations as they see fit. Within the Congress there are about a dozen study committees, many of which are directly concerned with various elements of the fish and game programs. Rather than set up still more organizations, I think we will utilize this existing body.

Planning is no panacea. It won't replace hard work on the ground, in the marsh, or wherever. But I think that it does offer some advantages over intuition, or historical accident, or whatever other nonplanned approach to fish and game management is offered as an alternative. It's not very mature yet, at least in Wisconsin, and the performance is still quite a bit less than the promise. But the promise still looks good, the performance is improving, and the gap is closing.

Comprehensive Wildlife Management Plans: Why Progress is Limited in Michigan

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Introduction

This paper is directed toward identifying the major reasons why progress has been limited in responding to the comprehensive planning option provided for by the 1970 amendment to the Fish and Wildlife Restoration Act. The paper also addresses the question of why fisheries and wildlife management programs do not receive higher priority in the state budget process and relates this issue to planning and management policy. In addition, a process is suggested through which Michigan can prepare a comprehensive *wildlife* plan consistent with what is practical for us to develop.

Historical Perspective

Prior to discussing requirements of the comprehensive planning option and results of inquiries concerning the progress of other states, it will be helpful to establish the basis from which the federal government attempts to stimulate wildlife and fisheries management within the states had its beginning. Several congressional actions involved the federal government with the states in fisheries and wildlife before the mid-1930's. However, the principal basis for today's involvement stems primarily from the Wildlife Restoration Act of 1937. This law established the federal excise tax on the sale of sporting firearms and ammunition, the receipts of which were to be used by the states for wildlife restoration purposes. Although this landmark legislation is familiar to all involved in federal and state wildlife programs, it is important to emphasize several key attributes.

The funds were administered to the states by the federal government on a 75 federal/25 state cost-share basis. Each state's hunting license sales and land area provided the basis for distributing the funds. Another important aspect is that the states were required to have conservation legislation to prevent diversion of license fees in order to be eligible for these funds. Generally this meant that the states hunting license revenues were to be used only by fish and game agencies. The states and congress obviously recognized that the influence of the federal dollars could be an important stimulus toward the development of wildlife management programs in the states. Most state conservation agencies were oriented towards establishing game seasons, bag limits, and law enforcement before this incentive was provided. The Fish Restoration and Management Act of 1950 provided additional incentive and extended federal involvement further. This law established an excise tax on the sale of certain sport fishing equipment. Funds from this source also required a 75/25 federal-state matching ratio. These two pieces of legislation, along with the discretionary authority vested in the

Secretary of Interior administered through the U.S. Fish and Wildlife Service, provided much of the basis for the development of wildlife and fisheries management among the states.

Although the eligibility requirements for federal funds under these two laws differ, they generally require that individual project descriptions and justifications must be submitted for each project. A summary of the basic requirements will serve to provide some perspective of the scope of effort required of the states. It will also help to understand the difficulties the states have in responding to the comprehensive planning option. These consist of the following general requirements for research, habitat improvement and/or development projects:

1. Narrative project description.
2. Outputs expected such as man/days of opportunity and species produced.
3. Identification of processes required such as land acquisition and habitat improvement practices.
4. Identification of the project's contribution to program and project objectives.
5. Land acquisition, development and operations cost estimates.
6. Manpower estimates.
7. Estimates of project costs relative to total program costs.

These prerequisites for funding have become increasingly difficult for the states to comply with. This situation played a role in Congress passing the Fish and Wildlife Restoration Act of 1970, P. L. 91-503, which amended existing legislation and provided the comprehensive plan option. The basic requirement consists of a strategic plan setting forth the goals, objectives, problems, demand and supply evaluation, program strategies and an operations plan which details all program elements for a five year period. The operations plan must be updated at least once every three years. Upon federal acceptance of a comprehensive plan, the states are eligible for block grants as opposed to individual project funding.

Status of the Comprehensive Plan Option

The status of the comprehensive plan option in other states reveals that the planning option has proved to be a difficult undertaking. Although the option has been available for a little more than four years, it is our understanding that no state has been able to follow through with an acceptable comprehensive plan. The accomplishments have been limited to publication of several strategic plan documents. No operating plans have been completed. This aspect represents the most difficult part of the process. The situation in Michigan is not unlike that of the other states. However, we suffer somewhat more because the Department was instrumental in the development of P. L. 91-503. Our recommendations were submitted through the Grants-in-aid committee of the International Association of Game, Fish and Conservation Commissioners. The late A. Gene Gazlay, former Director of the Michigan Department of Natural Resources, was chairman of this committee. We had several reasons for wanting legislation of this type: a) better planning and coordination of effort to help meet increasing responsibilities and respond to increasing complexity of management, b) elimination of duplicating state and federal budget procedures, and c) relief from excessive administrative requirements imposed upon an already over-burdened staff. All of these problems were compounded by a declining financial support base—namely the Department's game and fish fund.

Causes of Current Situation

The concept of a comprehensive management plan and the opportunity to choose this mechanism as a basis for funding approval and decision-making seem sound. Why then has this option resulted in only limited progress? There are three basic reasons. The first and most important reason is that the comprehensive planning option was offered prior to a sound evaluation of the resource base information required to carry out the task at the state level. The results could have been predicted if an evaluation of the situation the states were in had been conducted. We really didn't understand what was required to carry this complex job forward. Michigan was simply not prepared to plan its fish and wildlife programs much beyond a project by project basis. It should be apparent that this is what we had been accustomed to doing for over 30 years! Although we have been able to do a good job of wildlife management on a project by project basis, extending requirements to all major species on a statewide scale, attempting to predict conditions for 15-20 years into the future, and conducting evaluations of alternative projects and programs is another matter. One cannot develop alternatives for management unless he has at his disposal all the principal ingredients for their development and evaluation. The major stumbling block to comprehensive planning on this scale is lack of adequate habitat inventories and accompanying research that provides the basis for determining the impacts of habitat management practices. Without comprehensive habitat inventories for the species in question, we can't determine where and how much might be gained in productivity even if the correct management practices were known. The problem is not with analytical techniques or models used in forecasting future conditions and evaluating alternatives. Current planning tools are adequate to provide a basis for planning, given a good set of parameters to start with.

Upon examining the nature and extent of habitat data available, it is apparent that the states concentrated efforts toward satisfying individual project requirements. This emphasis has resulted in only fragments of an overall habitat base. Thus, while the federal legislation provided a major incentive for management on behalf of the states, over 30 years of the project approach has contributed to our inability to respond to the comprehensive planning option.

In Michigan, habitat information is limited and restricted in its application. Acres of land according to 15 classes of timber and vegetative cover is available for Region 1 and 2. Region 1 includes the Upper Peninsula and Region 2 includes the northern half of the Lower Peninsula. This information is primarily for forestry and northern deer management purposes. Age and size class data for forest cover is available for only parts of these regions. The data is confined to about 3.8 million acres of State Forest lands. Harvest levels and total deer population estimates are also available on a county basis for these two regions.

Table 1 represents the majority of the public lands in Michigan according to federal and state jurisdiction and the proportion these lands represent of total state land area. The total land area of Michigan represents approximately 36 million acres. This total includes lakes less than 40 acres and rivers less than one-eighth mile in width. The public land area represents about twenty percent of the total. However, the majority of this land resource is located in the northern part of the state, Regions 1 and 2, while our population is concentrated in the southern part of the state in Region 3. Despite the relatively large public land holding, numerous limitations obviously are imposed on the wildlife management options available for these lands.

The state game and wildlife areas represent 63 different areas available for intensive management. Forty-seven of these areas were established to address public hunting lands deficiencies in Region 3, the southern part of the state, and to assure part of the habitat needs were being met. We also have 50 mini-game and pheasant areas and 14 recreation areas. Management plans based on acres of treatable habitat are available for most of these areas.

Apart from information on individual state game and waterfowl areas, the only other habitat data available concerns townships in the northern part of the state. A total of 361 townships, involving 40 counties, has been inventoried. Data on cover type according to marsh, open upland, brush, and seven classes of timber has been collected. The timber types consist of aspen, oak, jack pine, red pine, white pine, swamp cedar and hardwood. Acreages for these types of timber are broken down according to three categories consisting of seedlings and saplings, pole, and sawlogs. Animal population densities for squirrel, turkey, hare, grouse and deer are also available for these townships. Again, however, this data is restricted to public lands. The vast amounts of privately owned land represent-

Table 1. Federal and State public lands.

		% Total Land Area
National Forests	2,642,246	7.3
National Parks	170,538	—
National Wildlife Refuges	111,384	—
Federal Total	2,974,218	8.2
State Forests	3,770,056	10.4
State Game Areas and Wildlife Areas	262,935	—
State Parks and Recreation Areas	218,171	—
State Total	4,251,162	11.7
Grand Total (State and Federal)	7,225,380	19.9

ing some of the more productive habitat is excluded. Further, the task of relating the habitat to productivity levels for the game species has not been accomplished in the fashion needed. Although efforts have been initiated toward this end, it will be several years before these efforts yield results. We simply lack the habitat data and corresponding productivity linkages to develop comprehensive management alternatives for the major species. The question of evaluating tradeoffs between management practices is another matter. To do this we not only need the linkage between productivity and management, but the users response to the results of management. It would appear that obtaining habitat data for all lands should be one of our first priorities. However, this decision is questionable when the cost and the opportunity to manage private lands is considered. Enough knowledge exists to recommend management practices on private lands, given the proper legislative action needed to make such improvements attractive to private land owners.

The second major reason for the current state of affairs is simply that the manpower skills necessary to carry out the comprehensive plan option are not available to the people directly responsible for carrying out the task. The majority of talent is not trained in the technical and managerial skills required for comprehensive planning. Game management is almost exclusively dominated by people trained in the biological sciences. This situation has also been partly created by the project approach required by the federal government. This approach focused primarily upon biological considerations and not on procedures that adapt easily to comprehensive planning.

The last major reason why progress has been limited toward this option is the lack of state commitment. To date, our commitment has been qualified. Even though this option is eligible for 75/25 cost share, the severely strained budgets of the game and fish divisions places Michigan in the awkward position of imposing work on a staff already overburdened with another task that many are not properly trained for. Although the Department has an Office of Planning Services, staffed with professional planners, economists and statisticians, this staff has primary responsibility for the state comprehensive recreation plan. This responsibility imposes limitations on assisting with fish and wildlife planning requirements. Michigan cannot pursue the plan option consistent with the intent of the guidelines developed by the Fish and Wildlife Service. We don't have the finances, staff and data necessary to carry the task out.

Requirements to Respond and General Approach

If progress toward the planning option is to be achieved, the process must be modified to meet our circumstances. It will be necessary to compromise on the "comprehensiveness" of the initial strategic plan and operating plan due principally to the problems mentioned. Our plan won't include a broad range of alternatives available in big game, upland game and waterfowl. We must restrict efforts primarily to management practices in those areas of the state where we know through years of experience they will be effective. With waterfowl, for example, the plan will be limited to areas known to have development potential. What might be gained through development of hundreds of small marshes that have been drained will have to be ignored until the information is available to allow this alternative to be evaluated.

We fully recognize the need for better methods for evaluating management programs and projects. Equally important is an urgent need for improving the mechanisms we have for gaining public understanding of our management issues and what is needed to resolve them. Citizen input is therefore mandatory and a strategic plan can provide the basis for gaining this support. This is probably the most important benefit of the process.

The steps outlined below address key elements of our process. They provide interim solutions to the problems. The strategic plan preparation process for Michigan's wildlife plan consists of:

1. Habitat conditions will be evaluated using the experience of field personnel. Existing and future productivity levels of this habitat for the major game species will be estimated. This will consist of a county by county analysis based largely upon judgement. Harvest levels will be assumed to remain constant. Results of the productivity forecasts will be compared to county level demand estimates.
2. Demand estimates will be based on extrapolations of past data using a combination of trend and cross-section analysis methods. These estimates will be conditioned by "foresight" relative to known conditions. Existing origin-destination relationships for big and small game hunters will be used to distribute future demand levels to counties.
3. Counties where management potential exists for improved habitat will be identified. The anticipated impact of both *direct* and *indirect* management practices with respect to potential productivity will be assessed. In most instances, management emphasis for each county will be directed to a primary species such as deer or waterfowl. Harvest levels will be assumed to remain constant.
4. Productivity forecasts resulting from both the continuance of existing conditions and direct/indirect management practices will be evaluated against the demand forecasts. County level opportunity indexes will be developed for comparing current effort/harvest ratios with probable future effort/harvest ratios. Assumptions will need to be made on the effects of private land closure on opportunity.
5. Identify counties where management can be effective and which practices can be effective. Establish objective targets for man/days of opportunity and outline the general five year management requirements. Objective targets for non-comsumptive use will also be set forth along with the means for attaining them. Management requirements should also be inclusive enough to identify the potential productivity that might be gained on private lands given the appropriate incentives.
6. Draft publication summarizing the results of the process. Problems and issues, program goals, objective targets, management requirements, and basic policy and legislative requirements will be outlined. Citizen review and government agency review will be obtained at this juncture.

An important stage will be reached at this point. Based on knowledge acquired from the strategic plan preparation and review, it will be possible to refine the procedures and requirements for preparing the operations plan. The operations plan will need to address the information deficiencies we are confronted with in preparing the strategic plan. With completion of our strategic plan it will be possible to begin an all-out effort toward gaining public understanding and support. The inability of the Department to receive budget priorities is caused by two basic factors. We don't have enough documentation and understanding of the problems and the management needed to solve them. Most of this knowledge exists in the minds of a select few and is rarely communicated to the man in the street whose support must be won. While we assume an ever increasing share of resource management responsibility, along with it goes the involvement of many citizens and organizations. We need to face the fact that if we are going to get a larger share of the budget pie, we need solid grass roots communication and support behind our efforts. This is where the initial strategic plan can play an important role and pay off. This is also where planning is tied to the political process and the budget. The greatest fault we have in this regard is defining what we need to accomplish and translating this into a manageable "plan for a plan." Planning is a process of preparing programs or courses of action needed to accomplish objectives. The process provides us with a formal basis to define emerging problems and to devise means of dealing with them. An important task of the process is to raise major policy issues for responsible public officials and the public to consider. This function relates directly to achieving the most important goal—educating ourselves and the public. The overriding management principle is, however, to never make the process any more complicated than is necessary to get the job done. This is what planning should be all about.

The Fish and Wildlife Service must recognize our circumstances and position. Flexibility within the guidelines for planning is badly needed. Incentives need to be instituted that will make the comprehensive planning option a more realistic task for the states. Accordingly, we recommend that the Wildlife Management Institute and the Grants-in-Aid Committee of the International Association of Game, Fish and Conservation Commissioners adopt resolutions requesting the Secretary of the Interior to authorize block funding to the states upon completion of a strategic plan and commitment to develop an operations plan. Further, we would recommend that block grants be allowed on the basis of either a wildlife plan or fisheries plan. A schedule could be employed to bring the two elements together. This could also be required for the operations plan to insure the integrity of the Secretary's responsibilities. We believe the Secretary has the authority to institute these measures. If not, then the legislation should be sought to authorize them. They will go a long way toward providing the support the states need to respond to the important job of long-range planning for our wildlife and fisheries resources.

Discussion

DISCUSSION LEADER BROWN: The Chairman tells me we are going to stay on schedule. I would like to take these papers in the order they were presented.

First of all, does anybody have questions with regard to Jim Rawson's paper? Jim said that better decisions are made with better information. That is about as succinct as you can get in describing the purpose of the planning system. Do we have any questions for Jim?

Also, as the paper of Monte Richards indicated, things are moving along in Idaho. I am very happy to hear that Joe Greenlee is giving you all the needed administrative backing. I have heard Joe say for many years that there has to be a better way of doing business. Are there any questions for Mr. Richards?

MR. DALE JONES: I would like to ask Monte a question. He mentioned that one of the problems between external and internal coordination of planning was the land base of the external planner versus the internal base and I was just wondering, with the new interest in so many more species, do you visualize a trend on the part of various states to possibly go to a land use base? Will there be a conservation officer area where they would manage a mix of species and the diversity of species within that area rather than the individual species plan that has been the rule of the game today?

MR. RICHARDS: I think this is possible. For instance, we are doing essentially just that in an inventory process. We are inventorying not only game species, but non-game species, and in this process, in order to obtain that data, we have started out with our smallest breakdown, which is the conservation district, and given them the responsibility of preparing this inventory for that district. Then, of course, this is accumulated as it goes up the line.

Yours is a rather difficult question, as I understand it, to answer. However, the only way I can answer it is to say we are going to have to go just so far before we see which is the best. We have considered this method. We have looked at it from several angles and, at least to begin with, we are going the species route. However, I would concede very readily that there are some areas, at least maybe in specific instances, where the geographic approach rather than species approach would be more appropriate.

DISCUSSION LEADER BROWN: Is there any other discussion of this paper?

The next paper, by Art Doll, involved the State of Wisconsin. I think that Art presented a very strong case that every state should determine for themselves how the planning system can best be implemented and if I am reading you right, Art, the best way is slowly and patiently. Are there any questions for Art Doll?

FROM THE FLOOR: I was wondering if the State of Wisconsin had identified their products and, if not, I can understand why then it would be very difficult to come up with objectives.

MR. DOLL: I think I heard you say "products." Okay, we are just getting to that in terms of fish and game plans. However, one of the things that we have tried to do in our program planning and the budgeting that went with it was to quantify some of these things.

You get a reaction out of people that are asked to do that, obviously, because it is very difficult, and I would say that we have taken our first faltering steps along the way. However, we are not very far along, but because we have faltered doesn't mean we are going to quit. We are not going to do that.

MR. HERBERT DOIG [New York]: I got the impression from your discussion that you felt that planning was going to take a lot of responsibility away from the Program Manager. I wonder if this is the case and I wonder if you could tell us how you see the planner in fish and wildlife interfacing with the Program Manager?

MR. DOLL: Well, I suppose that kind of impression does get conveyed, no matter how carefully one tries to set up a program that avoids it. What we are trying to do is to build planning capability into the various program bureaus. In other words, the Bureau of Planning is not going to produce the fish and game plan. The Bureau of Fish and Game, which is a program bureau, is going to produce that plan, just as the Bureau of Forestry would produce a plan that deals with forestry and so on.

I would say that at this moment we are not totally successful, obviously, because we have taken staff away from fish and game and assigned them to this task, which resulted in immediate resentment. However, if we can get what we asked for in the next budget, and we can put program planners into these various bureaus, I think we will then overcome part of the difficulty.

However, in our reorganization, where the operations are decentralized into the six districts, the only real function that is left for the bureaus that are located in the central office is, in fact, planning. As a matter of fact, some years ago, when we were first talking about the reorganization, I suggested, facetiously at the moment, or rather, in an off-handed manner—"let's take all the people left in all the staff positions and put them into a great big Bureau of Planning because that is what they are supposed to do." There are days now when I wished I had not made that statement facetiously, but, nevertheless, that is supposed to be their function.

MR. BOSSENMAIER [Manitoba, Canada]: I wonder whether you have identified any real danger signals ahead? I know this is a new planning experience and it seems to be moving ahead quite well and some problems have been identified. However, have there been any real danger signals—things you feel, when you get to them, that you don't know how you are going to surmount them? For example, I have reference to the point that Hugh Boyd was trying to make earlier, which essentially comes down to the question of what is a satisfactory use and who is going to determine it?

DISCUSSION LEADER BROWN: Satisfactory use, as described by most of these papers, I think, is going to be determined on an ever-changing basis. That is why the plans are going to have to be dynamic. Art, you probably want to address this.

MR. DOLL: I am not sure I want to address that off-handedly or not, but I would say, if nothing else, that I cannot think of anything I can agree with more than the idea that this is probably the heart of the difficulty. As I mentioned earlier, you can set a goal of a million man days of big game hunting. Well, so what? Whose satisfaction are you using as that standard?

This is one thing I believe we are going to be wrestling with for a long time. As a matter of fact, I am not sure that we will ever have a satisfactory answer. Maybe you can even say there are some people who will be satisfied with one level, others who would take maybe half of that in terms of success, and then a few people who will not accept it at all. I suppose that when we get all through, we are going to be arbitrary and say that we will settle for satisfying 80 percent of the people at some level, whatever it may turn out to be. However, it is going to be arbitrary.

FROM THE FLOOR: I would like to address Mr. Bossenmier's question on satisfactory use. The use of a resource is like beauty—it is in the mind of the beholder. I don't think it is right for an agency to set an arbitrary satisfactory use on a resource, for instance big game or waterfowl, wherein they harvest X number of animals, etc., on a particular time scale. I think you have to manage and establish a framework that is biologically feasible and then provide a diverse amount of opportunity.

This is the position that Colorado has taken. If we provide a lot of different types of use, the people themselves will tell you what they are satisfied with. This is what makes your plan feasible, but you cannot arbitrarily set it.

MR. UNDERHILL [Bureau of Outdoor Recreation]: I guess I would address this to all or any of the panelists. Certainly, fish and wildlife are one of the resource basis that provide outdoor recreation and, as you all know, the states now pretty much prepare comprehensive statewide outdoor recreation plans. I would like to ask how the fish and wildlife management planning, which is being done by the fish and game agencies in the states, tie into the total comprehensive planning in the state, for example, how it pertains to the transportation network, the location of industrial development, etc. They must have a significant impact in your fish and wildlife management. Therefore, it seems to me that all of this needs to be tied in together and yet, I don't believe it is. I think all of these various plans are being prepared almost in vacuums which, to me, is extremely short-sighted.

DISCUSSION LEADER BROWN: I am going to start answering that by saying, "Not so." Ours, in Montana, is designed to dovetail. Does anybody else on the panel care to address that?

MR. DOLL: I would not say that we are preparing each of these in a vacuum. Neither would I say they are in a full degree of coordination because that is obviously not true.

I would say this, however, that in terms of the broader kind of state land use planning, I have yet to see any state successfully produce what could be called a comprehensive land use plan. Here, I include my own state, where we do have, in fact, within the Department of Administration, an organization that is supposed to do this. However, there are many elements involved in this kind of thing. For example, there is the transportation plan and, within that more specifically, an airport plan, rail plan, highway plan and so on. We have, I would say, a reasonable degree of coordination of those various plans with other state agencies.

Also, there are technical advisory groups. I am a member of almost too many of them. In a sense, it detracts from what I am supposed to be doing; yet, I look upon these as being equally important and perhaps more important than the day to day operations within the department, because I can let my staff take care of that. Therefore, there is an attempt to tie these elements together. Fish and Game have addressed them in our state, and so have most of the other departments, but not at the level or degree of detail that it will be addressed in a plan as specific as the one for fish and game. Thus, the scope is the broad plan that I alluded to in my earlier remarks. The Fish and Game Plan is a more detailed one. I don't think it is fair to say that they are not tied together at all, but they undoubtedly could be tied together much better.

MR. RICHARDS: I might briefly add something to that. I agree with Art. There is no parameter of any comprehensive state planning corresponding to all activities. There are, however, as in Idaho, several individual plans, such as a state water plan, a state recreation plan and, hopefully, some day a state fish and wildlife plan.

To my way of thinking, the benefits of these, when they are all looked at together, is that when somebody is doing something, they also have another plan to refer to. They can check what they are going to do against what is contained in the other plan. This is probably the time at which the coordination, the meshing together and the adjustments will be made—not necessarily at the time when these individual plans are initially designed and brought together.

DISCUSSION LEADER BROWN: I think we are going to have to cut off discussion on that aspect until we get through John Kennedy's paper from Michigan.

The question has come up again as to how much information is adequate for writing a strategic plan and here again I think we have the committment to plan. We can only try it out and see. We may well have to alter our plans to accommodate changes.

With that brief comment, are there any comments to John Kennedy of Michigan?

MR. KEN ANDERSON [Maine]: The question I have for Mr. Kennedy is a very simple one. Did your department recognize the inventory deficiencies before you started to attempt to plan?

MR. KENNEDY: No, I don't think the department did—either that or the department, when it was considering the importance of comprehensive fish and wildlife management plans, had a process radically different in mind, at least different from what we now interpret the guidelines to mean. We will have to follow through in order to comply with the guidelines. Honestly, I don't feel that the department clearly understands the amount of work and complexity that is going to be required to carry that job forward.

MR. ANDERSON: From my point of view, it is not whether it is necessary to carry the job forward, but, from the way you have been operating in the past, you really don't know what you have and you have nothing on which you base your decisions. However, I submit to you that you have accomplished one of the major goals of planning—you have looked at your program, you have evaluated it, you have reviewed it and you are now finding its shortcomings. This likewise is a part of the problem and is what we all need to do.

I personally do not believe that we have enough inventories. I think that as professionals we have been much too interested in the little microcosms that interest us personally and not necessarily the whole.

MR. KENNEDY: In answer to your comment, yes, that is probably true. I indicated that we have been able to do a good job of planning and of projecting planning on a project by project basis. That is essentially what the department decisions in behalf of fish and wildlife were made on.

That isn't to say that the department did not have sufficient information to handle the planning process and review, project by project, planning parts of the process. I think we did, but in view of interpreting the guidelines and what they require for overall, comprehensive planning, no, we do not have information to carry that job forward.

MR. ANDERSON: I am picking on your state, but ours has operated the same way ever since it began and the time has come when we have to take a broader viewpoint than just a project by project basis. This is the point I am trying to make.

MR. KENNEDY: I would certainly agree.

MR. ANDERSON: I have one other question for any or all of you. Who determines what these species management goal or goals and objectives will be?

MR. KENNEDY: I would say that the fisheries and wildlife management people should indicate—and I say, "indicate"—what those goals and targets should be. On the other hand, I think that the political process, in the final analysis, would decide how far we get toward the target and how these goals will be set.

MR. ANDERSON: How do you intend to implement that? Do you intend to set up committees, as I heard mentioned here before, of citizen groups or whatever?

MR. KENNEDY: Yes, that would be part of it. Also the legislative response to the plan recommendations and program recommendations.

DISCUSSION LEADER BROWN: We have gone from the no planning concept of the first presentation to almost infinite detail planning and everywhere in between. It becomes clear that in order to determine a workable plan or system, you must get involved and carry it out to its operational planning phase. If you have too much detail, it is correctable; if you lack detail or if your system lacks sensitivity to changes, it will become apparent and you can again correct your system. However, apathy and reaction to crisis is less than an alternative to planning.

CHAIRMAN BRAY: Thank you, Don.

Please stay with us because we have two more speakers who will be getting into what I feel are very important papers with reference to the cooperative attitude and cooperative approach.

However, I must address for a second, the satisfied use question that was brought up. I think that you and I, as managers, will have to worry about satisfied use or, believe you me, those people that carry the rod and reel and firearms in the field will certainly express their opinions about it. We will know what their desires are, so I don't think we will really have to worry so much about that right now. It will get to us and then we will have to respond to it.

The Need for Cooperative Approaches to Fish and Wildlife Management Planning

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It is clearly recognized that the cooperative approach to fish and wildlife management between State fish and wildlife managing agencies and the U. S. Forest Service, on lands administered by the latter cannot be presented as a new concept. However, it does bear definite restatement and commitment in these times of increasing environmental needs, which unfortunately are also times of increased costs and austere governmental budgets for purposes of this kind. The losses of key fish and wildlife habitat are not only continuing, but the rate of this erosive process is quickening. If the animals involved had a voice in the matter, I surmise they would plead for more concerted action, greater understanding of the problems involved, and the type of approach to the solutions of those problems that better assures success by generating a combined effort exerted in the same direction at the same time.

First, let me say that the long standing policy which recognizes the management of resident wildlife as being a State responsibility, while the Forest Service assumes the responsibility for fish and wildlife habitat on the lands under its administration (i.e. the National Forests and National Grasslands), still exists. This policy is reiterated from the Forest Service inservice directives to the preamble of practically every memorandum of understanding and cooperative agreement we have with other agencies. However, since the animal and its habitat are inevitably and interdependently related, a cooperative approach is imperative if the wildlife resource is not to suffer irreparable damage and loss. There are a number of new facets to this relationship, particularly in the ramifications of planning, that present some different and challenging situations.

It probably is more difficult for agencies to plan cooperatively than it is to cooperatively conduct management procedures. Reasons for this seem to be bound up in the separateness of the thought that ordinarily goes into the internal planning process. Each agency tends to plan from an isolated position within its regulations, legal authority, management responsibility and management philosophies developed through long periods of trial and tribulation. It may have been satisfactory in the past to develop management programs and actions within an organizational bubble, but in this age of ecological awareness, interrelated objectives, and competition for the not-so-available dollars, it may prove most beneficial to all concerned to determine how we can support the total effort rather than "attempting the end run without any blocking." It may be that too many think of planning as an end in itself; or perhaps everyone doesn't agree that comprehensive planning:

1. Plays an essential part in functional administration by governmental agencies.

2. Is concerned with shaping and directing the action needed to attain determined goals.
3. Is done as a continuing process for assessing needs and problems, identifying their interrelationships, and setting priorities and programming actions to meet them in effective and economic ways, or
4. Is a means of facilitating cooperative action on common problems.

It should be possible to subscribe to the first three if we recognize that, as stated in the fourth, our problems are mainly common ones and that we all have a mutual real-world interest in solving them. Idealized, insulated, strictly unilateral planning is probably no more relevant than trying to confine such planning within the artificial boundaries of agency responsibility with the thought it has no effect on anything else. If we are truly interested in maintaining or improving the environment of man and other living things, we must think of it in its fullest ecological aspects. Since environment is the controlling factor of animal welfare, it must be a matter of common concern.

When reference is made to "cooperative planning" in this presentation it is not intended that it is necessary to agree with every idea presented, but it is necessary to have some common objectives and willingness to work out areas of conflict so these objectives can be realized. Many opportunities exist to contribute to this effort and I would like to remind you of some now.

Public Involvement

The increased public awareness and concern about land resource management issues, and the public scrutiny that goes with this knowledge, provide opportunities for developing the kind of informed public that can produce the foundation of support so badly needed. This public needs to know the interrelationship of responsibilities between agencies and to be aware of the cooperative efforts that are at work. Otherwise, there is the tendency to choose sides and put emphasis in places where it upsets the balance it is necessary to maintain if a uniform and workable approach to wildlife habitat management is to be realized.

Strong interagency collaboration is also needed in conservation education and publicity. Public support is a must if conservation programs are to succeed, but this is possible only if the public can recognize a unified approach. Leadership is, of course, important but it must be a leadership based on a coordinated understanding and without domination by any participant.

Endangered and Threatened Species Programs

The provisions of the Endangered Species Act of 1973 establish areas in which cooperative effort and planning are essential. This begins with the inventory process to determine where, or if, the species in question are present; the extent of the populations of each, the condition of the habitats on which they depend and finally the "critical" habitat areas essential for the preservation of these species. Because the land-use planning and management involving these areas must not be detrimental to the overriding needs of the endangered species, closely coordinated and cooperative planning and management are imperative. In addition, many States are supplementing the Federal Endangered Species Act with control measures aimed at benefitting species considered rare or unique within the concerned State.

To satisfy both situations, adjustments are being made in the management programs for other resources when endangered wildlife species are involved. This may require a different perspective for some agency administrators since it is necessary they adjust their programs to satisfy the needs of endangered and threatened species rather than the other way around. The need is for considerations that recognize this new area of common concern and permit a cooperative effort that gets the job done, while avoiding conflicts.

Non-game Species Programs

The wildlife management agencies are extending their programs much more into management areas other than those for big game and game birds. The recognition of a responsibility for the maintenance and possible increase of all wildlife species has put a strain on budgets historically supported by the sale of hunting and fishing licenses. Consequently other sources of income are being explored.

By the same token, a greater diversity of wildlife demands a greater diversity of habitat conditions. The land-use patterns on private lands cannot be radically changed unless the areas in question change ownership. This then leaves public lands as the main areas available for manipulation into diverse habitats. Sometimes this can be done as a wildlife management initiated project. More often it is a result of being able to take advantage of securing wildlife benefits from some other action, such as appropriately planned and executed timber harvests, road construction, grazing practices, etc. All these are best realized when a cooperative attitude prevails that keeps everyone, regardless of management agency, advised of the wildlife and other needs, of management programs, objectives and priorities, and of the constraints involved (finanacial, legal and those related to other resource management programs).

Water Management

As the country's population continues to grow and as population centers shift with its industrial and recreational developments, the availability of water becomes more and more critical for all purposes. Fish and wildlife particularly suffer because they have historically been assigned a lower priority than most other uses, if in fact they have been considered at all.

It is necessary now that the minimum flows-deemed necessary for each need in each waterway be quantified so each can be given its due consideration in the processes of water appropriation, acquisition, pollution control and litigation that have become a way of life in Western U. S. To get any kind of "fair shake" for fish and wildlife, it is necessary that the agencies concerned with their welfare band together in establishing the needs for this purpose and "hang tight" against all comers thereafter who are bent on siphoning off everything they can get for other purposes.

Right now several agencies are working together to develop uniform criteria for determining the minimum flows needed at differing seasons of the year for fish, wildlife and recreation purposes. These are to be such that they can be used by everyone concerned and will "stand up" in court. Streams are being surveyed by interagency teams to: (1) determine their fishery values, (2) to determine their qualifications as wild and scenic rivers, (3) to collect the data necessary on which to base minimum flow demands, and (4) to monitor the maintenance of water quality.

The maintenance of lake and reservoir fisheries constitutes unique situations in that rough fish and aquatic vegetation problems present themselves. Adhering to the policy of State responsibility for the species and Federal land management agency responsibility for the habitat, the control of both these problems again requires a cooperative approach. Speaking for the Forest Service, we often purchase the materials and the State people do the actual control work. This keeps them involved in the fish species management aspects of the job and we take credit for having improved the habitat. However, the situation is often in reverse in the case of stream improvement work which the State may finance the work while we furnish the personnel and equipment and actually install the needed improvement devices. This then puts us in the position of improving the habitat and the state fisheries' management agency can take credit for having improved the fish survival (and hopefully the quality of fishing).

Access and Off-road Vehicular Travel

The access situation presents some new problems in that the continuing increases in the number of hunters and fishermen and the more sophisticated means of transportation available to them severely tax the public lands and waters. Where only a few years ago we were developing cooperative access road construction projects with state wildlife management agencies, now we are endeavoring to find ways to control the amount of access to some areas. This will better distribute hunting and fishing pressure to ensure a quality outdoor experience and greater individual success, improved safety factors, better control over harvests, and less wear on the soil and vegetation in the areas in question so they are not irreparably damaged by off-road vehicular travel.

This has become nearly as important a factor for agreement in recent years as the dates and lengths of the hunting and fishing seasons. In an effort to control the amount of human use in an area while still making it available to hunters, fishermen, snowmobilers, etc., we hit upon the idea of closing entire areas, except for designated routes of travel. Thus, only the few open roads have to be signed instead of all the routes that are closed. Signs that mark an open route are more apt to stay up than a closure sign. In fact, if an "open-road" announcement is torn down under these regulations it serves only to close the road because it is no longer designated as open. The wildlife managing agencies find this a desirable procedure and a cooperative arrangement of law enforcement is established which has mutual benefits.

Every National Forest has maps of the closed areas and open access routes printed on newsprint and available ahead of the hunting seasons. In several cases the State and Federal agencies have cooperatively printed color-coded landownership maps so a hunter can determine where open lands are available to him. Such maps have proven to be particularly useful in the National Grasslands' areas where an interspersion of ownership prevails.

Animal Damage Control

Many states where animal damage control has been a perennial problem have in recent years experienced the results of some political machinizations which brought changes in responsibility, extent of involvement and the planning approach. Where the Fish and Wildlife Service had previously acted as the agent for land-managing agencies in the area of predator and rodent control, that activity has been assumed by one state agency or another, or in some cases by some county entity. In any case, a whole new planning approach is necessary since in most instances the control responsibility is not with the agency still held responsible for wildlife management, nor is it necessarily with the agencies responsible for land-use decisions. This has some odd aspects at a time when most wildlife management agencies are expanding into more realistic action beyond that associated only with the management of game species. It remains necessary to maintain the traditional state wildlife management agency responsibility for matters concerning wildlife while asking some other state agency to control animals in order to protect habitat or uses of the lands administered by federal agencies. Obviously, new types of understandings and agreements are necessary.

Fish Stocking Programs

The stocking of fish is another type of management action that rarely is considered anything but a state responsibility, i.e., within the realm of species management. To be properly coordinated this needs to even include those fish produced by federally-operated hatcheries and stocked in public fishing waters. A cooperatively developed program is called for. Because fish are raised in federal hatcheries in no way dictates they should be planted only in federally administered waters. We see it as a federallv-financed program which dictates that the fish produced should be utilized for public benefits wherever stocked. A coordinated (cooperative) program should be developed and followed to see that fish are stocked by species and numbers in those waters where recreation and land use demands are duly considered.

The passage of legislation classifying many areas of federal land as wilderness poses yet another problem. The land management agency is required, under the law, to prepare a management plan for each Wilderness Area under its administration. However, such a plan must include considerations for the control of public use where it might detrimentally effect these fragile ecosystems. Since fishing is a popular activity in the Wilderness Area and, in fact, is considered an important feature of the wilderness experience (even to the point of furnishing a non-transported means of sustenance by long-staying visitors) it does cause human use to be concentrated around the best fishing waters. This can only be offset by planned fish stocking which is manipulated in such a way as to move the concentrations of use from place to place. Thus, heavily used areas surrounding, or on the way to, those waters are rested from time to time. An associated system of publicity is involved to keep the users advised of fish stocking programs. Both fish stocking and publicity programs are incorporated in a cooperative agreement drawn within the framework of the Wilderness management plan.

Research

There is much duplication of research and study effort that could generally be avoided by all agencies if there was a better rapport between agencies on research and study needs. There is little enough wildlife oriented research in progress in relation to the need to accept duplicating research projects, to allow the misspending of difficult-to-secure funds, or permit the lack of needed research merely because the priority of need is not recognized. At times there also appears to have been a failing channel of communications between research and management personnel within agencies and between agencies.

One means of rectifying this situation that has worked in Colorado has been through the formation of an interagency organization known as the Council of Wildlife Ecology. Two-man representation is established for each agency that is directly associated with wildlife management or with land use management, with one each from their administrative and research arms. The so called Council then meets twice a year to exchange ideas for new research and to discuss the results of ongoing research and studies. The Council is in position to suggest interagency study or research committees to work cooperatively on projects which their respective administrators approve. Thus, a cooperative atmosphere exists from the inception of a research or study idea to its completion. Proposals of considerable magnitude and pure research are referred to the research facilities of the appropriate agency. Thus, the research programs are a meld of management and research philosophies, as well as having interagency coordination.

Requirements of the National Environmental Policy Act

Under the provisions of the National Environmental Policy Act, Federal agencies are required to analyze and report the anticipated environmental effects of nearly every proposed action on the lands they administer. In the effort to assure that the fish and wildlife resources are fully covered, along with others, we strongly recommend to the state wildlife managing agencies that they instruct their personnel to make input into the on-the-ground analyses. If the intra-agency as well as the interagency lines of communication are fully utilized, the subsequent review process is simplified because the reviewers have better knowledge of the on-the-ground situation and misunderstandings resulting from differences in perspective are less apt to occur.

The passage of similar state environmental policy legislation is currently being considered, or has been recently passed, in many state legislatures. When such legislation is passed, reciprocal action on the part of the federal agencies should be expected.

An area of extreme importance within any land-use management agency is the coordination of activities so that the optimum conditions for each resource is secured within the constraints and priorities of the management situation in question. This actually may be considered a type of in-service cooperative effort. Although each resource division strives to secure equitable consideration for its area of responsibility, it is the administrator's responsibility to see that the proper combination of things is maintained to conform to the requirements of multiple use planning and to permit realization of management objectives. This is the multiple use principle in action and in proper practice it becomes a way of thinking, as well as doing. In other words, it should not have to take special direction or effort, but should be a standard operational procedure.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act requires that when any waters within a state are to be in any way altered by a federal project or by a project that is federally financed, the affected fish and wildlife resources will be determined and recommendations will be made as to how they may be maintained or enhanced, or if this is not possible, how any losses can be mitigated. The Fish and Wildlife Service is responsible for writing the report and it must be concurred in by the concerned State fish and wildlife management agencies. The land managing agency then can use the recommendations from the report as considered stipulations in its use permit or, in the case of U. S. Bureau of Reclamation projects, as fish and wildlife benefitting features included as project costs.

The provisions and intent of this Act work best when the involved agencies keep one another informed of impending projects and work together from the first on-the-ground surveys through to the completed "Coordination Act report."

Land Use Planning

A unique situation was recently created in Colorado when its State Legislature passed the Colorado Land Use Planning Coordination Act. In essence, it gives the local Governments (i.e., counties and municipalities) the responsibility of establishing and administering their own land use planning regulations based on certain predetermined areas of "State interest." If they do not or cannot assume this responsibility, the State Land Use Commission steps in to fill the void. The Forest Service views this as an opportunity to fulfill its established mission for the support of state and local government and to focus land-use management at the ground level, "where the action is." It also affords the opportunity to more fully coordinate inter-government resource management and land-use controls. In other words, it is another way of making the multiple use management principle work. Since areas of significant wildlife values are stated in the law as being one of the "matters of state interest," it again throws the state and federal agencies together in cooperatively developing guidelines and performance standards which will be applicable to all combinations of landownership and interrelations of use that can be utilized in local land-use planning.

All agencies also work with the State and county planning boards and county commissioners to assist them in the accumulation of the necessary facts required to make knowledgeable decisions on zoning and land-use planning. For the first time, fish and wildlife resources are getting equitable consideration in these planning processes. However, growth and municipal expansion is so dynamic at this point that the agencies are sorely pressed to keep up with the demands on their funds and personnel, particularly when the procedures themselves are still in the formative stages.The job is considered so important that it is given a high priority in the current work programs.

P.L. 93-452 (Sikes Act) for Cooperative Wildlife ProgramDevelopment on Federal Lands

Title II of that Act singles out the Forest Service, Bureau of Land Management, NASA and AEC administered lands as offering States the option of establishing special fund raising programs for designated areas of public land having especial wildlife values. The funds so raised as to be "plowed back into" the designated areas for cooperative wildlife habitat development and maintenance purposes. The Forest Service sees the provisions of this Act as opportunities to assist in carrying out the desired, but so far insufficiently funded, programs for nongame management; protection or rejuvenation of endangered and threatened species; as well as improving conditions for or preventing the loss of, important habitats of game species located on federally-managed lands. If the States don't care to participate in the fund-raising options of the Act, the Federal agencies involved can still use their share of the Federal allocations to develop programs of their own or to cooperatively develop habitat improvement programs on designated areas of particular wildlife importance. To qualify, the Federal agencies must have developed a Statewide comprehensive wildlife plan for the lands they administer within each State. Such a plan is, in my estimation, meaningless without State wildlife managing agency input and we solicit that kind of assistance.

We like to point to similar programs which have been conducted so successfully on National Forest System lands in Virginia, Missouri, West Virginia and North Carolina before the passage of this Act. We are now in a position to apply this concept elsewhere. If the Act is financed as proposed, we finally have some matching funds to put along side those of the other involved agencies. Many States have developed, or are in the process of developing, comprehensive and objective management plans of their own. One example is Colorado's so-called "Strategic Plan" (The Strategy of Today for Wildlife Tomorrow). In it, an effort has been made to project its objectives and the means of realizing them into the future. This evolves as an effort to have as much wildlife, of as many kinds, in as many places as is possible. We in the Forest Service propose to help them realize that ambition within the constraints dictated by the other uses and needs of the land under our administration. We do not recognize those as conflicting goals or philosophies. Rather, we think of them as another example of how the different agency responsibilities, policies and management plans can be melded to work for "the greatest good for the greatest number."

It is high time that we all become involved in combatting environmental degradation and insuring restoration and continued functioning of all environmental systems. Man simply must give considered attention to all alternatives and apply some brakes to the downhill glide in which he finds himself. Only man is in a position to aid all the other creatures he is affecting. They in turn, if given the opportunity, can help maintain the environmental equilibrium that is essential to the best welfare of all. Once an understanding of the needs of other animals is fully known, man can determine the condition of his own environment by the condition of the other creatures. Let us hope we can bring about the needed turnaround before an environmental catastrophe occurs. Planning with that prospect before us may actually keep it from occurring. Ignoring the prospect is liable to put us beyond a point of no return once the balance begins to swing past center. Even the hunter, the anti-hunter and the wildlife manager will do well to consider each other's ethical philosophies and social constraints in order to cooperate in and strengthen their overall conservation efforts.

The total job is of such magnitude that there is more than enough to be done within the individual sphere of influence of each involved management agency. The only hope of real accomplishment lies in a combined and coordinated effort. I might add parenthetically, if as much effort could go into this aspect as has gone into the adversary actions of the past, the wildlife management profession, the wildlife and the habitat on which the latter depends might all be in better condition today. Be that as it may, we can't go back in time, but there is good reason to go forward with an affirmative attitude and renewed vigor. There is nothing wrong with applying the system of checks and balances in the process that interagency relationships provide.

Setting Priorities for the Endangered Species Program

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The passage of the Endangered Species Act of 1973 broadened the responsibilities of endangered wildlife programs to include all members of the animal kingdom. The Endangered Species List maintained by the Secretary of the Interior now (May 1974) includes 311 foreign species including one invertebrate, and 109 U. S. vertebrates. The 1973 Act also directed increased attention to invertebrates and plants, and implied that action would be taken to protect ecosystems which are vital to the preservation of any species. This broad charge will result in a greatly expanded list of threatened and endangered organisms. The mandate of the Act to take action to protect and rehabilitate all species far exceeds the available resources of manpower and money, and a need therefore exists for a system that can assist in guiding allocations of available resources to endangered species programs.

We have undertaken the development of an endangered species priority system over the past two years. This development has included a test of an early version of the system in which priority listings were generated, and the soundness of the system and the data base were assessed. A second version was prepared on the basis of this experience and submitted for peer review. More than 40 biologists from universities, state and federal agencies, and private organizations provided critiques of the system which were used to assist in preparing the version being presented here.

The basis of the priority system is an assessment of the imminence of the threat to the species' continued existence. It is not an attempt to replace human judgment, but merely an aid to ranking endangered status prior to making decisions for action. The system is largely based on the biology of the animal and the security of its habitat. Biological considerations center on numeric status, capability of the animal to respond to actions taken to reduce the threat to extinction, and genetic and evolutionary characteristics of the species. Trends in the amount and suitability of critical habitats are evaluated and man's capacity to manage habitats is scored. There are four main sections of this priority system. They deal with the species': (1) population status, (2) vulnerability, (3) recovery potential, and (4) special attributes. Assignment of values (100 points total) to the sections and their subheadings are our subjective evaluations following consultation with other scientists.

The kind of system that can be used is influenced by the available data base. Many species, regardless of their biological characteristics, have simply not been of great interest or value to man, and thus our knowledge about them is sparse. Other species have either been elusive and hard to study, or have yielded data we cannot yet understand. The result is that we know quite a bit about some animals or about certain characteristics of groups of animals, and little or nothing about others. These disparities in the preciseness of information exist throughout the animal kingdom and influence the way in which any priority system can be constructed or used. There is *no scientific justification* for designing more sensitivity into the system than is warranted by the quality and quantity of the data. A useful comparison may be the following: if you measure an elephant in grams and he defecates, your attempt at added precision has been fruitless.

The use of general statements characterizing biological attributes of animals in different taxonomic groups may assure generally high scores for all animals which possess that attribute; for example, all animals which occupy high trophic levels may get high scores. It is also possible, of course, that animals in higher trophic levels *are* more vulnerable and more likely to become endangered.

In general, with our system we expect species in the most desperate straits to score highest. In addition, species about which we know little will also score high. This is because we have provided an "unknown" score in all sections of the system, and each of these unknowns can equal the score assigned to the most desperate condition. We suggest that total scores include the unknown component listed separately so that the contribution to a total score based on incomplete information can be identified. The first value will be the total score assigned for all sections, and the second the number of these total points that were the result of unknowns. Thus, an animal could receive a score 75/15, meaning that 15 of the 75 points were based on a lack of data. Most likely, action on a species about which little is known would therefore be directed at providing information needed to assess its status. Obviously, if an imminent threat which could wipe out the species has been identified, action to halt this threat would be taken regardless of the need for information.

The priority system which follows has been constructed to be as flexible as possible to cope with the huge differences in quality and quantity of available information, and the great array of differences in biological characteristics between animals. Once animals have been scored with the priority system, and other information about them has been considered, the scores will be used to list them in rank order of endangered status. Action will be partly determined by political, economic, social, and biological factors. Overwhelming biological realities may supersede other considerations, and administrative realities may supersede biological considerations; but all who examine the program as it proceeds will be able to see from these priority lists where the departures are made.

Endangered Species Priority System	*Assigned Value*
I. *Current Status of Population* (25 possible points of 100 total)	
A. *Index of population size* (10/25)	
1. No reduction in numbers and/or distribution.	0
2. Descriptions indicate some reduction in numbers and/or distribution.	1

3. Counts or estimates indicate some reduction in numbers and/or distribution. 2
4. Descriptions indicate low population, rare animal, or population possibly always low. 4
5. Counts or estimates indicate significant reduction from former numbers, or data indicate population probably always low. 5
6. Descriptions Indicate possible extinction, extremely low population or severe reduction from former numbers. 8
7. Counts or estimates indicate severe reduction from former numbers, or descriptions indicate probable extinction. 10
8. Population size *unknown*. 10

B. *Index to population trend*(15/25)
1. Data or descriptions indicate a stable or increasing population. 0
2. Population stable or increasing, but data or descriptions show a history of large fluctuations in numbers. 2
3. Verbal description indicates declining population. 6
4. Population declining but data or descriptions show a history of large fluctuations in numbers. 8
5. Preliminary counts or estimates indicate a pattern of decreasing numbers. 10
6. Counts or estimates indicate population decline of several years duration which will, if unchecked, lead to extinction within 50 years. 12
7. Counts or estimates indicate population decline of several years duration which will, if unchecked, lead to extinction within 25 years. 15
8. Population trend *unknown*. 15

Total points for Section I ___

Unknown component of total (Points based on lack of data) ___

II. *Vulnerability* (35 possible points of 100 total)

A. *Reduction in amount and/or suitability of critical habitats which has occurred or is imminent* (10/35)
1. No reduction (not a problem). 0
2. Slight reduction (no urgent problem). 1
3. Significant reduction (up to 1/2). 3
4. Severe reduction (more than 1/2). 5
5. Approaching total loss. 7
6. Total loss of original habitat (go to IIC). 10
7. Insufficient knowledge (*unknown*) as to what constitutes critical habitats (go to IIC). 10

B. *Rate of reduction in amount or suitability of remaining critical habitats–present or imminent* (3/35)
1. No further reduction (not a problem). 0
2. Slow (critical problem in next 50 years). 1
3. Moderate (critical problem in next 25 years). 2
4. Rapid (critical problem now or in next 5-10 years). 3

5. *Unknown* rate of reduction		3
C. *Population concentration* (6/35)		
1. Does not concentrate (go to IIE).	0	
2. Concentrates briefly (up to 1 month).	2	
3. Concentrates for substantial time (1-4 months).	4	
4. Species concentrated for all or most of year.	6	
5. Patterns of concentration *unknown*.		6
D. *Patterns of concentration* (4/35)		
1. Species concentrate at many points.	0	
2. Species concentrate at few points.	2	
3. Species concentrate at a single point.	4	
4. Patterns of concentration *unknown*.		4
E. *Reproductive rate of existing animals* (8/35)		
1. Normal for the species.	0	
2. Slightly less than normal.	2	
3. Much less than normal.	6	
4. Reproduction not occurring.	8	
5. Reproductive rate *unknown* (go to IIG).		8
F. *Environmental contaminants, competition, unusual predators* (7/35) or *other mortality factors*		
1. Not present or problem.	0	
2. May exert some adverse effect.	3	
3. Likely to exert adverse effects or known to exert adverse effect on similar animals.	5	
4. Present and known to exert adverse effects.	7	
5. *Unknown*.		7
Total points for Section II	—	
Unknown component of total (points based on lack of data)		—

III. *Recovery Potential* (25 possible points of 100 total)		
A. *Protection of habitats* (5/25)		
1. Critical habitats protected or protection not required.	0	
2. Needed habitats in state or federal ownership; long term protection assurable.	2	
3. Requires purchase or transfer of critical habitats.	3	
4. Protection essential but difficult or impossible to assure.	5	
5. Needs for habitat protection *unknown*.		5
B. *Management of succession* (5/25)		
1. Critical successional stages not in short supply.	0	
2. Species requires early to mid-seral stages of communities which are in short supply or soon will be.	2	
3. Species requires mature to climax communities which are in short supply, or species has highly specialized requirements for habitats that are in short supply and cannot be readily provided.	5	

4. Insufficient knowledge (*unknown*) of management techniques to maintain optimum habitat.		5
C. *Potential for growth of population* (expressed as percent growth normally possible from one breeding season to the next under favorable conditions) (10/25)		
1. High—growth rate greater than 100%.	0	
2. High - intermediate—growth rate 50 to 100%.	2	
3. Intermediate—growth rate 25 to 50 %.	4	
4. Low - intermediate—growth rate 10 to 25%.	6	
5. Low—growth rate 5 to 10%.	8	
6. Very low—growth rate 0 to 5%.	10	
7. *Unknown* growth rate		10
D. *Potential for recovery* (5/25)		
1. Following restoration of habitat, species should become ecologically secure.	0	
2. Maintenance of the species will require continued high intensity management.	3	
3. Present hope for preservation of the species requires zoo or aquaria-type husbandry.	5	
4. *Unknown* potential.		5
Total points for Section III	___	
Unknown component of total (points based on lack of data)		___
IV. *The Species* (15 possible points of 100 total)		
A. *The animal is classified as:*		
1. A subspecies (go to IVC).	0	
2. A species (go to IVB, skip IVC).	3	
3. *Unknown* (taxonomy in doubt, go to IVD).		6
B. *For the species*		
1. Hybridization currently known to occur	0	
2. Hybridization is possible but is not presently occurring.	1	
3. Hybridization not possible due to isolation.	2	
4. Hybridization not possible because of an effective reproductive barrier with sympatric forms	3	
5. Hybridization potential *unknown.*		3
C. (If a subspecies) *The animal has evolved as a*		
1. Clinal subspecies.	1	
2. Geographic isolate or is otherwise clearly isolated from other forms.	2	
Unknown.		
D. *The taxon, species, or subspecies exhibits:*		
1. No limiting specialization.	0	
2. A somewhat limiting specialization.	1	
3. A highly limiting specialization—very narrow niche (food, habitat, etc.).	2	
4. *Unknown* degree of specialization.		2

E. *Uniqueness; the taxon is a member of:*		
1. A polytypic species.	0	
2. A monotypic species or all subspecies are threatened.	1	
3. A polytypic genus.	2	
4. A monotypic genus.	4	
5. A monotypic family.	5	
6. *Unknown.*		5
F. *Security of taxonomic unit*		
1. Related animals are not threatened.	0	
2. More than one threatened form in genus or family	2	
3. *Unknown* whether related forms are threatened or not.		2
Total points for Section IV	__	
Unknown component to total (points based on lack of data)		__

Explanation of Priority System Sections

I. Current Status of the Population

Under this heading, population size and trend are combined to provide an index to the current numeric status of the species. Here, we first approach the critical question of how to evaluate the *amount and reliability of information* available on endangered species.

In a few endangered species, such as the whooping crane, direct enumeration of the size of the population is possible. For most species, estimates are all we will ever have to work with. Numerical population estimates are usually lacking for species with high annual turnover rates such as mice, small birds, most amphibians and reptiles. Where this is the case. usually all that can be given to indicate the size of the population are generalized statements such as: "rare," "population low," "possibly extinct." Even here we feel that some effort should be made to organize these statements into a ranking from "approaching extinction" to "abundant" so that a specialist in a particular species will be able to choose from standardized, verbal descriptions that might best fit his appraisal of the status of the population.

For many endangered species, the trend in population size is more critical than the current size of the population. A downward trend in population size may reflect deterioration of the habitat, reproductive failure, or increased mortality. Estimates of population size in species with a high reproductive potential may be highly variable, and may reflect varying reproductive success or survival rates each year. For this reason, the evaluation of population size and trend for these species should include several years of data to establish the long-term trend.

II. Vulnerability

We assess the vulnerability of a species on the basis of the deterioration of its habitat and characteristics of the species which cause it to become vulnerable. Those conditions affecting a species habitat, which in turn affect food supply, reproduction and survival, can cause a species to become endangered. Critical habitats are defined as those essential elements in a species' range that provide adequate food, cover, and water so as to allow the species to reproduce at sufficient rate so that reproduction balances mortality over the long term, special niche requirements are met, and required isolation is provided.

Note that the section on critical habitats includes consideration not only of *amount*, but also of *suitability* of habitat, and that it also allows consideration of an imminent threat such as a large public works project which might drastically reduce habitat. An example of habitat which has not deteriorated in amount, but is now largely unsuitable, is that of the peregrine falcon in the eastern U.S.

The potential of a species to become vulnerable is partly related to the degree of specialization exhibited by that species. For instance, the Florida Everglade kite, with a highly specialized adaptation for feeding on one species of snail, is inherently more vulnerable than a marsh hawk that has a wider (less specialized) food base on which to feed.

Other aspects of vulnerability are reproductive rate, and special survival problems. Animals which are concentrated and/or localized over their range, such as some waterfowl, are more vulnerable than those which are dispersed widely or occur at a number of localized points. The presence of introduced animals, or otherwise intensified interactions can create special survival problems through predation or competition (e.g., red wolf-coyote interactions). The special problem of pesticides may supersede other factors (e.g., DDT and peregrines). Any single factor can conceivably override many, or all, others in a determination of vulnerability. Obviously, if a threat to an animal's habitat and/or population is so great that it becomes permanent, then human judgment can and should supersede this priority system in responding to this critical situation.

III. Recovery Potential

The recovery potential of an endangered species is defined as the potential to effect a meaningful improvement in the status of the population of the species. Endangered species that have little or no critical habitat left, in which inherent reproductive rate is very low, or which have a slow mean generation time reflecting very low capacity for population growth, may be difficult to rehabilitate. Some species are in such a plight that their only hope lies in removal to aquaria or zoo-type husbandry for retention of the gene pool until habitat problems are solved. For some species, even this possibility may now be lost.

The first consideration in this section is an assessment of the potential for achieving long-term protection of critical habitats. This is followed by ranking of the potential to manage habitat by manipulation of succession, as a means to provide for critical habitats or specialized niche requirements. For example, the needs of an animal that requires a habitat in an early stage of forest succession can be quickly and easily provided for by timber harvest, controlled burning, brush clearing, or managed grazing. To provide habitat for a forest-dwelling species that requires climax habitats, on the other hand, may mean protection of a forest for 150-300 years. If this type of habitat is in very short supply, the species may be beyond saving.

Another factor considered in assessing the potential for a species to recover from endangered status is its reproductive rate. Because of great differences in the reproductive strategies employed by species in different classes, it was apparent that we could not compare the several thousand eggs laid by some species of fish with the average of one young born per year for many large mammals and birds. A more meaningful expression of the recovery potential of a species is its capacity to reproduce itself and increase in numbers under favorable conditions. We recognize that the scoring of this section may require some mature biological judgments based on an assessment of the reproductive rate of the species and the expected survival rates of both young and adults, so that an estimate of the rate of average potential population growth might be made. The scores for this section are assigned on the premise that a species that possesses a high average capability for population growth could be expected to respond readily to effective management of those factors responsible for its endangered status. Species with inherently low capability for annual population growth might be delayed a decade or longer even though conditions adverse to survival had been alleviated.

Some species with a low reproductive rate—such as the whooping crane, the California condor, the grizzly bear, and several of the marine mammals—also exhibit great longevity as adults. Longevity can be an advantage by allowing the species to persist while adverse environmental conditions are corrected. This undoubtedly mitigates, somewhat, against the extended time required to accommodate the slow growth of populations to a safe level.

Another assessment of the potential for a species to recover from its endangered status judges the level at which recovery is currently possible. Obviously, a species that needs immediate removal to a zoo for artificial maintenance of the gene pool until other habitat factors can be corrected is less secure than a species that can become ecologically secure once preservation of scarce habitats is assured.

IV. The Species

The Endangered Species Conservation Act of 1973 clearly defines the responsibility to provide for the conservation, protection and propagation of species, subspecies, or even populations, of threatened fish and wildlife. There is no priority established or mentioned as to whether a full species should take precedence over a subspecies in a case where there is no difference in the degree of endangerment of the two. We suggest that the potential loss of the gene pool represented by a biologically defined species should give it precedence over a subspecies. The concept of a species and the process of speciation are topics that must be considered in developing a priority system for endangered animals.

For terrestrial vertebrates, we adapt the ideas of Mayr (1965. Evolution at the species level. Pp. 315-355 *in* J. A. Moore (ed.), Ideas in modern biology. Nat. Hist. Press, Garden City, NJ), who states "Most biologists whether geneticists, systematists, or evolutionists, are now in essential agreement on what a species is...We can hold that species are characterized by certain qualities, of which two are most important:

> "(l) They are reproductively isolated from other species—that is they do not interbreed with them in nature. Interbreeding is prevented by so-called isolating mechanizms, among which sterility is best known but mating behavior most important (at least in animals).
>
> "(2) They occupy definite stations in nature (their niches), and their requirements are sufficiently different from those of other sympatric species to permit coexistence without fatal competition.

"Species are usually also characterized morphologically, but the morphological criterion is not infallible, since various phenotypes within one species may be far more different from each other than are some good species (sibling species)."

Fisheries biologists who have critiqued our priority system have pointed out that the criteria of species designation based on reproductive isolation has not been adopted in the taxonomy of fishes. In many cases, intraspecific and even intrageneric hybridization has been reported. We have attempted to make the system sufficiently flexible to accommodate the differing taxonomic bases and still retain our concern for gene pool contamination which might threaten the integrity of a taxon.

The potential for gene pool contamination is a consideration in establishing the priorities with which to guide the Endangered Species Program. Potential contamination has as its base incomplete evolution of a genetic or behavioral barrier to interbreeding with closely related, sympatric species or subspecies. Mayr (*op. cit.* p. 15) discussed this and points out that many examples are known of species formed by geographic isolation that become "fused" again with the parental species. If we concern ourselves with the threat of a population "fusing" again with the parental species, we may be managing against normalcy.

Perhaps the greatest justification for attempting to counteract this process would be a case where an artificial introduction has been made of a species not indigenous to the range of the endangered species we might wish to protect. Even here, one must recognize the great difficulty in attempting to counteract this kind of blunder.

The Numerical Score

The numerical score indicates the status of the species as determined within the previously stated conceptual framework of the priority system. It is not a "magic number," but a guide to be used to list animals according to degree of endangerment. The score may also partially indicate our general lack of knowledge about the species, animals like it, or certain areas of natural science. It may reflect a fundamental insensitivity of the system to cope with the array of differences in biological characteristics among the classes of animals. Because of these differences, it is our judgment that separate lists should be compiled for each class, and cross-class comparisons in priority ratings should not be made.

Results of Testing the System

Four advanced graduate students with differing backgrounds were employed to score 180 species or subspecies using the second version of the priority system, with the 1973 edition of *Threatened Wildlife of the United States* as a standard data source. Objectives of this test were (a) to evaluate the performance and utility of the system for the diverse array of threatened animals; and (b) to evaluate the quantity, quality, and method of presentation of data in the standard data source with respect to coordination with the priority system. Variables analyzed were: (1) the four individual scorers; (2) the four sections of the priority system; (3) the four taxonomic groups (reptiles and amphibians, fish, birds, mammals); (4) the unknown component of the scores for each animal; and (5) recurring problems with the use of the priority system and the soundness of the standard data source.

A spread of average scores from 32-78 for the 180 animals indicated a reasonable level of discrimination within the test. Three of the scorers were similar in their scoring, but one responded to the system with lower scores, a low rate of use of the unknown component, and an infrequent use of problem categories. Average scores given each taxa were similar, but not enough mammals (17) nor reptiles and amphibians (8) were scored to conclude whether the system is biased on a taxonomic basis. None of the four sections of the system seem to be biased toward a higher or lower score. Some of the more celebrated endangered species like the California condor, red wolf, peregrine falcon, and Indiana bat received relatively high scores with low unknown components. More confidence is warrented for priorities based on these scores than for lesser known species for which information is lacking. Unknown scores were a greater part of the total scores for fish and reptiles and amphibians, indicating a difference in quantity and quality of data for taxonomic groups.

Sample scores presented in Table 1 are based on an earlier version of the priority system and used the 1973 Edition of *Threatened Wildlife of the United States* as a standard data source. Scores are presented here to demonstrate the typical output of this priority system, but do not represent an up-tp-date assessment of the species scored.

Two recurring problems with the standard data source were 1) insufficient information on which to make a judgment; and 2) the lack of consistency in the manner of presentation of available knowledge. Individual scorers interpreted the same source data differently and produced divergent scores on the same animal. We propose that a standard data source is essential for the priority system to work efficiently. Data on population status, vulnerability, recovery potential, and taxonomic status should be presented in the standard data source with consistent terminology. Value judgments based on available data should be made *before* information is entered into the data source, so that a scorer using the system doesn't have to read a narrative and decide, for example, whether it indicates that habitat is increasing or decreasing. The use of common descriptors, that are precisely defined, to indicate biological facts about each animal would allow for regular updating of the data base.

A new edition of *Threatened Wildlife of the United States* could serve as a standard data source if a format is adopted that matches the priority system and uses consistent terminology. Comprehensive literature reviews, contact with scientific experts, and regular interchange with private, state, and federal agencies and organizations would keep this data source up to date. Storage of information in a computer would provide a mechanism for regular updating and retrieval of information on the status of each species, and, in fact, will be necessary to handle the huge volume of data on the diverse array of threatened animals and plants. Regular periodic printouts in the form of editions of *Threatened Wildlife of the United States* would allow review by all concerned of the basis on which decisions are made for action on endangered species.

Using the Priority System to Make Decisions for Action

The first step in using the priority system in the Endangered Species Program is to score each animal with the numerical ranking system. These scores will be used to list animals in rank order of endangered status. This status does not change with an ability or lack of ability to take specific management steps, and it should not. The status of the animal and the *need* for management should be reflected by its position on the endangered list, but *action* will partly be determined by the entire program itself. These two expressions of priority should be kept separate.

Table 1. Selected scores for examples of threatened or endangered animals from four classes. Average scores* by 4 scorers, using the 1973 Edition of *Threatened Wildlife of the United States* as a standard data source.

	Total/Unknown
BIRDS	
Masked Bobwhite, *Colinas virginianus ridgwayi*	52/ 8
Southern Bald Eagle, *Haliaeetus leucocephalus l.*	58/ 5
American Peregrine Falcon, *Falco peregrinus anatum*	63/ 2
Kirtlands Warbler, *Dendroica kirtlandii*	66/ 8
Large Kauai Thrush, *Phaeornis obscurus myadestina*	71/19
Eskimo Curlew, *Numenius borealis*	76/37
California Condor, *Gymnogyps californianus*	80/ 3
FISHES	
Devils Hole Pupfish, *Cyprinodon diabolis*	56/12
Gila Trout, *Salmo gilae*	61/11
Mohave Chub, *Siphateles mohavensis*	68/32
Maryland Darter, *Ethoestoma sellare*	70/32
Colorado River Squawfish, *Ptychocheilus lucius*	75/25
Longjaw Cisco, *Coregonus alpenae*	80/33
MAMMALS	
Key Deer, *Odocoileus virginianus clavium*	47/ 9
Utah Prairie Dog, *Cynomys parvidens*	53/ 9
Eastern Timber Wolf, *Canis lupus lycaon*	60/13
Florida Manatee, *Trichechus manatus*	61/27
Indiana Bat, *Myotis sodalis*	67/ 9
Red Wolf, *Canis rufus*	73/14
REPTILES AND AMPHIBIANS	
American Alligator, *Alligator mississipiensis*	56/11
Blunt-nosed Leopard Lizard, *Crotaphytus silus*	62/15
Desert Slender Salamander, *Batrachoseps aridus*	74/36
Houston Toad, *Bufo houstonensis*	75/12

*Scores based on an earlier version of the priority system. These scores are not necessarily indicative of the current status of these species.

The second step of taking action to attempt to alleviate the threats to a species' existence will be influenced by political, economic, social, and biological factors. Certain biological considerations which make an animal score *high* in endangered status may result in a *lower* priority for management action. For example, an animal with a low potential for population growth may score high in endangered status, but another species which offers a better chance of a quick, complete recovery may be chosen for immediate action. Administrative decisions for action regarding each species should be made on the basis of degree of endangerment whenever possible, but this will not always occur.

The following outline presents some considerations in action decisions which go beyond the use of numerical scores from the priority system:

A. *Aspects of the Total Program Which Affect Decisions for Action.*

1. *Public Interest*–A high interest species (e.g. bald eagle) may bring attention to the entire program and may demand action, but likewise the low interest species *needs* support.
2. *Cooperative Program Potential*–Existing or easily established state, Federal, or private programs may be able to carry much of the load and enhance chances for success.
3. *Continuity of Program*–Existing programs showing significant chances for long-term success should be carried to completion, but no action should be continued solely because it is already underway.
4. *Reliability of Information*–Where data are scarce, action should be aimed at gathering information needed for sound decision-making. In an emergency, human judgment must be the basis for decisions.
5. *Budget Considerations*–When funding levels cannot handle all species, animals with the most urgent management needs and a high chance for successful recovery will receive highest priority for action. A balance will have to be achieved between spreading finances to do some work on several species, and substantial investments to materially assist a single species.

B. *Likelihood of Success.*

1. *Biological Capacity to Respond to Management*–Generally, animals with a high turnover rate which are capable of adapting to managed environments offer the highest likelihood of success and may receive higher priority for action.
2. *Capacity of Habitat to Support the Animal*–Changes in land management on public lands, private lands under subsidy, or purchase of land-types not in great demand may be easiest to provide. The presence of such unusual obstacles as pesticides, total absence of needed habitats, or exotic predators or competitors may offer the least likelihood of successful management.
3. *Relative Costs and Benefits*–The mandate of the 1973 Act indicates that attention will be paid to all species, but funding levels necessary to manage all endangered species are unlikely. It is more likely that priorities set with the aid of this system will be balanced against the probability of significant chances for success with moderate dollar investment.

Conclusion

A priority system to aid making decisions in the endangered species program, based on determinations of the immenence of the threat to the animal, is offered for review. This system ranks endangered status of species on the basis of population status, vulnerability, recovery potential, and special attributes of the species. The system is designed to assist in setting priorities for action to reduce the threat to the species, but it does not replace human judgment. A standard data base is suggested for using the system, to provide consistency in dealing with the huge volume of data on endangered animals, and to allow input from private, state, and federal agencies and organizations. Continuing input from these sources and repeated use of the system will accommodate changes in the data base and will aid in assuring cooperative efforts directed at the ultimate goal of an endangered species program: to *remove* species from the endangered list.

Acknowledgments

Gene Ruhr attempted to construct a priority system prior to this one, and provided ideas and criticism at several stages. Keith Schreiner provided frequent encouragement to proceed with development of a usable system. More than 40 biologists critiqued the priority system, and their ideas, plus ideas offered by many other biologists over the last two years, have been carefully considered in producing this draft of the system. We are grateful to all of these people for their help and encouragement.

Discussion

FROM THE FLOOR: I wondered whether you considered the use of any scale, other than that of adding up the points, that would tend to distinguish between species which are severely endangered and those not so endangered?

MR. SPARROWE: I don't understand what you are getting at.

FROM THE FLOOR: When you assign points to different categories, you have indicated those in different ways. However, you can also present them on different types of scales. For example, as I followed you, you showed numeric values, where, for example, you simply added up all the points. Is that correct?

MR. SPARROWE: Correct.

FROM THE FLOOR: Well, just in looking at the few results you presented, it would seem to me that this was not a strong enough differentiation to indicate the higher endangered species category from other species. In other words, what does the score of 80 mean versus the score of 60 in your scale.

MR. SPARROWE: In my presentation, I mentioned that in order to get this done, I employed graduate students and we ranked some 180 animals by use of the Redbook. We did a lot of comparing and we had a point spread from 38 to 72, or 38 to 78, which gave us, I thought, pretty good discrimination between species.

There was one point I neglected to make in the presentation and that is we feel that at this stage, the single list of all endangered animals which cuts across classes should not be made. We feel that the difference between birds and mammals and fishes is such that perhaps we should list them separately and then make our comparisons.

FROM THE FLOOR: You might look at it another way—how do your calculations relate to the probability of survival of these species, given no allocation other than what is currently being undertaken?

MR. SPARROWE: I have not looked at it from that standpoint.

MR. WAYNE GAGNE [Honolulu, Hawaii]: I would like to try and argue that the scoring system for the insular species is really lower than it should be. You have a component in your scoring system for highly restricted species, which is fine, but I think that aspect of your scoring system needs to be broken down to take into account the realities of the highly insular situation. I have reference to the insular species, such as those in Hawaii, which tend not only to be restricted, but are in systems that are highly disharmonic and are easily penetrated by aggressive continental species and are highly vulnerable to the introduction of diseases, such as malaria and so on, which they have not had exposure to in the evolutionary existence. Almost half of the endangered species in the nation are Hawaiian insular species and I think you should look into that again in relation to the highly restricted components.

Also I have one more point with regard to the insular species. I think secondary continental island species should get added into the scoring system. Further, I think they should become a little higher in your scale in relation to the continental species.

MR. SPARROWE: We did recognize this because the Hawaiian species came out very dominant in the high scores. My only comment at this time is that we need input from people like you with more familiarity with these types of situations.

The suggestion was already made in the Office of Endangered Species that we need to deal with the Hawaiian species separately and maybe make a separate list. Our system is still at the stage where it is quite simple, so it does have a difficulty in maybe separating the very fine points of difference, the very fine points of the endangerment. I question at this time whether we want to build into it specialized problems such as this. We may want to simply deal with those animals in a separate list or on a separate basis.

MR. McCULLOUGH [University of Michigan]: I would like to ask you about the system, the way you arrived at the scores within your group. The value of a system like this is the degree to which it can be repeated. I have reference to the fact that different groups or different individuals can go through the ranking or come out with the same or similar scores. Did you score these as individuals or as a group and if you scored them as a group, did you do the standard deviations? In other words, you can distinguish the differences in the numerical scores by species if you have the variants.

MR. SPARROWE: Yes. I have not run all of the 180 species in the Redbook through this current draft, but the system has been changed enough so that the scores would be somewhat different. However, in our earlier tests we compared individual variations using four people. One individual's scores were much different from the rest, but the others were almost identical.

We looked at the variability between the four sections of the test. We looked at variation on the basis of taxonomy, birds versus mammals versus fishes versus reptiles, and we did not have very much variability there. However, I was a little suspicious because there was a difference in the amount of score due to the unknown category, as I previously mentioned.

So, in answer to your question, we did look at variability. This needs to be done again with this system as it now stands. The thing we are still hampered by is having an adequate standard data source to test it against because the existing information in the Redbook is now out of date and it was presented in such a way that there are too many different descriptors, too many decisions that the reader has to make before he assigns a score.

MR. McCULLOUGH: Did you have some representative measures of that variation, such as for the California Condor, where I think you had some 80 points?

MR. SPARROWE: Right.

MR. McCULLOUGH: Is that 80 plus or minus ten at a 95 percent confidence limit? In other words, I would like to see some verification because it seems a little improbable that a group of people working independently could break down the categories of up to 25 points and come out with the same results with five different categories.

MR. SPARROWE: You are right, these four people had a range of 66 to 85 in the score.

DISCUSSION LEADER BROWN: Are there any more questions?

MR. STEVE BERWICK [Yale University]: I have a couple of points. I was wondering if you could quantify or give the indices of the economic motivation for your system. For example, what, in the United States, is the total number of dollars in the endangered species programs for the number of endangered species, something on that order, and then compare that with the foreign amounts and see whether there is a difference. I think that on this basis you would be able to evaluate the needs of the foreign countries versus our country in using our system.

Secondly, I wonder if we can, or whether it would be meaningful, to use the method you developed in evaluating ecosystems and endangered areas rather than just species. I am thinking particularly of the Gir forest in India, where the lions are endangered. However, it is meaningless to look at just the lions. It is much more important to look at the whole system from the productivity of the soils and nutrients and what not.

Also, in part three or four, under "species", you listed certain characteristics and one I thought that might be adequate would be the possibility of inbreeding, particularly where you isolate the small, fluctuating and polygamous populations, such as big horn sheep and where you get coefficients on inbreeding of some thirty-five to forty percent. Would you comment on those three aspects, please?

MR. SPARROWE: You have listed three or four and I just cannot remember them all.

At any rate, the first one I believe concerned the foreign situation. When we began this priority system, as a matter of fact, we worked a full year on it and had it in pretty advanced shape before the 1973 Act was added to look at the foreign endangered species. However, as you recall, the prior laws were for native species only and so we were really thinking more in terms of the North American species at the time we constructed this. However, since then we have done some thinking about the foreign situation, but I simply am not personally as well aware about foreign endangered problems. Here is another case where this can be developed further and perhaps a look would modify it on the basis of foreign needs. That is about all I can say in relation to your questions.

DISCUSSION LEADER BROWN: Thank you all for coming. A gentleman just handed me this rather lengthy question, but he does have a very relevant point. We have identified our problems and what we need to do in the future. He states the question thusly—"that academic institutions must provide adequate training in resource planning techniques for both future and current professional Biologists. What should we do in developing such a curriculum?"

Well, I don't think we will try to answer that question. It is a thought we should all take home with us.

Enhancing Coordination of Forestry and Wildlife Management

Chairman:
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Compatibilities and Incompatibilities in Multiple Uses of Forests

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The forests of North America include a large number of complex ecosystems. Within the United States alone there are some 865 species of trees, 210 of which have some commercial value. The Forest Service presents data on some 20 major forest types. In addition, there are hundreds of species of shrubs, ferns, grasses, forbs, and other plants within the forest or in its openings. Considering the number of forest types, the various geographic or regional locations, the number of site productivity classes, differences in degrees of stocking, and categories, each with its own objectives and standards, I estimate that there are some 4,000 significantly different forest management situations in the United States; there are others in Canada and Mexico but I have not tried to estimate how many.

For some purposes, it is valid to generalize about "forests" in the same way one may generalize about "farms" or "factories" or "schools." For other purposes, categories or classes within each of these broad concepts are necessary. What may be reasonable for a mature disease-ridden stand of lodgepole pine on a national forest in Wyoming may not be appropriate for a thriftily growing loblolly pine stand on a forest industry forest in Georgia, even though each is a kind of pine forest. In this paper, due primarily to limits of space, I shall generalize about forests, but the immense differences in forests should be borne in mind by the reader.

Forests are one of the important ecosystems for wildlife, which may find food, shelter, and a suitable habitat for reproduction within the forest or at its edge. "Wildlife," of course, includes an enormous range of living things. Most attention focuses on the larger game animals, but small animals, birds, and perhaps even reptiles and insects must be considered in any truly inclusive approach to wildlife management. The forms of wildlife are dependent upon the precise characteristics of the forest at any given time, but the wildlife may in turn influence that forest, as well as influence the uses which man may seek to make of the forest. The great variety of forests is matched by the great variety of wildlife; there is commonly some correlation between forest situation and wildlife situation, as readers of this paper know full well.

For this paper, I shall generalize about "wildlife" in the same way I am generalizing about forests, and for the same reason. For many purposes, distinction among kinds of wildlife are essential.

Forest Uses

Forests can be used by man for many purposes. I find it useful to recognize seven different "uses," though I realize that some people will not agree with some of the uses I describe and others would like very much to subdivide some of the uses I group under one heading (Table 1). I list maintenance of an attractive forest environment high on my list of uses, for I think the American public over the past several years have made it clear that they insist upon attractive forests, especially publicly owned forests, but privately owned ones as well. Many people who do not own forests, do not directly and personally use them, and bear no part of the costs of managing forests, nevertheless have strong convictions about how forest should be managed, and foresters and wildlife management specialists alike would do well to heed such popular attitudes.

The provision of outdoor recreation opportunity can occur in a nonforested situation, but forests, or at least trees, are valuable assets to any recreation area. Public participation in outdoor recreation has grown rapidly and rather steadily during the past generation or longer, as all land managing agencies know full well. Outdoor recreation can be a productive use of land forest resources. A special form of outdoor recreation, but one having such unique characteristics that I think it useful to recognize it as a separate use, is wilderness. The meaning of this term seems to have changed, and many areas today are recognized as wilderness which once would not have been. Wilderness is a kind of experience as well as a kind of area. Some wilderness areas are forested, some are not; some of the latter lie above timberline or otherwise are unsuitable for tree growth.

In Table 1, I have grouped all wildlife as one use of forests, for the reasons previously indicated. Wildlife specialists would almost surely wish to subdivide this use. The direct food or other commodity value of wildlife is much less than their contribution to the enjoyment of people. Wildlife viewing is a form of outdoor recreation, of course, but it seemed to me desirable to separate wildlife and outdoor recreation as two separate forest uses.

Forests are important watersheds in the United States, both in their extent and in their particular characteristics. Often times the watershed management objective is preservation of the characteristics of the natural or undisturbed watershed, and that is what is shown in Table 1. In some cases, watersheds might be managed to try to establish conditions or relationships not found on the natural watershed, such as the replacement of deep-rooted trees by shallower-rooted shrubs and grasses in order to increase runoff.

"General conservation" is perhaps the most questionable of the seven forest uses in Table 1. It may well be argued that the other uses leave nothing for this use other than the prevention of soil erosion, but it seems to me that the general public has strong convictions here, as in the maintenance of the attractive forest environment, which justify separate recognition. The analysis of this paper is not significantly changed if this use is omitted.

The last but by far the most important economic use of forests is wood production and harvest. This is the use which today pays the management bills on public and private land alike; it is often the primary objective of forest management. This use, perhaps more than any other, deserves subdivision into several, if space in the Table had permitted. There is enormous difference between the growing of pulpwood and the growing of sawlogs, and among size categories of the latter.

In the Table, with its space limitations, I have tried to show in a general way the degree to which the different uses are compatible or incompatible. Three of these seven uses are largely or wholly incompatible, among themselves: wilderness, outdoor recreation, and wood production and harvest. The physical characteristics of the forested wilderness would be destroyed by timber harvest, but the character of the wilderness experience would equally be destroyed by intensive outdoor recreation. Too many people can destroy the wilderness character as effectively as can the chain saw. There can be some limited compatibility between wood growing and harvest and outdoor recreation. Hunting, for instance, is often better on cutover than on forested sites. Even campgrounds can sometimes be rotated to other sites or have limited timber harvest.

The other four uses shown in the Table have, or can have, varying degrees of compatibility with the three "intolerant" uses. Timber harvest can be conducted in such a way as to maintain the attractiveness of the forest, to minimize soil erosion and watershed disturbance, and to protect and encourage wildlife, although it must be recognized that the kind of wildlife may vary at different times in the timber rotation cycle. Likewise, these other uses are reasonably well taken care of in a wilderness area, although some kinds of wildlife may not flourish there as well as in cutover forests. Outdoor recreation, if not too intensive, need not destroy the attractiveness of the area, need not create erosion, and may continue satisfactory natural watershed conditions. Too many recreationists greatly modify the wildlife environment, of course. It will be noted that in the Table, most of the pairs of uses, other than those involving two of the incompatibles, range from "generally compatible" or "moderately compatible" to "fully compatible."

Before leaving this Table, four qualifying comments must be made quickly: it is general for forests, not specific to any forest situation, and in particular situations the relationships may be different; it takes no account of the differences in scale of each use per unit of area; it takes no account of the intensity of management for each use; and it is in physical or biological terms, not in terms of economic values.

Management Alternatives of Compatible-Incompatible Uses

When two forest uses are completely incompatible, the management alternatives are fairly simple, though the decision may be hard to reach: all of one, none of the other. The same area cannot be used for wood growing and harvest, and for wilderness, or for outdoor recreation (if only moderately intensive) and wilderness. One management objective must be chosen, and the other excluded. The decision may rest upon estimates of economic value, upon biological consid-

Table 1. Degree of compatibility among various forest users.

Primary use	Maintain attractive environment	Provide recreation opportunity	Wilderness	Wildlife	Natural watershed	General Conservation	Wood production and harvest
Maintain attractive environment		Moderately compatible; may limit intensity of use	Not inimical to wilderness but does not insure	Compatible to most wildlife, less so to a few	Fully compatible	Fully compatible	Limited compatibility; often affects amount of harvest
Provide recreation opportunity	Moderately compatible unless use intensity excessive		Incompatible; would destroy wilderness character	Incompatible for some kinds; others can tolerate	Moderately compatible; depends on intensity of recreation use	Moderately comaptible; incompatible if use too heavy	Limited compatibility depends on harvest timing and intensity; roads provide access
Wilderness	Fully compatible	Completely incompatible, can't tolerate heavy use		Highly compatible to much wildlife, less so to others	Fully compatible	Fully compatible	Completely incompatible, precludes all harvest
Wildlife	Generally compatible	Limited compatibility; use intensity must be limited	Mostly compatible though some wildlife require vegetative manipulation		Generally fully compatible	Generally fully compatible	Generally limits volume or conditions of harvest

Natural watershed	Fully compatible	Moderate compatibility; may require limitation on intensity	Not inimical to wilderness but does not insure	Generally compatible		Fully compatible	Moderate compatibility; restricts harvest methods but does not prevent timber harvest
General Conservation	Fully compatible	Moderately compatible; if use not excessive	Not inimical to wilderness but does not ensure	Generally compatible	Fully compatible		Compatible but requires modifications in methods of timber harvest
Wood production and harvest	Compatible if harvest methods strictly controlled	Moderately compatible	Completely incompatible; would destroy wilderness	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	

erations, upon social or philosophic convictions, or on any other basis, or combination of bases, but the alternatives are clear.

When two uses are completely compatible, so that management for one purpose completely achieves management objectives for the other purpose, there is equally no problem—manage for either, and the other follows naturally and satisfactorily. If Table 1 be accepted as accurate, then management to maintain a natural watershed is equally satisfactory as management to maintain an attractive forest environment, and also the reverse. In this happy circumstance, it would not matter which management objective comes first, for the final management result would be the same.

In a great many of the pairs of uses shown in Table 1, uses are moderately or reasonably compatible, but often require some special management steps or programs to make them so. The timber harvest may have to be modified or structured to protect the watershed or the wildlife, for instance. The management possibilities here are very great, often testing the skills of the resource manager. When these circumstances prevail, it often matters which use is primary and which is secondary. That is, if wood production and harvest is primary and wildlife protection is secondary, the specific management programs may be different than if wildlife protection were primary and wood production and harvest were secondary, but in each case both use objectives were sought.

Whatever may be the relationship between pairs of uses, or among groups of uses, and whatever may be the objectives of management, certain facts or relationships must be borne in mind: (1) there always exists some biological or physical consequences of management actions; (2) there are always economic values and costs involved in every decision, even when the governing criteria for management decisions is not economics; and (3) from every management decision some people are gainers and some are losers—it is impossible to conceive of a management decision which equally or proportionately benefits everyone. Because of space limitations in a paper such as this, it is not possible to explore these relationships and consequences in depth, but wildlife managers, as other resource managers, should be fully aware of them.

Forest Uses and Forest Characteristics

The different forest uses listed in Table 1 make quite different demands on the different characteristics or attributes of the forest. All use land, it is essential to each. Competition among the uses is keener and sharper for forest land than for any other aspect of the forest, but this competition can be resolved if sufficient effort is expended for this objective.

A forest, by definition, has, or recently had, or shortly will have, or all three, trees in some "stand" or timber volume. Foresters generally, and the Forest Service in particular, distinguish between "commercial" forests which are capable of growing 20 or more cubic feet of wood per acre annually in a fully stocked natural stand, and noncommercial forests which are less productive (as well as some noncommercial forests reserved by law from cutting, as in parks). Even among commercial forests, the present stand of timber varies greatly, and this affects the usability of the site for different uses. Wilderness users want the maximum natural stand the site can support; in the absence of recent fire, storm, or disease, the undisturbed wilderness will have this maximum stand. It may vary from no trees, for a wilderness site above timberline, to a very large volume of wood in a mature Douglas fir or Ponderosa pine forest.

Wood production and harvest requires a reasonable stand of timber on the site, neither a bare and unstocked site nor yet a fully mature stand on which no net growth is taking place. The other uses shown in Table 1 are much less closely related to present timber stand; some trees are desirable for a recreation site, but not a heavy stand; or some trees are useful for natural watersheds, but the stand need not be the biological optimum; and so on. These other uses are in some sense "tolerant" of timber stand volume—that is, they can exist fairly well over a considerable range in volume of stand.

Similarly, the different forest uses depend to quite different degrees on annual growth of wood. Growth is critical for wood production and harvest; unless there is wood growth there can be no harvest beyond the cutting of the present stand; but, equally, unless there is harvest there will be no net growth beyond time when the stand reaches its maximum. For wilderness areas, annual growth is unimportant and in practice, net annual growth will be zero or close to it, since the undisturbed stand will be at or close to its biological maximum. For the other uses, annual growth has limited importance. A reasonably thrifty stand of trees may be advantageous for outdoor recreation, for watershed preservation, or for aesthetic purposes, but net annual growth is not an important factor for these uses.

The different uses of the forest respond in greatly different ways to annual harvest of wood. For wood growing, harvest is critical in both a biological and an economic sense. For wilderness, wood harvest is antithetical, intolerable. For the other uses, wood harvest is generally but not universally undesirable, but may be made tolerable by various management practices. As noted earlier, timber harvest can often be conducted to reduce and nearly eliminate adverse effects upon the watershed or the forest environment. Timber harvest affects some species of life adversely, until the forest regrows, but it may affect other species favorably. Timber harvest may affect some kinds of outdoor recreation adversely, but improve the forest for other kinds of activity.

It is precisely in these different demands of different forest uses upon the different characteristics or attributes of the forest that lies the best opportunities for reconciling the different uses. One should not minimize the conflicts and the differences in interests among various forest users, but neither should one minimize the management possibilities. I touch on these very briefly in the following section of this paper.

Multiple Use

Multiple use is a term widely and popularly used, and imbedded in national forest legislation. Yet its very popularity clouds its meaning; many people endorse it because they give the term their meaning, without understanding what others mean by the same term. If one means that every major use of forests occurs each year (or other modestly short time interval) on every acre of forest, then the idea is absurd. Such a complex of uses per unit of area and of time is impossible and always will be. If one means that several but not all uses can occur on the same acre, or that different uses can occur on closely intermingled separate tracts, or that different uses can occur at different points in the life cycle of a timber stand, then multiple use begins to have many more possibilities.

The moment one begins to put some uses ahead of others, in management planning, then one begins to approach "dominant use."If the latter were carried to its extreme, it would be a single use. In fact, however, it is rarely possible to have but a single use of any forest if "use" is defined as in Table 1. Every acre of forest is watershed in the sense that some rain falls on it, every acre has some wildlife, every acre has some aesthetic or conservation value, although the magnitude of each of these may vary greatly. If dominant use is taken to mean that some use of the forest is put first, but this use modified to some extent by other uses, and the latter in turn largely adjusted to the dominant use, then dominant use approaches multiple use and in fact is very common.

Because of the popularity and consequent lack of clarity of these terms, I prefer to use the compatibility-incompatibility approach of Table 1. I recognize that not everyone will accept my terminology, but I think that the concepts expressed in the Table have great utility in discussions of forest management.

Regardless of terminology, one major consideration is the scale at which the interrelationships among uses is considered. In much of the forestry literature, the discussion of multiple uses is concerned with the reconciliation of different uses on the same tract of forest. This is indeed an important scale of forest management, one of concern to the forest ranger or to the owner of a single tract of forest. But the interrelationship of forest uses may be considered on a watershed, regional, or even national scale. Some forests might be managed rather intensively for wood production, with other uses subordinate on those forests, while other forests could be reserved from harvest for wilderness use or for intensive recreation. The result might be far more of each use or output than if the attempt were made to obtain every output from every acre.

For instance, in the sources cited at the end of this paper, I have calculated a high-intensity, low-harvest-acreage model of forest management at the national scale. In this model, by intensive forestry on much of the more productive wood growing sites, considerably more wood can be grown annually than in fact was grown in 1970, and well over half of the commercial forest acreage not harvested at all for wood, or harvested only at very long intervals and under special conditions. Moreover, as nearly as I can judge from available data, this type of wood growing would be economically sound. On the forests regularly harvested, some of the other uses could also be found; some species of wildlife would thrive in such forests, for instance. On the large proportion of the forests not subject to regular harvest, other uses, such as wilderness, could flourish. My model is a very rough one, subject to much refinement even if the general idea is accepted; and it should be applied regionally as well as nationally. There are many intermediaries between the present forest management situations in the United States and my model, of course. I advance it for your consideration, not a a final answer, but as a suggestion that there are many management alternatives which can produce more of every one of the forest outputs. The competition among uses and users for forests is real and important but there are solutions in which the gain of one is not entirely at the expense of someone else. In the modern terminology, it is not a zero sum game.

Need for Better Information and Understanding

In no important resource management situation do the decisionmakers have all the facts and all the understanding they really need. If there were all the facts and all the understanding, the management problems would have been solved before now. It is thus wholly accurate, as well as customary, to end a paper such as this by pointing to the need for more research. My concern here is less to emphasize the need for more research than it is to suggest the kinds of research that I think are most needed. While many research directions could be pointed out, I limit myself to three major ones.

First of all, forest managers and the general public need to know more accurately and more precisely than we now know, what are the trade-offs between different uses described in Table 1, in specific forest situations. If some tract of forest is managed more intensively to produce more wood per acre per year, then precisely what is the impact upon the various species of wildlife, or upon volume and quality of stream flow? Where I have used such terms as "generally compatible", we need to substitute quantitative data for the various important forest types and situations. How much, in physical terms, can one output be increased at what cost, in physical terms, of any other output? The range of possible combinations of uses and of possible forest situations is very great. Some of these interrelationships perhaps involve wildlife managers only tangentially or inferentially, but others involve them directly.

Secondly, what are the input-output curves for the different uses or outputs of the forest, also in terms of specific forest situations? We all know that every output of a forest requires labor, capital, management, and often machinery and other inputs, as well as land and forest stands. We also know that each output can be increased by a larger quantity of the various inputs other than land, at least within a considerable range. But just how much does wood growth respond to fertilizer? How does this differ for different specific forest sites? Likewise, how can the numbers and variety of wildlife as a whole, or of selected species, be increased in some forest situation, by more inputs of appropriate kinds? These are physical-biological relationships, to which economic analysis may or may not be applied. But every forest manager would like to know more accurately than at present, what happens when he varies his management practices. Some of this may be called "intensive forestry" or "high yield forestry" or by some other term, but regardless of the names, we need to know more about the results. Thirdly, there is great need to know more about management practices and other ways in which the compatibilities between pairs of uses can be increased and incompatibilities reduced, again under specific forest situations, and again in quantitative terms. It has been proposed, for instance, that clearcuts of forest be limited to 50 acres per clearing, in order to reduce the impact of the harvest upon some kinds of wildlife. But the forest manager, whether public or private, needs to know precisely how many more wildlife, of what kinds, a 50 acre clearcut produces in a given situation than does a 100 acre clearcut, and how much less than a 25 acre clearcut would produce. The range of forest management practices to reduce the frictions and impacts between pairs of uses is so great, and so variable from site to site, that I cannot possibly attempt to describe them in one paper. General rules, often based as much on intuition as on hard fact, are better than nothing, but solid research of quantitative relationships under defined conditions would be immensely more dependable for the forest manager.

I would simply like to close by stating that, in my judgment, the opportunities and the need for wildlife specialists to contribute to forest management in the future are very great, enough to challenge you to offer your best.

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Discussion

DISCUSSION LEADER TOMBAUGH: Thank you, Dr. Clawson, for an excellent presentation. I think this is a good groundwork paper that defines the type of activities in which forestry and wildlife can be most effectively enhanced and which is going to lead into some others coming on.

I will now open the floor for any questions that you desire to direct to Dr. Clawson. I feel this is a very provocative paper. I can think of a number of questions myself.

MR. JOHN GRANDY [Defenders of Wildlife, Washington, D. C.]: Dr. Clawson, it seems to me you set up a straw man in terms of comparability and lack of it, in the sense at least that in terms of United States law, National Forest Wilderness Areas are by legislation specifically excluded from multiple use and, in fact, are not included in those lands on which the Multiple Use Act suggests that multiple uses should be practiced. It would seem to me that despite this, many of our forest management techniques can in fact be manipulated in such a way as to provide essentially a national forest environment, though not strict wilderness in the true sense of the word.

Was that, in your view, an oversight or, were you trying to set a straw man to show that, in fact, sustained yield and multiple use could not always be compatible?

DR. CLAWSON: I did not use the words "sustained yield" at any time in my speech or in the paper. I think of multiple use as far more than timber harvests, as I tried to say.

The Wilderness Act, to the contrary notwithstanding, there are, I think, as you have indicated, many uses of wilderness areas. The fact that timber harvest is excluded from them does not preclude them from wildlife nor for their watershed values or for some of the other values I indicated.

Secondly, I do think there are many areas, as you have indicated, that are essentially wilderness in character, even though they do not carry that name now and perhaps never will. Of course, the Forest Service has to take into account its legislation—what legislation can be changed and often has been changed and the way it is implemented. This is likewise very important.

I should also like to add that when I was talking about forests, I was not confining my remarks to National Forests which are managed by the Forest Service but all forests of the United States—private and public.

MR. GRANDY: Thank you. I wish to follow that up just a little bit. I think that is a very, very important distinction. However, I did get a copy of your paper and wondered to what extent is the maintenance of National Forest types compatible with your high intensity, low harvest acreage model?

DR. CLAWSON: I did not have the time nor the space in the paper to comment on that. I think it is not only compatible, but that my high intensity-low harvest area model greatly increases the opportunity for the kind of multiple use that I have in mind.

On the areas that would be intensively managed for wood production, there could be a lot of the other activities involved here.

On the considerable acreage of forest that would not be subject to regular harvest, there could be even more of other activities and what I said toward the end of my presentation, and I think I failed to emphasize it, is that I am convinced that this model would produce more, overall, of the outputs of forest than any other system of management. I think there has been, to be parenthetical, far too much talk about the conflicts between the different uses—as if one had to gain wholly at the cost of the other. I think it is possible for all uses of forest to be increased, not necessarily on every acre, but in total. It is not, as I said, a zero sum game. There can be a lot of games played at the same time.

Economic Feasibility of Including Game Habitats in Timber Management Systems

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Profits largely determine management decisions on commercial forest lands. Past decisions have therefore favored timber production over wildlife, and practices advantageous to wildlife were usually incidental. This paper explains how effective timber management on public and private lands can be coordinated with wildlife needs to obtain revenues from hunting as well as timber. The examples are drawn from the South, but the principles and trends apply to forest lands throughout the United States.

Southern Forests And Hunters

Commercial forests in the South—from Virginia to east Texas—occupy 192.5 million acres, approximately 60 percent of the total land area. Most commercial forest land—73.3 percent or 139.9 million acres—belongs to private, nonindustrial owners with little interest in timber growing (Sternitzke and Christopher 1972). Because the owners have little interest in forestry or are unwilling to expend time and effort, the tracts are usually undermanaged (Siegel 1974). Moreover, small, private forest landowners seldom have definite goals for wildlife management (Moody 1969). The new Forest Incentives Program (FIP) will help landowners with less than 500 acres improve tree-growing, but the program offers no inducement for improving wildlife habitats.

Private industries now own 35.3 million acres or 18 percent of the South's commercial forests. Industry lands are generally well-managed and devoted primarily to timber production. They constitute some of the South's finest hunting grounds (Heyward 1960).

Publicly owned commercial forest lands comprise 9 percent of the total, about 17.3 million acres, of which three-fifths are national forests. These lands are managed under the multiple-use concept and are generally used for timber, wildlife, and other resources.

Approximately 10 percent or 5 million people over 12 years of age hunted in the South in 1970 (USDI 1970). The number has not increased since 1960, but the proportion declined to 6 percent. Small game hunters outnumbered big game hunters by nearly 2 to 1. About 80 percent hunted exclusively on private lands, while only four percent spent all of their hunting time on federal lands. The most commonly hunted species and approximate annual harvests are shown in Table 1 (Halls and Stransky 1971).

The recent Economic Survey of Wildlife Recreation (Horvath 1974) reported on hunters in the Southeast. Data were collected by interviewing occupants of randomly selected households. Thirty-two percent of the families interviewed

Table 1. Southern forest game species and annual harvest.

Kind of Game	Annual harvest[1]
	Number
White - tailed deer *(Odocoileus virginianus)*	396,600
Gray and fox squirrels *(Sciurus carolinensis; S. niger)*	1,942,000
Cottontail, swamp, and marsh rabbits *(Sylvilagus floridanus; S. aquaticus; S. palustris)*	1,177,000
Bobwhite quail *(Colinus virginianus)*	15,000,000
Eastern wild turkey *(Meleagris gallopavo)*	55,900
Mourning dove *(Zenaidura macroura)*	16,532,000
Ruffed grouse *(Bonasa umbellus)*	10,430
American woodcock *(Philohela minor)*	145,000
Ducks *(Anatinae subf.)*	2,323,000

[1]Data from Halls and Stransky 1971.

participated in hunting. About half of them hunted small game only, and an additional 25 percent hunted both small and big game. Hunting was most frequent in the home or adjacent State.

The largest percentage of hunters (21.3 percent) earned $7,000 to $10,000 annually. Less than 20 percent had an annual income exceeding $15,000. Households with an income over $10,000 showed an increasing proportion of big game hunters and a lower proportion of small game hunters.

Convenience of travel and abundance of game were the most important aspects of quality hunting, and the presence of trophy animals was least important. Preferred hunting grounds, in order, were unmanaged fields and woods, privately managed areas, and publicly managed areas.

The survey further showed that participants were willing to pay a total of $3.9 billion for hunting: $2.2 billion for small game, $1.6 billion for big game, and $163 million for waterfowl. Hunters were willing to pay $61.00 per day for big game, $49,00 for waterfowl, and $39.00 for small game.

The majority of hunters favored paying extra fees on public lands where hunting conditions were above average. Approximately half were willing to pay additional fees on private lands where some effort was made to improve the food and cover for game, but over one-third of those who intended to buy a license were not willing to pay any additional fees even though the money would be used to increase the number and condition of game. Hunters living in urban areas were generally willing to pay higher fees than those in rural areas.

Alternative Management Decisions

In privately owned commercial forests, economics determines whether timber or wildlife should be emphasized. Profit is the basic responsibility of the forest landowner (Orell 1964), who is unlikely to consider wildlife as an integral part of forest management unless he receives a monetary return from game (Glasgow and Noble 1971). Davis (1967) used a simulated program to quantify alternate courses of action. He concluded that no adjustments in timber management were justified to favor deer when a harvested buck brought a return of only $1.50. When the value of the buck was $13.00 on poor timberland or $37.00 on good timberland, some management practices should meet the needs of deer. When the price of a harvested buck was $37.00 on poor timberland, and $190.00 on good timberland, managers were justified in emphasizing deer in resource management.

In the past, many landowners liked the idea of having game within the context of normal timber management, but few were willing to practice special techniques to benefit the animals. It is known, for example, that prescribed burning of pine forests in small, well-distributed units benefits deer. Yet timber industry foresters indicated an interest in burning to improve deer habitats only if timber also benefited, and they would not agree to any added expenditures for deer.

Although economic factors may be less important on public lands than private, they still influence most public management decisions (Byrd and Holbrook 1974).

Landowners now seem receptive to proposals for adjusting timber harvests and other management practices and schedules to accommodate game. Before attempting habitat improvement, managers need information about costs and expected returns, long-term maintenance requirements, and the duration of specific treatments. Because over 90 percent of commercial forest land in the South is the privately owned acreage preferred by hunters, management prescriptions must be applicable to private landowners, particularly the small nonindustrial ones, if the practices are to have regional or national impact.

Habitat Improvements

Game habitat conditions are governed primarily by timber management practices, the two most common systems being selection and even-aged. In the South, the even-aged system is more common. Which system is the most beneficial to wildlife has not been determined, but the quality of management seems more important than the system selected.

Silvicultural practices improve wildlife food supply and provide cover for specific game animals (Halls 1971 and 1973, Rosene 1969, Byrd and Holbrook 1974, Goodrum 1961, Lay 1957, Ripley and Campbell 1960, Hewitt 1967). Management practices that most influence habitat are cutting cycles and rotations; the size, shape, and distribution of cutting units; timber stand density; and prescribed burning. Some animals have natural affinities for certain timber types (Stransky and Halls 1968), so each practice should be evaluated for a particular animal (Byrd and Holbrook 1974) and locality (Gould 1963).

The U. S. Forest Service, Southern Region, has developed the "featured species" concept to guide habitat management practices in even-aged forests.

For each designated unit of land, one wildlife species is selected for management of its needs, regardless of the presence of other species. The concept fits readily into unit planning, which guides management of all resources on a unit of National Forest. Species are selected according to habitat capability, compatibility with other resources, public interest and needs, and coordination with State and Federal wildlife agencies. Such items as cost, effects on other resources, benefits, management zones, uniqueness (rare and endangered species), and maintenance of water quality standards are also considered. Management options are then modified to meet the "featured species" habitat requirements, as well as the needs of timber and other resources.

Game should respond positively to habitat improvements (Carter and Dow 1969, Rosene 1969). Increasing forage production from 500 to 1,000 pounds per acre would probably influence the number, size, reproduction, and antler size of deer as well as affecting timber production, but the extent of response is speculative. Forest managers need reliable estimates of expected improvements before they commit resources to wildlife habitat. The Forest Service's Southern Forest Experiment Station, in cooperation with state game and fish agencies, is currently studing the response of white-tailed deer to timber stand conditions and management practices. Also being developed are models that show how improved habitat affect deer in shortleaf-loblolly pine-hardwood forests.

Costs

Relative costs and returns will determine both the share of available funds, land, and labor that should be devoted to game interests and the extent to which game will be allowed to interfere with timber and other resources. In commercial forests, any activity designed specifically to improve game and habitat should be financed by income derived from the game. For practices that mutually benefit game and timber, such as prescribed burning, costs should be apportioned.

Forest landowners who wish to benefit game may easily adjust most management practices to habitat improvement. Keeping cutting units small (100 acres or less) adds little or nothing to harvest costs, and limiting stand density helps maintain food production (Schuster and Halls 1963) and benefits pine growth. For example, a residual stocking of 500 to 750 pine stems per acre will give rapid diameter growth without reducing volume production (Mann and Lohrey 1974). Moreover, extremely dense stands are undesirable for both wildlife and timber. Frequent cuts would provide several payments to the landowner over a 10-to 50-year period and would probably provide better tax benefits than one large cut, especially for the small landowner. Increasing the frequency of prescribed burns and keeping the burning units small and well-distributed in pinelands might increase costs, but such burning provides protection against wild fire.

A computer simulation study in Missouri (Smith 1974) indicated that the extra cost of manipulating timber stands to improve habitat conditions was approximately $.10 per acre per year at current stumpage prices and $.54 per acre per year at potential prices when allocated over a 40-year period.

Some practices designed to benefit wildlife are expensive. Establishing and maintaining permanent forest openings with native vegetation may cost over $100 per acre of opening when the areas are cultivated, fertilized,and planted with improved food. Reduced timber production from openings must be regarded as a cost of growing food for game.

Returns

Monetary returns from game are usually a result of fees charged for hunting on a per-acre, per-hunt, or per-gun basis. Although non-game species have monetary value, they rarely contribute directly to forest management decisions.

"Fee-hunting" began in Texas in the early 1920's, and is now common throughout the State. Average returns per acre were $1.07 in 1964 (Teer and Forrest 1968) and are now probably higher because of the wide variety of services offered.

Most large forest landowners in the South now charge a fee for hunting on at least some portion of their lands even though management is timber-oriented (Stransky 1971). Minimum rates in east Texas forests are about $1.00 per acre per year, $125.00 per gun, or $10.00 per day on areas where no special wildlife management practices are imposed. The buck deer harvest probably does not exceed one animal per 150 acres.

At the Piedmont Wildlife Refuge in Texas, timber receipts have averaged approximately $10.00 per acre per year, and leased hunting rates are about $1.50 to $2.00 per acre per year (Pass 1974). Glasgow and Nobel (1971) predicted that hunting rights on most bottomland hardwood areas of the Midsouth would bring a minimum of $5.00 per acre per year within 25 years.

An example of how fee hunting has progressed with large forest ownership is shown by Gulf States Paper Company in Alabama (Stout, In press). Before 1946, hunting was not allowed; from 1956 to 1964 free hunting was allowed with limited permits; from 1965 to 1972, a nominal fee was required; and in 1972, fee hunting was expanded to allow profits. Charges ranged from $1.00 to $3.00 per acre on upland sites, $2.50 to $6.00 per acre on bottomland hardwoods, and $10.00 to $20.00 per acre on especially good sites with special services. In addition to allowing fee hunting, the company adjusted timber management to accommodate game by reducing the size of cutting blocks, distributing the blocks over a wide area, prescribe-burning every 3 years, thinning timber, and scheduling cuts throughout the rotation.

Fee charging by small forest landowners is less common. Most upland bird hunting (quail, woodcock, and dove) takes place on small forest land holdings (Heyward 1960), but fees are not charged as often as with big game. Most small land holdings are scattered and are not large enough to lease. The possibility of combining them into hunting leases has been suggested (Stransky and Halls 1969) but has not yet been adopted. As hunting space becomes increasingly scarce, small private landowners may wish to develop this vast potential. Although FIP will soon place many acres of small ownership lands under improved timber management practices, the preference of hunter for unmanaged woods (Horvath 1974) and strict emphasis on timber production may reduce the value of these lands for hunting. The FIP may therefore be indirectly increasing hunting pressures on industrial and public lands.

Many landowners in the South are willing to allow hunters on their land (Moody 1969, Horvath 1974, Stout in press) and are willing to help increase game, especially if expenses are shared by hunters or wildlife agencies (Emerson and Burbank 1968). As an incentive to habitat improvement, Wright and Lancaster (1973) have suggested a federally sponsored program that pays farmers an average of $300.00 to allow hunting and fishing on their property.

The costs of maintaining and improving habitats on public lands are just as high as for private. Taxes currently pay the costs, but there is strong feeling that users should be charged directly, which might result in hunting fees on National Forests. The "Game Lands" program in North Carolina (Amundsen 1973) illustrates how the Southern National Forests are applying this principle in cooperation with State Game commissions and private landowners. Each hunter pays a $6.00 annual fee that gives him access to nearly 2 million acres of private, state, and federal lands. This fee is used to reimburse private landowners and to develop and improve the habitat for wildlife.

The Sikes Act (H.R. 11537) authorizes federal agencies, including the Forest Service, to cooperate with state wildlife agencies to improve wildlife habitat on federal lands. The states may charge hunters and fishermen an additional fee or stamp requirement to be used only for improving the area where the fee was collected.

Predictably, state-owned game management areas give high priority to wildlife. In the past, hunting on these areas has been free, but now a fee is frequently charged to defray the cost of administration and in some cases to improve the habitat. For example, in Texas, a fee of $10,00 per day is charged to hunt deer, and $1.00 is charged for squirrel. Glasgow and Noble (1971) predicted that hunting on both state and federal land will probably increase. In well managed areas with good hunting, hunters appear willing to pay a nominal fee.

Conclusions

Regardless of landownership and size of holdings, the trend in Southern forest management is to include game and to charge a fee for hunting. The cost of the hunting permit or lease will eventually be determined by supply and demand, particularly on private lands. The dollar return will then determine what adjustments are justified to integrate the needs of game with other resources. The process is difficult because of continual changes in the relative values of resource products and in public attitudes. Both the timber grower and game manager have to plan for long-term responses, yet values may change drastically in a short time, as the rapid change in timber prices over the past two years illustrates.

Few question the desirability of including game as a component of the forest environment. Most forest landowners, however, would have to be assured of a monetary return before making any adjustments to favor game habitat at the expense of timber growing.

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Discussion

DISCUSSION LEADER TOMBAUGH: Thank you, Mr. Halls. I would like to ask one question myself before we get into additional ones. Your work concentrated largely in the revenue states. There have been studies that indicate that per unit costs for industrial provision of fee hunting have been reduced through perhaps a greater respect for the resource and for property that is being hunted on. Is this cost factor a side issue?

MR. HALLS: I indicated in some of these studies that some of the cost, at least some of these theoretical programs, can be very little . However, I am not familiar with any particular study that has shown exactly what the cost would be to the private land owner.

DISCUSSION LEADER TOMBAUGH: Thank you.

MR. BOB HUGHES [Sierra Club]: After listening to you and reading your paper and seeing some of the terminology such as "under-managed forests and no wildlife management goals by forest owners," one question that occurs is that it might be desirable, socially, to retain these small woodlands with balanced wildlife populations rather than skew them to game populations. In relation to the finding that you mentioned, for example, such as the Sykes Act, the implication is that they are game oriented, but is that really true or can the State Fish and Game Department use this money for all species? You referred in your paper to the featured species concept of the Forest Service and I would like to know just how much of these featured species concepts are utilized to enhance habitat for non-game species, endangered species, etc. . . .

DISCUSSION LEADER TOMBAUGH: You are putting your speaker at a terrible disadvantage with all of these questions at once. Could you handle them one at a time?

MR. HUGHES: Fine. My first actual question was in relation to the small woodlands. Is it better socially to merge them for balanced wildlife populations or for game populations and do we really have to manage them by interference?

MR. HALLS: My assigned paper here was on economics and I have avoided talking too much about some of the values of other species. Of course there are very definite values from other species and so I am sure there would be benefit from including other species on these lands. However, I think that the major incentive to improve management of some of these lands would still come from the returns that you got from the game animal. Insofar as the social values are involved, yes, I think this depends on other species.

MR. HUGHES: What about the featured species concept? How is that utilized for non-game species?

MR. HALLS: The featured species concept very definitely includes non-game or other species—very definitely so, yes.

MR. HUGHES: Do you have any examples of that?

MR. HALLS: The red cockaded woodpecker.

MR. HUGHES: In the last paragraph of your paper, you state that you question the desirability of including game as component of the forest environment. I am rather disappointed if, as you say, your directon in preparing the paper was strictly on the economics,that in this day and age, at this type of session, we are still separating these things out.

FROM THE FLOOR: Do you have any population figures for white-tailed deer on private lands in the South?

MR. HALLS: No, I don't have any specific figures on that. I might say, that the white-tailed deer population, although I don't have any specific figures for the past thirty or forty years, in the South, has increased considerably, almost doubling every ten-year period and most of this increase has come on private lands. As to the exact figures, I don't know and I don't know that there are any specific figures.

MR. CAROTHERS [Louisiana]: I wonder if any of you people here have heard of one of our problems in Louisiana called "Hunters Unlimited." I know that you have heard of Ducks Unlimited, but this is a new breed.

In the State Legislature of Louisiana last year, a bill was introduced to restrict hunting clubs and posting of land on areas one thousand acres and larger. This was defeated, but may be back in our legislature this year. I thought perhaps you ladies and gentlemen might like to know about this.

The idea seems to be that game belongs to everybody and if you have large acreages and are leasing it to hunting clubs, getting three to four dollars an acre a year or whatever, you are excluding a large number of people who think they own the game.

MR. HALLS: This is just a comment, but one of the large timber–land companies in east

Texas is quite aware of this and they have a fee hunting system on their land. They don't exclude anybody, but they charge everyone. Therefore, it is not exclusive to a certain group.

They do this to avoid what you are talking about, so they do not exclude any particular person. It costs them, however, quite a bit more in management and administration of this type of program than it does to lease the land out. However, they feel it is worthwhile doing it on this basis.

CHAIRMAN SEVERINGHAUS: I wonder if I can take the Chairman's prerogative here and ask one further question of you, Lowell. You referred, at least once, to the concept of "quality hunting." This is something that I find very poorly defined. With regard to doing what you are proposing, what is "quality hunting" in relation to small game and deer? Is it related to success or related to recreational opportunity?

MR. HALLS: I think, as I mentioned in the paper, most of the time we equated it with success, but I am afraid that maybe we would be better off if we equated it with recreational attitudes. However, the literature does indicate that people are more interested in being able to go out, being able to find enough game, and being able to shoot it. That, to them, is one of the prime requisites for what they call "quality hunting". In the South particularly, this trophy business was, like I said, fairly well down on the scale.

MR. GLASGOW [Louisiana]: In a recent Georgia survey, there was quite a high value placed on wildlife by bird-watchers, a non-consumptive group. Do you have any suggestion as to how this can be translated into economics for the land owner?

MR. HALLS: Well, frankly, no. I think there have been several suggestions made but insofar as I know, nothing has been very successful. For example, there has been some effort to sell Duck Stamps to people that are not necessarily interested in huntmg, but were just interested in the preservation of ducks. However, I understand this wasn't very successful. Only a very few were sold.

MR. GLASGOW: That goes to a state or federal agency, I believe. However, what I am trying to get at is what can the land owner derive from this group?

MR. HALLS: Well, I don't really know what he can get or even expect from it. I think there are possibilities for some of this, but I really do not have an answer to that question.

MR. GEORGE MATTFELD [New York]: I am very concerned about that same question. I would like to hear some audience reaction to the idea that people who wish to purchase the right to trespass on private lands to extract other wildlife values, perhaps could be charged the same fee that the hunter is charged in the Fall, yet use the land the year round and still not have to pay a license as a hunter does.

MR. HALLS: Well, I have no comment to that.

Incentives to Enhance Timber and Wildlife Management on Private Forest Lands

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Wildlife management is a "partnership enterprise to which the landowners, the sportsmen, and the public each contribute appropriate services and from which each derives appropriate rewards." (Leopold 1933). The same can be said of timber management by substituting *wood-based industries* for the word *sportsman*. Granted, timber and wildlife are different kinds of forest products needed by different segments of society, but the programs to produce each have a common base. Both programs result in public benefits by way of goods and services, and both are provided by the key link in the chain—the landowner. Fortunately, through a planned management program, the landowner can provide wood products, improved wildlife habitat, and more wildlife recreation opportunities all at the same time.

We first want to present evidence to show convincingly the dominant role of forests to wildlife in general, and the major contributions of private woodland owners in terms of their potential for supplying the wood, wildlife, and wildlife-based recreation needs of our country. This will be followed by a discussion of incentives needed to promote better coordination of timber and wildlife programs.

Forest Land as Wildlife Habitat

The birds and mammals of North America (north of Mexico) have been classified according to their forest habitat dependence. (Yeager 1961) Three preference classes were used: (1) primarily forest or brushland, (2) secondarily forest or brushland, and (3) woody cover rarely used. Yeager so classified 369 species of mammals and 714 species of birds. By combining (1) and (2) and eliminating species definitely associated with the oceans we find that 329 species of mammals (64 percent) and 547 species of birds (70 percent) have primary or a secondary dependence on forest or brushland habitat.

Birds and mammals combined show a 68 percent preference. Here's the clincher. Forests and associated shrublands occupy only one-third of the United States land surface. Thus we see that about two-thirds of the species of land birds and mammals are positively associated with woody vegetation which makes up only one-third of the habitat available. Apparently forest land does double duty for wildlife.

Think in terms of just game and fur animals that can be legally taken under state game laws. One hundred acres of well managed eastern hardwood forest can support a fall population of two turkeys, three deer, 25 grouse, 50 rabbits, and 100 squirrels, or 180 game animals. Add some fur animals like fox and raccoon and this 100 acres can easily provide the living requirements for more than two animals per acre. In what other habitat type can the sportsman or wildlife observer find such a variety and density of animals?

As for hunter use of forest habitat, it is estimated that at least two-thirds of all days afield in the United States are spent in pursuit of forest wildlife (120 million recreation days), and 80 percent of this occurs on privately owned woodlands. (Shaw 1970)

The case for concentrating wildlife management effort on forest land is well established. Decisions regarding the kind and amount of wildlife and hunting habitat to protect and manage in the future must be made now so they can be incorporated into land use planning programs to which the states are becoming increasingly committed. Forestry and wildlife agencies and organizations should be making their pitch now. We should take action now, rather than depend on reaction later when it may be too late.

Role of Private Forest Lands

Discussions in this paper are confined to private forest lands, exclusive of those owned by forest industries. We do this for three reasons: (1) lands in public and industrial ownerships usually have their own know-how and management flexibility to coordinate timber and wildlife programs without the need for incentives, (2) very few owners of private, non-industrial woodlands will practice sound management in the absence of incentives, and (3) the latter group is the most important one in terms of both acreage owned and potential for supplying wood and wildlife.

One-third of the land area in the United States is classified as forest land. Two-thirds of this forest acreage—nearly 500 million acres—is classed as commercial timberland, which means it is both available and suitable for growing continuous crops of saw logs or other industrial timber products. These commercial forests are broken down by acreage and type of ownership in Table 1 (USDA, Forest Service 1973).

Thus we see that about three out of five acres of commercial forest land in this country are owned by private citizens such as business and professional people, wage and salary workers, housewives, and farmers. Farmers own 44 percent and all others 56 percent of the nearly 300 million acres in the non-industrial private category. These tracts are owned by almost four million private individuals or family combinations. The average size is about 70 acres. They are often called family forests, and 90 percent of the acreage is in the eastern half of the United States where recreational opportunities are needed the most.

If placed under good management and with public access assured, these private woodlands could potentially provide an additional 100 million days of recreational hunting, enough to supply the expected increase in demand for the next several decades (Shaw 1970). In addition, they are a vast storehouse of trees needed to supply future wood products, although presently we are utilizing only a portion of their potential share.

Table 1. Area of commercial timberland in the United States, by type of ownership, January 1, 1970.

	Area (Thousand acres)	Proportion (Percent)
Federal	107,108	21
State	21,423	4
County and Municipal	7,589	2
Total public	136,120	27
Forest industry	67,341	14
Non-industrial private	296,236	59
Total private	363,577	73
Total all land	499,697	100

As we have seen, non-industrial private forests make up 59 percent of the commercial forest acreage, but in 1970 they produced only 48 percent of the cubic foot and only 40 percent of the board foot volume of roundwood products. This is due primarily to the reduced intensity of management on these lands compared with that on other ownerships, as indicated by the following estimates (USDA Forest Service 1973):

(1) Perhaps only 5 percent of the private non-industrial forest is managed intensively on a continuing basis.
(2) Roughly a third is held by owners who practice some management, but it is unplanned or accomplished at random.
(3) Nearly one half is in the hands of owners who display no interest in intensified forestry practices, although they will occasionally sell timber as it matures naturally.
(4) The remaining 15 percent is held by owners essentially for non-timber purposes.

In general we can say that most private forest owners do not consider timber growing investments to be sufficiently profitable to take priority over other investment or consumption opportunities. They must devote what time and money they have to obtaining other sources of income. Yet we need as much intensive management on the lands as practicable, not only to supply future wood products but also to increase the productivity of wildlife habitat.

It is not our purpose here to give the how-to of timber wildlife coordination, but to bring the subject into focus we quote just one statement:

> "If timber is cut in the right places, at the right time, and in the right amounts with wildlife requirements in mind, there will be a definite enhancement of habitat which can be perpetuated by sustained-yield forestry practices. If I were asked to make a wildlife management plan for a sizeable woodlot, I would make a timber rather than a wildlife plan. I might

dress up the area with some shrub plantings, a sod clearing or a waterhole if funds were available, but I am convinced that area-wide, at least 90 percent of the vegetative manipulations needed for forest wildlife can be achieved through a well planned cutting program." (Shaw 1970)

Why Incentives are Needed

The need for more intensive timber and wildlife management on private forest land is clearly evident. How do we get it implemented? That brings us to the prime subject of this paper—incentives. Let's begin with our rationale for thinking that incentives are needed and justified.

(1) An expanding population with more demands, more money, and more leisure time will be looking to the Nation's forest lands for greater supplies of timber and wildlife.

(2) Outputs of timber and wildlife will not be sufficient to satisfy these aspiring demands without more intensive forest management.

(3) Private, non-industrial forest ownerships offer some of the best opportunities for plugging this gap.

(4) But these owners are generally not motivated or able to make the timely investments needed to get the job done.

(5) Therefore, incentives offer a legitimate and promising means for getting such owners to take the action necessary to provide adequate supplies of timber and wildlife.

Incentives to do What

The concept of incentives is simple and logical in theory. It involves two parties—society and landowners.

—Society has specific needs—wood and wildlife.
—Society cannot satisfy these needs unless landowners change their mode of operation.
—A deal is negotiated whereby society pays landowners to change their ways.
—Both society and landowners are satisfied with the costs.
—Landowners do what society wants them to and both parties end up happy.

This sounds like a reasonable arrangement, but how does it work in practice? Society is the big problem. Its demands are constantly changing and depend on the interaction of several unpredictable social, political and economic forces. How can we ever hope to zero in on society's specific needs?

What we need most of all are some well founded, specific goals to shoot for. For example, suppose we knew with some certainty that the marketplace will require 500,000 tons of softwood pulpwood from Aroostook County, Maine, in 1985, or that Warren County, Pennsylvania, will need to provide 200,000 man-days of deer hunting in 1990. These kinds of targets would make planning for the use of incentives a lot easier, but such precise guides are not available.

Presently, political decisions, based primarily on value judgments and gut feelings, often dictate the use of incentive payments—how much, where, and for what. Program managers end up doing as much as they can wherever they can with the budget constraints foisted upon them. To make incentives effective we need joint target setting by forestry, wildlife, and land use planning organizations that zeros in on specific targets by defined geographic planning areas within a given time frame. Until this happens, things are not likely to change for the better.

Faced with the current maze of uncertainties and imperfections is there any reason to consider guidelines for timber-wildlife incentive programs? If our goals are not clear on what we are trying to do, should we fret about how to get it done? Because the authors both see better days ahead, we answer *yes* to both questions. We further suggest that any timber and wildlife incentive program aimed at private woodland owners should, at minimum, satisfy three basic requirements.

First, it should encourage *long-term retention of woodland.* There's no way to produce forest products or forest wildlife without trees and associated vegetation. What's the sense of providing incentives to improve productivity if a few years hence the woodlot is cleared for a housing development. Second, it should encourage *continued maintenance of that woodland.* All of us know that an untended stand of trees can stagnate to produce zero or negative timber growth while the wildlife habitat quality also deteriorates. Last, it should provide for *continual public access* to forest products. Since the taxpayer foots part of the bill, he should be allowed to reap a share of the benefits.

Admittedly, these requirements will be difficult to enforce because of their long-term nature. Also we know that we are dealing with a rather independent segment of the citizenry who do not want much interference with their fee simple property rights. The best that public agents can hope for is to get owners started in the right direction and use friendly persuasion based on sound scientific knowledge to keep them on track.

Kinds of Incentives

Tax Break to Retain Forest Land

A very important kind of incentive is the one which encourages the landowner to keep his land in forest cover by offering a tax reduction—in other words to prevent a change in land use. Most states already have legislation along this line, but there are varying degrees of effectiveness when it comes to application.

Connecticut, for example, has such a law and it is working very well. It is called the "Farm, Forest and Open Space Current Use Tax Law," enacted in 1963 and amended in 1971 and 1973. It is administered by the local assessor, State Forester, State Tax Commissioner, and the municipal planning commission. Forest and other open space land is assessed for property tax purposes on the basis of its "current use value" rather than its "highest and best use," to quote from the law. Contracts are for ten years and are renewable. The owner must have a minimum of 25 acres of woodland. To date, approximately 4,600 landowners involving 416,000 acres of forest land have signed up under the program. If Connecticut can do it, so can other States.

State forestry and wildlife administrators and land use planners should be working together in every state to make sure there is an effective law on the books, then they should do everything possible to insure that forest landowners take advantage of it. Let's face it, management for timber and wildlife cannot be practiced unless there are forests to manage.

Cost Sharing by ASCS

The Agricultural Stabilization and Conservation Service, an agency of the U. S. Department of Agriculture, has offered cost share help to private forest landowners for more than three decades. Incentives were first offered for timber growing practices in 1936 and for wildlife habitat improvement practices in 1962. Unfortunately there has been no concerted attempt to coordinate the timber and wildlife practices.

Tree planting and timber stand improvement are the two timber practices eligible for payment. The program has created a large workload on State-employed foresters who are responsible for approving eligibility of the practices and for certifying their satisfactory completion. Records for the past 25 years show approximately 4.5 million acres of trees planted and 3.6 million acres of stand improvements (thinnings) at a total Federal cost of around $97 million. During this period about 725,000 owners were involved, although we know that some owners received assistance more than once.

These figures may sound impressive until we realize that the combined acreage of planting and stand improvement, amounting to 8.1 million acres, represents only two percent of the forest acreage in non-industrial private ownerships. Up until 1973, when a special forestry incentives program was offered, funds spent on forestry practices were very small, amounting to between 0.27 and 5.15 percent of ASCS's annual budget for cost sharing.

The wildlife practices have fared much worse. During the seven-year period 1966—1972, average yearly accomplishments have been about 36,000 acres of food plots established, 2,000 acres of shallow water areas created, 4,000 acres of wildlife ponds built, and 3,000 acres of "other practices" installed. This adds up to 45,000 acres a year dedicated to wildlife—really just a drop in the bucket—and only a very small proportion of these improvements were on forest land.

Most foresters and wildlifers are well aware of the impact that forestry practices can have on the quality of wildlife habitat. In most cases these practices will have to be modified if habitat enhancement is the desired end. But the forester and biologist have not yet joined forces to affect the modifications needed with respect to this Federal cost share program. We strongly recommend they do.

If we expect the landowner to provide additional wildlife benefits, we should be willing to pay him at least the difference between what he could earn from a strategy resulting in maximum timber returns and what he would earn from a cutting plan designed to enhance wildlife habitat. Thus, cost share payments for stand improvement and tree planting should be increased if they are carried out to enhance wildlife habitat and some potential income from timber is sacrificed.

What Constitutes a Fair Incentive

How much should society pay a woodland owner to practice good timber and wildlife management? Conceptually, the answer to this question is simple. The net return to the landowner from any recommended system of sound timber and wildlife management should be at least as great as his best economic alternative. If not, the owner should be compensated to make up the difference (Gansner 1973). Only then would we expect him to consider our recommended system.

Unfortunately, this textbook solution is a lot easier to preach than to practice. A couple of simple hypothetical examples will illustrate. Pretend I am Sam P. Agent and you are John Q. Woodsowner. Somehow we get together, I say to you, "John, we've got a management package here we'd like you to try on 20 acres of your forest land. It's a system based on sound scientific study, designed to increase the production of both timber and wildlife for you and the rest of society over the next 50 years. I've estimated the costs and returns associated with this package and, using an appropriate discount rate, I calculate that it will yield a present net value to you of $100 per acre or a total of $2,000."

Now you might say to me, "Sam, that's a fair amount of money and I'm impressed. But it just so happens that a developer offered me $20,000 for that 20 acre tract yesterday. I'd be happy to hold on to my woods and adopt your system if you could make up the difference."

Now the difference between $20,000 and $2,000 is $18,000 which would amount to an incentive payment of $900 per acre. Obviously, we cannot afford this kind of client. So I say to you: "God bless you, John, and enjoy your $20,000."

Fortunately, most of our potential clients will not have such lucrative alternatives, at least not at the same time. We will reset the scene to illustrate a case in point. Assume you are the same owner, with the same 20 acre tract, but this time there is no developer on the door step with $20,000 in hand. Further assume that I am pushing the same management system designed to produce both timber and wildlife—the one that will yield you a net return of $100 per acre. We might revise the script as follows: You say to me, "Yes, Sam, your package sounds like a good deal, but couldn't I earn more money if I forgot about wildlife and concentrated just on the timber?"

To which I reply, "You're right, John. My calculations show that if you went for a system that maximized timber production alone, you would receive a present net value of $125 per acre. But we need that wildlife. Suppose I pay you the difference of $25. Would you go for the system that gives us both timber and wildlife?"

To which you reply, "That system of timber production you're talking about involves periodic thinnings and all that jazz. Most of the payoff won't come for years. I can clearcut now and get $150 per acre for the timber. And if I do it right, mother nature will grow me a new stand of trees in a few years."

My reply goes: "John, you drive a hard bargain. Suppose I pay you $50 an acre to cover the difference between what you would net from the clearcut option and the package we recommend for both timber and wildlife. Now will you go for our timber plus wildlife package?"

To which you reply, "I don't know, Sam. That clearcut gives me cash on the barrel head—$150 per acre right now. On paper, your package nets me $100 per acre. That plus the $50 incentive you pay me makes your package look pretty good. But what if the bottom drops out of the timber market. Or what if fire or the gypsy moth wipe me out. Maybe you should raise the ante a bit to cover such contingencies."

And so it goes. Obviously the textbook approach would be a headache to administer if we tried to apply it to every case encountered in the field. Each woodland owner has a different set of economic opportunities, objectives and values. That is not to say the approach is worthless. The calculations are sound. We could combine this with our knowledge of the attitudes and economic alternatives of the entire population of woodland owners to derive across-the-board estimates of payments necessary to get a large share of them to take action. Incentive payments thus derived could be considered fair, at least in a strict economic sense. These payments, coupled with adequate budgets and some friendly persuasion on the part of public agents, could get a lot of good timber and wildlife management implemented.

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Discussion

DISCUSSION LEADER TOMBAUGH: Thank you, Sam. I am now thoroughly confused on a point that comes up in relation to Lowell's paper and yours and I wonder if any of you can help me out.

Either Lowell or you, Sam, have indicated there is an economic feasibility, perhaps, to game management on private lands—that it can't be treated basically as a commodity and I believe you, Sam, argue that perhaps some incentive might be appropriate with relation to money going into it. I am wondering if there is not some incompatibility there. I am wondering that the more we view that game is pure commodity, if we don't weaken the argument for support of this kind of program. Can you comment on that?

MR. SHAW: I read Lowell's paper and most of it deals with user fees for land owners. This is great. I think we need this.

However, to me, we need all the incentives we can get and the kind of program we are recommending in this paper was based on strict economics of what it cost to practice good timber and wildlife management. I think the landowner is entitled to that compensation whether he lets hunters on his land or not.

However, I should not say it that way. One of our requirements was, if he adopts this program, he should allow hunting on his land, but I think Lowell's paper and mine are compatible in that we just add one to the other and it gives the land owner more incentive to want to practice good timber and wildlife management.

MR. GEORGE DELLINGER [Missouri Department of Conservation]: I did not particularly want to ask a question because I don't think you can answer it today, but I wanted to make a statement in relation to your chart on the economics showing a loss of income to the land owner in the magnitude of $50.00 an acre.

I would like to explore sometime the origin of those figures because those are grossly in excess of a similar type of study we worked out for all timber management versus coordinated timber management in Missouri. In a good part of the new system we were using there, it showed, and I don't remember the exact quantity, an almost insignificant difference over a rotation. I don't want to let your projection of a gross loss in timber revenue for coordinating it with wildlife stand as an image in the mind of everybody here because I would challenge its accuracy.

MR. SHAW: Okay, that is your privilege.

Actually, the economist wrote that section of the paper. He did publish a bulletin on this, which is available in Upper Darby. David Gansner was the author, but his figures were somewhat lower. However, I said that these figures, for today's purposes, in his opinion, could be considered realistic

MR. DELLINGER: Your figures show that in considering wildlife you are taking too big a chunk out of the timber production—is that your point? As a comparative study, I had Dr. Smith's paper which I presented at a symposium in Missouri in 1971. I have those figures for those who are interested.

MR. SHAW: Well, I believe I could add the statement that, for example, if you practiced good habitat management along with timber management you very seldom would sacrifice more than ten percent of your total timberland.

MR. JOHN GRANDY [Defenders of Wildlife]: You showed a group of animals and you said you had those on a hundred acres, I believe. If you had good management, what did you benefit by that?

MR. SHAW: Well, by good forest management, I meant, first of all, sustained yield management. I meant that you need a balance of age classes, and you don't have any one stand too large. This creates diversity. This, mixed in with the wildlife practice that you will be hearing more about in the next paper, to me is a multiple use package, and you could expect to get populations of game and fur animals like I referred to.

MR. GRANDY: For example, let us take some five-acre blocks—if you cut that area into this pattern, or take a hundred year rotation, five acres per year on five-hundred acres, five acres per year for a hundred acres or five-hundred acres in a hundred years, would you end up with that kind of diversity?

MR. SHAW: Yes, right. That is the whole purpose. When you look at it in total and if you strive to get about half of your total management unit in saw-timber stands about twenty-five percent in pole stands, and about twenty-five percent in samplings, this would be sustained yield management.

MR. GRANDY: Okay, right.

Now, although your paper was on private land and you discussed an incentive payment scheme, would you favor, or think it wise, to require that type of forest management, namely small patch cutting, on national forest lands so as to have those values?

MR. SHAW: I did write a bulletin applicable to private lands. It was called "Managing Woodlands for Wildlife." In that bulletin, I recommended the maximum size of any single clear-cut be 20 acres. At that time, even the Eastern Region of the Forest Service was on a 50 year minimum. So I was criticized because one branch of the Forest Service was not consistent with the other. Two years later, however, they brought that 50 acre minimum down to 20, so now we are all right.

Blending Wildlife Needs in Forest Management Systems

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We are now entering what I think of as the Fourth Era of the conservation movement. I hesitate to use the word conservation because of the difficulty these days of distinguishing the conservationists from the preservationists, from the so-called ecologists, or the environmentalists. My use of the word conservation follows Gifford Pinchot's definition of "wise use of our natural resources." To me, conservation and resource management are synonymous.

Youth today feels it is responsible for the birth of the Environmental Movement in this country. In reality, it is responsible only for the rebirth, as the Environmental Movement was born in the late 1800's and early 1900's by the efforts of men like Pinchot, Major J. W. Powell, and Aldo Leopold, during the First Era of the Conservation Movement. This Era, not unlike the Environmental Movement of today, was a period of propaganda in which attempts were made to arouse and awaken the public to the need for control of, and restraints on, the use of our natural resources.

The Second Era was marked as a protective period in which we attempted to conserve what was left of our resources. During this Era, through the 1920's and 1930's, National and State Forests were established and wildlife refuges came into existence. We stopped the destruction of the forest by wildfires; we planted trees; and we saved wildlife from extinction by imposing bag limits and closed seasons.

The Third Era, born during World War II and just now coming to a close, was a period of single resource management. Timber, protected during the Second Era, had grown large enough to provide salable products and was in demand to support the war effort and the postwar building boom. During the Third Era we were blessed with an ample land base on which the demands were relatively low. Foresters were concerned with planting trees on every acre of open land, while at the same time wildlife managers were cutting or bulldozing poletimber stands for browse.

We are now embarking on the fourth Era which will be characterized by intensive management, not of single resources but a coordinated program encompassing all forest resources.

It is interesting to note the contrast between the definition of forest resources as we know it today and what it was 10 to 20 years ago. A discussion of forest resources in 1950, or even as late as 1960, dealt with statistics on acreage of commercial forest, timber growth and cut, and past and future trends in wood product demands. Perhaps in passing, the word multiple-use would have been worked in, to indicate there were other uses of the forest, but for the most part the growth and availability of wood products would dominate.

Today, the term, forest resource, has taken on a much broader meaning. The new concept includes, in addition to the timber, the water, wildlife, mineral, and recreation resources of the forest.

It includes everything that is produced or can be seen or heard in a forest environment. This is not to say that every segment of our society accepts this broad definition. Depending on the interest group we are attuned to, forest resources may mean only one or it may include all of the aforementioned resources. It can vary from true multiple resource use to narrow interests that think only in terms of wood, wildlife, or wilderness. There are many factors such as mobility, leisure time, environmental concern, increased water needs, the energy crisis and new recreational interests that have brought about the change in concept for forest resources.

As we enter this Fourth Era of resource management we find a growing population that is highly mobile, and with the time and money to take advantage of this mobility. During the past two Eras, we foresters and wildlife managers had the woods pretty much to ourselves. Today, thanks to the interstate highway system, the forests are only hours away from the highly populated megalopolis. During the first three Eras, the urban dwellers were behind the conservation movement but took little or no active part in it. Today, because of their mobility, concern over the environment, and exposure to forested areas they are a part of the movement, and a very outspoken part at that.

There are factors other than the concern for the environment that will influence the future use and management of forests. In recent years we have seen a phenomenal growth in the recreational use of forest land through hiking, camping, horseback riding, and the new array of motorized toys such as ATV's, snowmobiles, and trail bikes. Another recreation interest in forest land, perhaps better termed a philosophy than an interest, is the wilderness concept. Wilderness advocates propose setting aside large tracts of land on which there will be no development or resource management.

Water is another important forest resource. More forest land will have to be set aside as municipal watersheds in order to meet our future water needs. Minerals are not normally considered forest resources, yet we must include them in any long-range planning dealing with forest lands. Due to the present fuel shortage, there can be no doubts about the active interest in mineral exploration and development underneath the trees.

Let us examine the outlook for wildlife, another segment of the recreational interest in forest land. There are 29 million acres in Pennsylvania, 17 million acres or 61 percent forested and 26 percent in cropland and pasture, a total of 87 percent available as wildlife habitat. Most of the forest land is open to hunting. However, less than one-half of the crop and pasture land remains open and this is shrinking at an alarming rate. Not only has the acreage in farm land decreased in recent years, but the acreage remaining in farms is fast disappearing as open hunting ground. The character of rural eastern United States has changed drastically in the past 20 years. Prior to World War II, agricultural areas in Pennsylvania consisted of scattered small towns surrounded by 100 to 200-acre farms, each with one residence. Home construction since World War II has spread out into the farms along all the major roads on ever-increasing lot sizes resulting in widely separated homes. Pennsylvania hunting regulations require a 150-yard safety zone around inhabited buildings. This amounts to as much as 18 acres lost to hunting for every building lot sold in rural areas. Every time we lose land for hunting, it increases the pressure on the remaining open land. Increased pressure on the open lands causes more irritated landowners, resulting in an increase in posted land. You can see the spiral we are caught up in.

Because of crowding, the time is coming when it will no longer be fun, in fact, it will no longer be safe, to hunt small game in open country and farm lands in Pennsylvania. Sportsmen who can't find a place to hunt small game due to posting, don't like the crowding, or feel unsafe in open areas, are turning to more mountainous forest areas for their recreation. I can see the day coming when hunting in Pennsylvania will mean going to the woods for big game and upland small game.

We have discussed many future uses for and demands on forest land, but what about the forest as a source of wood? The United States Forest Service, in its recent publication *The Outlook for Timber in the United States*, indicates our softwood cut exceeds growth by 18 percent and although the picture for hardwoods is much brighter, the overcutting of softwoods is rapidly increasing the demand for hardwoods.

Lest we forget, it seems proper to re-examine the unique, natural material—*wood*—in light of the environmental movement's concern over its use, misuse and non-use. Wood, unlike iron, coal, gas, and oil is a renewable material resource. It is an ideal resource compared to steel, aluminum and plastics in that it requires low energy input for conversion into useful products. Many wood products fit the requirements for recycling and, more important, by today's standards, wood is biodegradable. Such a resource cannot possibly lose its position in the list of prime raw materials available to man—it can only increase in importance as other resources are depleted.

Whereas the wood-using industry is interested in the timber resource, watershed managers look to the forest as a source of clean, unpolluted water. Mineral developers prospect for gas, coal and oil. Hunters are interested in an ample supply of trophy animals; and fishermen want clear mountain streams. Hikers and bird watchers seek a beautiful, unmolested natural environment, while the motorized vehicle riders look to the forest as a place to test their skills and endurance. Then there is the wilderness advocate who looks to the forest as a haven for peace and solitude. All of these uses of the forest are legitimate and fulfill a basic need or provide personal fulfillment. As resource managers, our challenge during the Fourth Era will be to produce more wood, more water, more minerals, more recreation, and more wildlife in an attempt to fulfill the needs and wants of the public.

Planning is the key to the future development of our resource program. Planning has been defined as a complex clustering of problems, and also as an organized, intelligent attempt to select the best available alternatives to achieve specific goals. The common attributes of planning include looking ahead, making choices, and where possible, arranging that future actions for attaining objectives follow fixed paths; or, where this is impossible, setting limits to the consequences which may arise from such action. Through planning we can maximize the resources and at the same time minimize the conflict between the resources and the rest of the environment.

The planning process is not new to resource management. Foresters have been writing timber management plans for 60 years. Wildlife managers and soil scientists have been developing management plans for only a slightly shorter period of time. The difference between past planning and that which we will be doing in the Fourth Era, is the change from single resource, to total resource management, along with all of the conflicts and complications that are inherent in such a complex system.

I am well aware that we foresters have talked a great deal about multiple-use management as evidenced by the list of objectives such as management for timber, water, wildlife, and recreation that have appeared in almost every forest management plan written during the past 30 years. In reality our management was aimed at protecting the water, wildlife, and recreational values as we carried on the timber management activities. Whenever we cut a tree, it provided browse for deer; on watersheds we reseeded skid roads to prevent sediment from reaching the reservoirs; and here and there, we really sacrificed and left a cull for a den tree. Planning the future will not be that simple.

Pennsylvania has developed a Forest Resource Plan for the 2 million acres of state forest land. The planning process consisted of six steps:

1. establishing objectives
2. inventorying the resources
3. studying past performance and predicting future demands
4. developing specific recommendations based on technical know-how
5. weighing the interactions of the recommendations, and
6. formulating a balanced action program.

Because of time constraints, I will confine my comments to two forest resources—timber and wildlife.

Step one in the planning process, that of establishing objectives, was accomplished by examining the legal mandates set down by the Pennsylvania legislature and by studying the needs and wants of the public. Both the social and economic values of the forest were given consideration. Ordinarily we refer to human wants and needs. I have purposely turned these two words around to read "needs and wants." Human needs are those things we must have to sustain life such as shelter, food, clothing and water. Wants, on the other hand, are those things we would like to have to make life more pleasant such as a beautiful place to live, or to hike, hunt and fish. In developing a resource plan we must first satisfy human needs, then incorporate as many wants as possible.

Step two, the inventory of the forest resources, was basic to any planning and development. It was necessary to determine what, where and how much we had. Aerial photographs, combined with many miles of shoe leather, were the primary tools. The commercial forest was mapped recognizing 48 possible type, site, size class combinations. Areas too steep or too rocky to be logged were classified as non-commerical forest. Important wildlife habitat such as open areas, beaver dams and coniferous cover were mapped. The development of resource maps was an essential part of the inventory and an invaluable tool in the planning process.

Step three was a study of past trends together with some crystal-balling into the future demand on the resources. Data on timber demands, trends in recreation use, highway development and other factors were assembled and analyzed in making these projections.

Step four in the planning process was the assembling of technical know-how in the development of specific management recommendations. In this step we pulled together the latest research reports and evaluated current management practices dealing with such things as silvicultural methods and wildlife habitat requirements.

Foresters provided the management recommendations for timber. The forests of Pennsylvania can be managed by either the even-aged or uneven-aged systems. Even-aged management, through clearcutting, lends itself to the efficient production and regeneration of high value timber species. It also provides a mechanism for creating deer browse, game cover and a variety of wildlife food plants. On the other hand, uneven-aged management through selective cutting produces lower quality trees and less valuable timber species, but often times higher valued trees from the standpoint of aesthetics. It is a means by which a forest can retain a semi-wilderness appearance in a vigorous, healthy condition.

Biologists in the Pennsylvania Game Commission provided specific recommendations for forest game habitat. Recommendations dealt with such things as the size and special arrangements of herbaceous openings and coniferous cover; the value of spring seeps and dusting areas; the importance of brush and mast. Biologists in the Fish Commission provided recommendations on trout habitat, stream temperature and aesthetic considerations for maintaining a high quality fishery.

The fifth and most challenging step in the planning process was that of weighing the interactions of the various management recommendations. Almost any management decision has an effect, either adverse or beneficial on the other resources or resource uses. Timber management can have an effect on water yield, aesthetics, stream temperature, and wildlife habitat. Wildlife can have an effect on a regenerating forest and devoting forest land to special wildlife or aesthetic uses can have an impact on timber production.

After reviewing steps 1 through 5, the objectives, the inventory, the projected demands, the management recommendations and their interactions, the final step was completed, that of formulating a balanced operating plan. The operating plan is based on priorites, alternatives, and ecological capabilities. The operating plan identifies areas where timber management should and should not be applied. For example, timber management is excluded from parks and picnic areas, natural areas, corridors along some hiking trails and from those areas classified as non-commercial forest. On the other hand, timber management will be applied to all land classified as commercial forest. Based on social, economic, silvicultural and wildlife considerations the commercial forest was zoned for either even-aged management where clearcutting will be applied or uneven-aged management where selection cutting will be applied.

The operating plan calls for 200-foot no-cutting buffer on both sides of Wilderness Trout Streams where a high quality native trout fishery will be maintained. All other trout streams have a 100-foot-wide uneven-aged management buffer to protect stream temperature and aesthetic values. Certain remote trout streams that do not qualify as wilderness streams due to stocking or low natural reproductive capacity have been designated as Wild Trout Streams where no new public motor vehicle access will be permitted, in order to create a walk-in fishery.

The Operating Plan calls for two to five percent of the forest to be in permanent herbaceous openings. All natural openings up to 40 acres in size will be maintained by periodically removing the invading woody stems. Additional permanent herbaceous openings will be created by enlarging log landings or by clearing one to two-acre patches of poorly stocked timber. Pipelines and power lines will also be maintained as openings. In this way the habitat requirement for permanent openings can be met with little impact on timber production.

A variety of forest wildlife game species is dependent on conifers for winter cover. It is recommended in the plan that coniferous cover occupy five percent of the forest in blocks five to 20 acres in size. Management practices are aimed at maintaining existing stands, releasing understory conifers and esablishing five-acre plantations where the first two options are not available.

Large, old trees are an important wildlife consideration. Theoretically, in a well-managed forest, defective trees are removed in thinnings and mature trees are cut, either individually or in blocks whenever they reach rotation age. Little room is left for the development of hollow den trees or large-crowned, overmature wolf trees. Recognizing the importance of such trees to both game and non-game wildlife species, we now provide for this habitat element within Natural Areas and non-commercial forest where no timber management is applied; within uneven-aged buffer zones where we allow up to 30 percent of the basal area to be in cull or wolf trees; or within Wild Areas where only salvage cuts are applied. In management units where none of the above occur, selected stands of good mast-producing trees will be allowed to exceed the normal 100-year rotation age. Here again, with proper planning, this habitat requirement can be satisfied with little impact on timber or other forest resources.

Spring seeps are important to turkey and grouse during the winter months. Although we can't create seeps where they do not exist, we can protect them and enhance their value through judicious cutting. Log roads and skid trails are located so as to avoid seeps. Careful thinning of the trees overtopping a seep can increase the mast-production on the residual trees and can increase the light energy reaching the acquatic plants in the seep.

Diversity, in both timber size classes and in species composition, is an important consideration in wildlife habitat. Well-planned commercial timber sales are the most effective and economical means of providing diversity. Clearcuts provide browse, cover, edge, temporary openings, a variety of shrubs and herbaceous material and are the first step in a diverse forest. The Operating Plan calls for clearcutting one percent per year of the area zoned for even-aged management. At this rate, five to six percent of the total forest area will be in the brush stage at any one point in time. Although a 100-acre maximum size is imposed on individual clearcuts, most cuts are between 30 and 60 acres because of wildlife considerations.

The border of clearcuts are purposely made irregular to lessen the visual impact and to increase the edge for wildlife. Game food species such as juneberry, dogwood and hawthorn are left within the cut areas and fruit prolifically after being opened up to full sunlight. Den trees near the edge of clearcuts are reserved, and on some clearcuts scattered trees are left as perches for hawks and owls who find an abundance of mice and moles in a recently cut-over area.

With planning, there can be a blending of wildlife needs in forest management systems. In Pennsylvania, with understanding and compromise, the Game Commission, the Fish Commission and the Bureau of Forestry have made it work.

Discussion

DISCUSSION LEADER TOMBAUGH: Jim, that was certainly a fine presentation. Are there questions from out in the audience? Well, while we are warming them up, I have one.

You mentioned, Jim, in the planning process for a multiplicity of forest uses, including wildlife—the need to take a look at urban needs—and I am wondering and trying to reflect in relation to my training—wondering, for example, what tools a professional wildlife manager and professional forester have for translating those urban needs and wants into land use plans and practices?

MR. NELSON: I think if we take my interpretation of the needs and wants, the needs are relatively easy to come to grips with. However, it is the wants that are the problem. Here again I think that in any planning system, the system has to be flexible enough to change as the wants change. I cannot see any change in the water demands, timber demands, shelter, or food demands, but certainly the wants will change and our whole system has to be flexible. We have to be attuned to what the public desires from the forest system.

In this connection, we have had a series of public meetings endeavoring to keep attuned to public wishes. One of the problems, however, is what public are we listening to?

DISCUSSION LEADER TOMBAUGH: Are there other questions or comments?

In addition to the 2 million acres of state forest lands that Jim is talking about, there are also 1 million acres of so-called state game lands in Pennsylvania. Of course, state game lands are purchased primarily for wildlife uses. I wonder if Jim would make a general comment on the difference between forest land plans on Bureau of Forestry lands and the program on game lands. Are they compatible?

MR. NELSON: I think I probably should ask someone from the Game Commission to respond to your question, but I would say, yes, for the most part, our management systems are compatible. On state forest lands, we probably go a little further toward providing a greater variety of recreation use than is provided on state game lands, but the overall management philosophy and management systems are pretty much the same on both state forests and state game lands.

MR. RUEBEN TRIPENSEE: That was an excellent program that you have proposed. I wonder, will the economics change your cutting system. Do you anticipate there will be more demands for wood and that sort of thing or, on the other hand, do you think all of these demands will sort of equalize themselves out and allow you to follow that program?

MR. NELSON: Well, if you asked me about increasing wood demand a year ago, I would have had to say "yes," there will be increasing demands. However, after the last six months of experience in relation to the timber market, which has been very depressed, I would have to take a different look at that. But in looking at it over the long pull, I cannot see any way but that the wood resource is going to have to become more important to our economy. This is one of the few renewable material resources that we have.

MR. TRIPENSEE: Will you be changing your plans as the demands of wood increase?

MR. NELSON: We have seen some of that on the National Forests, where there was a demand for wood and where clear-cutting was substituted in places for other types of managemment. However, as far as our regulations or allowable cut are concerned, in relation to state forest lands, no, there will not be any increase. Increase in wood production can come from the more extensive areas we have zoned for commercial forests and this is where any increased production will have to come from. I don't see any great change in the management systems that we have at the present time.

MR. TRIPENSEE: I want to again thank you for an excellent job of not only presenting your information but the job of planning that you did.

MR. NELSON: Thank you.

Coordinating Forestry and Elk Management in Montana: Initial Recommendations

L. Jack Lyon
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Introduction

In the Rocky Mountain West, coordination between timber harvesting and management of Rocky Mountain elk (*Cervus canadensis nelsoni Bailey*) has become virtually mandatory. Elk are always associated with a timbered habitat, and during recent years it has become apparent that widespread modification of this habitat may produce complex and possibly detrimental effects. In many situations, land managers and game managers have been unable to reach common agreement because the information needed for sound decisions is simply not available.

As a result of this controversy, the Montana Cooperative Elk-Logging Study was initiated in 1970 with the objective of determining . . . "the influences of logging and road construction, together and individually, on the behavior, movement, harvesting and survival of Rocky Mountain Elk in Montana." Cooperators include the Montana Fish and Game Department; the Intermountain Forest and Range Experiment Station and Region 1 of the USDA Forest Service; the Forestry School, University of Montana; and Missoula District, USDI Bureau of Land Management. The cooperative agreement and initial research program have been described previously (Lyon 1971).

After 4 years of investigation, the Montana Cooperative Study has produced substantial amounts of new information. Five postgraduate studies have been completed and several papers are in preparation. In addition, the Research Committee has compiled five initial recommendations for the coordination of timber harvesting, road construction, and elk management in Montana. These five recommendations and brief summaries of the study data leading to their formulation are the subject of this paper.

Because many of our studies are still in progress, the recommendations are subject to further clarification and modification. However, we believe it is important that even partial information be made available as quickly as possible to aid managers in their decisions.

The summary information presented here represents the combined efforts of several dozen scientists, technicians, and students. Because papers in preparation will describe most of the studies mentioned, only brief abstracts of results are given here. I have cited the individuals responsible for each study and would like to acknowledge the debt we all have to the many additional contributors who are not cited.

Recommendation I

Planning for timber sales on elk summer range should provide for a security area immediately adjacent to the disturbed area during active logging and road construction.

Studies

Burdette Creek - Deer Creek

L. Jack Lyon, Intermountain Forest and Range Experiment Station

This study area is located on the Lolo National Forest, 25 miles west of Missoula. It includes about 75 square miles of timberland with a scattering of small to large brush fields. Topographic relief is strong with many loose talus slides, rocky outcrops, and slopes in excess of 50 percent. The area includes seven stream basins, each draining five or more sections of land. The largest, Burdette Creek, drains 25 square miles in the center of the study area. Roughly half of this unroaded drainage is an open, shrub winter range. Deer Creek, to the northwest, drains about 12 square miles, all of which is forested. During the period 1971-1974, about 56 miles of road were constructed in Deer Creek and 2,958 acres of timber logged. Elk pellet distributions in Deer Creek, Burdette Creek, and all adjacent drainages have been determined annually since 1970 by surveying approximately 300 miles of belt transects in early September.

Road construction and logging in Deer Creek initiated a continuing decline in numbers of elk pellets in the drainage. Corresponding increases were recorded over the ridgelines in adjacent, undisturbed drainages. Subsequent road construction on the ridge between Deer Creek and Burdette Creek resulted in a decline in pellets near the ridge and further elk movement away from construction activity. Changes in elk distribution were detected up to 4 miles from the ridgeline disturbance.

Sapphire Mountains

Robert R. Ream, Forestry School, University of Montana

This study is based on radio-tracking of elk captured at the Three Mile Winter Game Range in the Bitterroot Valley, 20 miles south of Missoula. To the east, the Sapphire Mountains summer range, on the Bitterroot and Lolo National Forests, includes approximately 150 square miles of forested land along the Bitterroot Divide. West of this Divide, the area is intensively roaded and heavily logged, but there are several large undeveloped drainages on the east side.

Movements of 35 animal years from the winter range to summer range on and over the Bitterroot Divide have been monitored between May and November since 1971. During this period, monitored elk actively avoided summer range areas in which timber sales were in progress. Movement patterns suggest that adequate security was provided by 2 miles of undisturbed heavy timber along a ridgeline and over a point.

Inferences

In both studies cited, elk avoided or moved away from logging and construction activity until adequate security was achieved. Apparently, an undisturbed topographic barrier, breaking line-of-sight contact, will satisfy this requirement, but 2 miles of undisturbed timber may also be adequate.

Implementation

Where determined to be an undesirable effect of timber sale activities, displacement of elk can be reduced by providing a security area immediately adjacent to the disturbed area during the active logging and road construction period. The size and location of such security areas should be determined by on-site consultation between wildlife and timber managers, but an acceptable area should provide a line-of-sight topographic barrier and be inaccessible to motorized traffic. To realize the full value of the security area, the ridge line separating the timber sale activity should remain undisturbed, with all roads and logging below the skyline.

Recommendation II

Five specific habitat types have been identified as key components of summer elk range. Where appropriately interspersed with other requirements of elk, these types should be managed to maintain the overall integrity of the elk habitat.

Studies

Long Tom Creek

Terry N. Lonner and Eugene O. Allen, Montana Fish and Game Department

This study area is located 25 miles southwest of Butte on about 36 square miles of the Beaverhead and Deerlodge National Forests. By contrast with areas further west, the Long Tom Creek drainage has a high proportion of nonforested land—nearly half of the area is open parks or parks with scattered timber. Elk move to the drainage during summer and fall from the Fleecer Mountain winter range 9 miles southeast.

Eleven permanently marked foot routes covering 62 miles of belt transect were surveyed from 1972 to 1974. Transects have been divided into segments of varying lengths to provide clear separations of cover types; and four to eight times each summer, on 700 transect segments, all elk sign, including pellets and other evidence of use, has been recorded. At the same time, each segment was classified as dry or wet in some degree. Between June and August 1973, half of all recorded elk use occurred on the 32 percent of the route system classified as wet; and 27 percent of elk use occurred in the 10 percent of the system classified as wet, broken parks.

The importance of wet areas was further confirmed by measurement of physical characteristics of 124 elk bedding sites in 1972-1973. Seventy-nine percent of these sites were located in wet conditions. Habitat types identified as significant by Phister, *et al* (in press) were *Abies lasiocarpa/Calamagrostis canadensis,* and *A. lasiocarpa (Pinus albicaulus)/Vaccinium scoparium.*

Sapphire Mountains

C. Les Marcum, Forestry School, University of Montana

During the summers of 1972 and 1973, 300 specific locations of radio-tagged elk were described by habitat type. A random sample of 200 points was also obtained to determine distribution of habitat types within the study area. Elk use of various habitat types appeared to be generally consistent with the amounts of each type present except for *Abies lasiocarpa/Galium triflorum,* a moist habitat type which received nearly four times the expected use.

Burdette Creek - Deer Creek
L. Jack Lyon, Intermountain Forest and Range Experiment Station
Each 40-acre unit on the study area was classified as an independent observation of elk use in relation to distance from water. With an average of 1,200 such observations in each of 4 years, units over one-half mile from water received consistently less use by elk than units within one-half mile of water.

In this part of western Montana, moist sites at the heads of drainages, bordering streams, or occupying moist swales on benches are usually classified as *Abies lasiocarpa/Luzula glabrata (Menziesia* phase), *A. lasiocarpa/Menziesia ferruginea* habitat types.

Inferences

Throughout studies on both eastern and western Montana elk ranges, moist sites in specific habitat types have been identified as important components of elk summer range. Preferred elk range exists where these moist sites are interspersed with other necessary habitat components, including various timber types, openings, and appropriate topography.

Implementation

Until all necessary components of elk summer range have been identified, moist areas in specific habitat types should be considered extremely important. Where elk are a significant resource, an area large enough to maintain the overall integrity of the habitat should be protected from alteration. The size of the area to be protected should be determined by on-site agreement between land managers and wildlife specialists.

Recommendation III

Area closures restricting motor vehicles can improve the quality of elk hunting, but proposed closures should be carefully evaluated in terms of elk management objectives because all results are not necessarily desirable.

Recommendation IV

The location and design of transportation system should include provision of secure road-crossing areas for elk.

Recommendation V

Decisions involving the construction or closure of roads should be evaluated on a case-by-case basis with specific elk management objectives in mind.

These three related recommendations concerning management of forest roads and transportation systems have evolved from two studies of area closures, one investigation of a specific road, observations on two other roads, and the subjective judgments of the combined research staff of the Montana Cooperative Study. As these investigations proceed, it has become apparent that there is no broad general rule applicable to management of roads where elk are present. Each situation must be evaluated as a unique combination of terrain characteristics, cover availability, vehicular traffic, and elk management objectives.

Studies

Ruby Road Closure

Eugene O. Allen and Terry N. Lonner, Montana Fish and Game Department

This study area is located in the Gravelly Mountains at the headwaters of the Ruby River about 50 miles west of Yellowstone National Park. The area is characterized by large expanses of sagebrush and grassland, with islands of coniferous timber and aspen. The gentle, rolling topography provides no particular obstacle to mechanized travel in most of 110 square miles. And, although little timber harvesting has been done, the area is extensively roaded.

Checking station data for 1970 and 1971 established that 90 percent of the elk harvest took place during the first half of a 7-week season and only 10 percent during the last 3 weeks. In addition, hunters reported seeing only one third as many elk per unit of hunting effort late in the hunting season as compared to the early weeks. Apparently, the disturbances caused by unrestricted vehicle access were sufficient to drive elk out of the study area and into other areas with better cover and less access for vehicles.

During 1972 and 1973, half of the study area was closed to vehicles except for five short spur roads and the boundary road. The other half of the area had no restrictions. The most immediate result of the closure appeared to be a doubling in the number of hours spent walking by the average hunter. Even the area without vehicle restrictions received proportionately more hunting pressure from hunters on foot. Surprisingly, this change in hunter behavior did not produce an increase in the number of elk seen per unit of hunter effort during the first half of the season. Apparently, the restrictions on vehicles increased security so much that fewer animals were forced to cross the large openings between timber patches. A more important result of the increased security was that the number of elk seen per unit of effort did not decline in the last half of the season on either part of the study area—and on the restricted access unit a fairly substantial increase was reported. In addition, but primarily in the restricted unit, a greater proportion of the elk harvest was taken in the last half of the season. Thus, while the total elk kill was unchanged by the restrictions, both hunter behavior and distribution of the kill were modified. Ninety percent of the hunters contacted at check stations approved of the vehicle restrictions. Many hunters indicated the relative quality of their hunting experience was enhanced, but some also complained that vehicle access should be allowed to retrieve downed animals.

Judith Road Closure

Joseph V. Basile, Intermountain Forest and Range Experiment Station

This study area includes about 225 square miles of the Lewis and Clark National Forest in the Little Belt Mountains of central Montana. The area is generally forested but interspersed with natural grassy parks and clearcuts. Extensive logging has produced a road system that provides vehicle access to within 1 mile of 80 percent of the area. Following 2 years of observation at checking stations, 70 of 167 miles of road in the central 50 percent of the area were closed and off-road vehicular travel was prohibited.

In this study, restrictions on vehicle access had no apparent effect on the seasonal distribution of the elk harvest. However, the proportion of road hunters was reduced by half and the number of elk seen per hunter day increased nearly 30 percent. The evidence also suggests that hunting success and elk harvest were increased by the restrictions on vehicles, but between-year variability in kill data is too great for a positive assertion.

Chamberlain Creek

Richard O. Ellison, Missoula District, Bureau of Land Management

The Chamberlain Creek drainage includes about 9 square miles of densely forested, unroaded summer-fall elk range in the Garnet Mountains 45 miles east of Missoula. A rough fire access road follows a shallow ridge for about 5 miles along the eastern edge of the drainage. Despite minimal levels of low-speed traffic on this road, elk pellet distributions within one quarter-mile demonstrate very light use in the first 200 feet except in areas which appear to be crossing points. Moreover, there was a concentration of pellets in a belt 200-400 feet from the road. This suggests that elk pause before crossing or move parallel to the road to preferred crossings screened by dense cover or topography.

Burdette Creek - Deer Creek

L. Jack Lyon, Intermountain Forest and Range Experiment Station

A long-established fire access road runs 8-10 miles along the east ridgeline above Deer Creek; the northwest ridgeline of Burdette Creek; and east-west on the ridge between Johns Creek and the South Fork of Petty Creek. Despite minimal traffic on this rough, single-lane road, the only areas in which elk pellets do not decline adjacent to the road are those in which dense timber cover is present.

At the upper end of Deer Creek, the 1970 pellet distributions revealed an east-west movement pattern across this narrow ridgeline road. A new access road connecting from the Deer Creek system disrupted this movement pattern after 1970 even though the new road was never used by logging traffic.

Sapphire Mountains

C. Les Marcum, Forestry School, University of Montana

Movement patterns of radio-monitored elk across the Bitterroot Divide and between drainages on either side of the Divide generally coincided with topographic saddles. Apparently, such saddles provide the normal avenues of travel.

Inferences

The two area closures reported here produced several similarities, some dissimilarities, a number of desirable effects, and a few problems. Generally, it appears that closing areas to vehicles will increase both the number of hunter-hours spent walking and the number of elk seen per unit of hunter effort. This combination could, potentially, increase the kill, but it may also enhance the recreation potential by providing a better distribution of harvest. Where timber cover is limited, vehicle restrictions may help to reduce harassment and attendant movement of animals, but where adequate cover is present this is probably not a factor. A majority of hunters appear to believe that vehicle restrictions enhance the quality of the hunting experience even though downed game is usually more difficult to retrieve. This observation appears to confirm the suggestion by Stankey and others (1973) that, "...excessive road development and attendant problems of easy access...appear to be important criteria against which successful hunters judge desirable hunting areas."

Elk reactions to even long-established, low-quality forest roads appeared to be generally negative unless adjacent timber cover was very dense. Construction of new roads, especially in areas identified as important to elk movement, appeared to be extremely disruptive.

Implementation

In designing and managing transportation systems to coordinate with elk management, there are apparently no broadly applicable rules other than that location and density of roads and the use made of those roads may be disturbing to elk. Existing roads and proposed new construction in elk range should be evaluated on a case–by–case basis consistent with elk management objectives.

Before a new road is constructed, elk movement patterns and potential road-crossing areas should be identified and provision made for secure, unimpeded movement. This may require maintenance of frequent, dense cover adjacent to the road, particularly in saddles; minimizing cuts and fills, right-of-way clearings and long, straight sections; and providing adequate slash disposal.

Where closures are contemplated, of either individual roads or areas, a variety of results are possible and the decision must be made on the basis of specific elk management objectives.

Summary and Conclusions

One result of the initial 4 years of investigation by the Montana Cooperative Elk-Logging Study has been the formulation of five recommendations for coordination of timber management and elk management.

None of the participants in the cooperative study have any illusion that these recommendations are truly definitive and not subject to further modification and clarification as more information is collected. However, we have shown that elk are disturbed by, and may move a considerable distance to avoid, activities and noise associated with logging and vehicular traffic on forest roads.

The recommendations presented here are intended to reduce the undesirable reaction as much as possible. In the future we hope to produce additional recommendations which will aid the land manager in deriving positive benefits as well.

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Discussion

MR. ROBERT BINGER [St. Paul, Minnesota]: I may have missed it in your remarks, but did you show in the closing of roads a reduction in the number of hunters actually going into the area?

MR. LYON: Not necessarily. What I said was, with the roads, we get a mixed kind of reaction. Actually, in both of our studies, the number of hunters held up. However, I think there is probably a limit to that. The Gravelly Study in particular was an area where we had access from a road that went around the outside of the area and we found we got the same number of hunters back, both pre and post-closure. We did not run the elk out after access to the total area was closed, but we did get a change in the hunter population. Prior to the closure, we had a much higher percentage of people from Butte who have four-wheel vehicles and they like to drive them around. Especially after the closure, also, because of the publicity associated with it, we had an influx of hunters from further away and an apparent drop, not very large, but an apparent drop of people who had been in the area driving around before and had elected to go elsewhere.

MR. GEORGE DELLINGER [Missouri]: Are deer present in this area or is this above their range?

MR. LYON: In Montana, elk ranges and deer ranges are simultaneous. Our overlap is more a matter of long-term population levels. Thirty years ago, this area had many, many deer and very few elk. It has grown up denser to timber. The amount of brush range available has been declining. The deer population has dropped considerably and the elk are much more important now than at that time.

MR. DELLINGER: The question I was going to get to was this—did you get any information on your deer while primarily concentrating on elk and could you, in a general way, characterize the similarities or dissimilarities of the effect of this on the deer?

MR. LYON: I would just rather answer the question with a "no." As a matter of fact, we did take both deer and elk pellet distribution counts. Our results on the deer have not been summarized or analyzed at all.

I have another study of elk and deer pellet distribution in relation to clearcuts, which does show a considerable difference in the size of clearcut that the animals would tolerate, the requirements for vegetation depth before they will start to use them and also the amount of slash they will tolerate in a clearcut.

MR. RONALD FIELD [Washington, D. C.]: Do you find that by closing the roads you find you get a change in elk movement patterns? In other words, after the roads are closed, how long does it take the elk to re-establish the same patterns they had prior to this?

MR. LYON: Well, we are talking about two different things here. One of them is road closure as a part of management of the hunting season. If you are talking about this kind of closure, you will get an instant response. For example, as soon as the hunting season starts, the elk find out the road is closed and their response will be immediate.

The other kind of response, the one we expect to get with the factor of doing the timber sale and closing the roads afterwards—the question then comes down to how soon will the elk move back into that area. That is, however, a question I cannot answer because this has now only been closed for one year and we have no data on it at this point. Our first information on it will come this fall.

MR. DALE JONES [New Mexico]: I did not hear your entire paper and so if you answered this I apologize. However, I believe I did hear you mention, for example, that recovery is a problem at times in relation to these road closed areas and, therefore, I was wondering if there had been any effort to come up with a technique where you did allow access to recover animals at any given time of day or anything to that effect?

MR. LYON: As a matter of fact, the Game Department suggested several alternatives. You could, for example, when you had a road system closed during the hunting season, open it after 2 o'clock in the afternoon to people without rifles, on the theory they could only go in and pick up what they had shot. As near as I can tell on the forests where this kind of thing has been done, the National Forest Administration is not very enthusiastic about it.

Of course, it is a supervisor's decision in relation to each forest, but any kind of mixed daily regulation is going to require some kind of enforcement and they simply do not have the people to enforce it. You can enforce something by putting up a barrier or a sign that says, "This Road Closed Permanently," but if you are going to open it up for a few hours and then close it again, you are talking about a lot of people to enforce it which is something you just do not have.

Improving Wildlife Habitat in Young Douglas-Fir Plantations

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Introduction

Washington and Oregon produce about one-quarter of the nation's softwood timber. Over 80 percent of the annual harvest in these states comes from the Douglas-fir (*Pseudotsuga menziesii*) region west of the Cascade crest. Most Douglas-fir is harvested by clearcutting from naturally regenerated, unmanaged stands of timber, but production from managed second-growth stands is steadily increasing.

Established stands of Douglas-fir can usually be managed by precommercial and commercial thinning, brush and hardwood control, and fertilization. Even-aged management of Douglas-fir is much more complex, encompassing the entire scheme of intensive management from clearcutting to final harvest, including site preparation (slash and vegetation removal by burning and/or machine scarification), prompt regeneration of trees by planting or seeding, periodic fertilization, brush and weed control, precommercial thinning when trees are 10 to 12 years old, and periodic commercial thinning thereafter. Such management programs are increasing. For example, in 1972-1973 over 133,500 hectares (about 330,000 acres) of clearcut and rehabilitated forest lands in Washington and Oregon were either planted (85 percent) or direct seeded (15 percent), about 30 percent more land than was planted or seeded in 1970-1971 and 60 percent more than in 1965-1966. In general, the trend is to harvest more, put more idle lands into timber production, plant more and seed less, increase stocking control, hasten regeneration, shorten rotation, and generally intensify all phases of timber management. This means greater productivity, but it also means that forest use by big game can increasingly affect potential timber harvest.

Big Game Problems in Reforestation

Since detailed reports on timber management practices, deer/elk/reforestation interactions, and approaches to big game problems in western Washington and Oregon are available elsewhere (Black, 1969, 1974; Berg 1970; Baumgartner 1971; Hermann and Lavender 1973), we will merely summarize most of this information as background.

Use of Reforested Areas

Big game use has been related to the size and shape of clearcuts, the proximity of clearcuts to standing timber, plant succession and browse availability following site preparation, thinning, and the animals' movement patterns and seasonal activities. Clearcutting for even-aged management of Douglas-fir seems to favor big game, and young reforested stands provide better habitat for black-tailed deer (*Odocoileus hemionus columbianus*) and elk (*Cervus canadensis roosevelti*) than stands of old-growth or mature second-growth timber. Generally, use of well-stocked reforested stands by deer and elk is low the first year after logging, peaks in about 4 to 8 years, and is low again from about 10 to 12 years after logging until final harvest. Understocked or retarded stands with brush competition problems provide better conditions for deer, extending peak use to 15 years or more.

We would like to stress that no stand of intensively managed timber in the Douglas-fir region has yet gone through a rotation (the entire period from stand regeneration to final harvest) and that many practices designed to increase timber productivity have not yet been implemented. Intensive timber management may have a profound effect on big game and other elements of the forest ecosystem, but it is still too early to tell what the impact will be.

Browse Damage to Regenerating Douglas-fir

Damage to Douglas-fir seedlings by black-tailed deer and elk is a major problem in western Washington and Oregon. Heavy browsing can result in delayed regeneration or even reforestation failures. The contribution of deer and elk to reforestation losses is sometimes hard to measure quantitatively because other factors, such as the interactions of other wildlife feeding on Douglas-fir and brush competition, also contribute. However, with expanding big game populations, the transplanting of elk, particularly in Oregon, and current timber management programming, losses due to deer and elk are probably increasing. Although trampling, antler rubbing, and pulling of newly planted seedlings are growing problems—the latter especially in areas used by elk—the major big game problem in young Douglas-fir plantations is still the browsing of seedlings.

Black-tailed deer and elk feed on Douglas-fir at various times of the year, but mainly on actively growing shoots from late spring to early summer and on dormant seedlings from fall to spring. Some plantations are damaged only in summer, some only in winter, and some during both summer and winter. In general, deer do more damage than elk, and summer damage by deer is a greater problem than winter damage, particularly in plantations throughout western Washington and coastal Oregon.

Approaches to the Browse Damage Problem

Although injuries caused by wildlife feeding can seriously delay growth or kill trees in established stands, an even greater concern is the protection of new regeneration. If damage to Douglas-fir seedlings can be minimized for the first 3 to 4 years after stocking, or until the seedlings are about 100 cm (40 inches) tall, browsing is usually no longer a limiting factor. Methods being used or tested to control browsing of young Douglas-fir seedlings include registered and experimental animal repellents; mesh cyclinders around individual seedlings; barrier fences; increased game harvest on problem areas; herbicide spraying to reduce the carrying capacity of the habitat for deer and elk; browse-resistant Douglas-fir seedlings; establishment of grasses, legumes, and woody plants to serve as browse; and—the basis for this report—the prompt introduction and establishment of native forbs as preferred foods.

Philosophy of Establishing Preferred Browse to Control Big Game Damage

Howard (1967) wrote: "In some situations there is every reason to believe that the intensity of undesirable browsing of young conifers by deer might be substantially reduced by increasing the amount and availability of alternate and more preferred species of browse. Such an increase in food supply will not necessarily result in a corresponding increase in deer numbers, nullifying this benefit."

We agree that artificially establishing preferred forbs may offset summer browsing of regenerating Douglas-fir by black-tailed deer and elk. Our reasoning is illustrated in Figure 1. This generalized model is based on our many observations in Douglas-fir stands, test results, and information from the literature.

In Figure 1, we show 35 percent browsing as the maximum damage tolerance limit. This is based on data from numerous tests showing that Douglas-fir plantations can tolerate repeated browsing of up to 30 to 40 percent of the seedlings before they begin to show significant height losses. We have seen some stands of Douglas-fir where continuous destructive browsing on seedlings for a decade or more has resulted in severely stunted, deformed trees. At the other extreme, some plantations virtually escape browsing. Figure 1A shows an intermediate situation—well-stocked stands of Douglas-fir reforested by planting and supporting a variety of naturally established preferred forbs. On these plantations, browsing of seedlings is generally light the first growing season, high (up to 80 percent) the second and third seasons, and then declines as preferred forbs increase in variety and abundance. In plantations where preferred forbs are limited, intolerable damage may continue for several years more than diagrammed.

Figure 1B shows what could happen if preferred forbs were artificially propagated and already fairly abundant the first year. Our preliminary tests have shown that such propagation is feasible (Campbell 1974). The availability of these forbs should reduce summer browse damage to within the tolerable limits. This hypothesis is based on observations made in plantations that for some reason have had a rapid, natural increase in preferred forbs and have experienced only negligible damage, and is supported by early observation in partially seeded plantations. We say *should* because we have not yet demonstrated this result experimentally. This is the aim of long-term studies now underway.

Study on Establishing Preferred Browse for Deer and Elk

There were two avenues of approach to determine if an abundance of preferred foods would limit browsing damage in new Douglas-fir plantings: (1) measure habitat features in 1- to 5-year-old plantations with and without damage throughout the Douglas-fir region and artificially stimulate the conditions associated with lack of damage, or (2) observe undamaged plantations, identify highly preferred alternative foods, evaluate their establishment potential, and test their effect on limiting damage. We chose the latter because it offered better built-in controls and faster development of practical damage control techniques and habitat improvement (Campbell 1974).

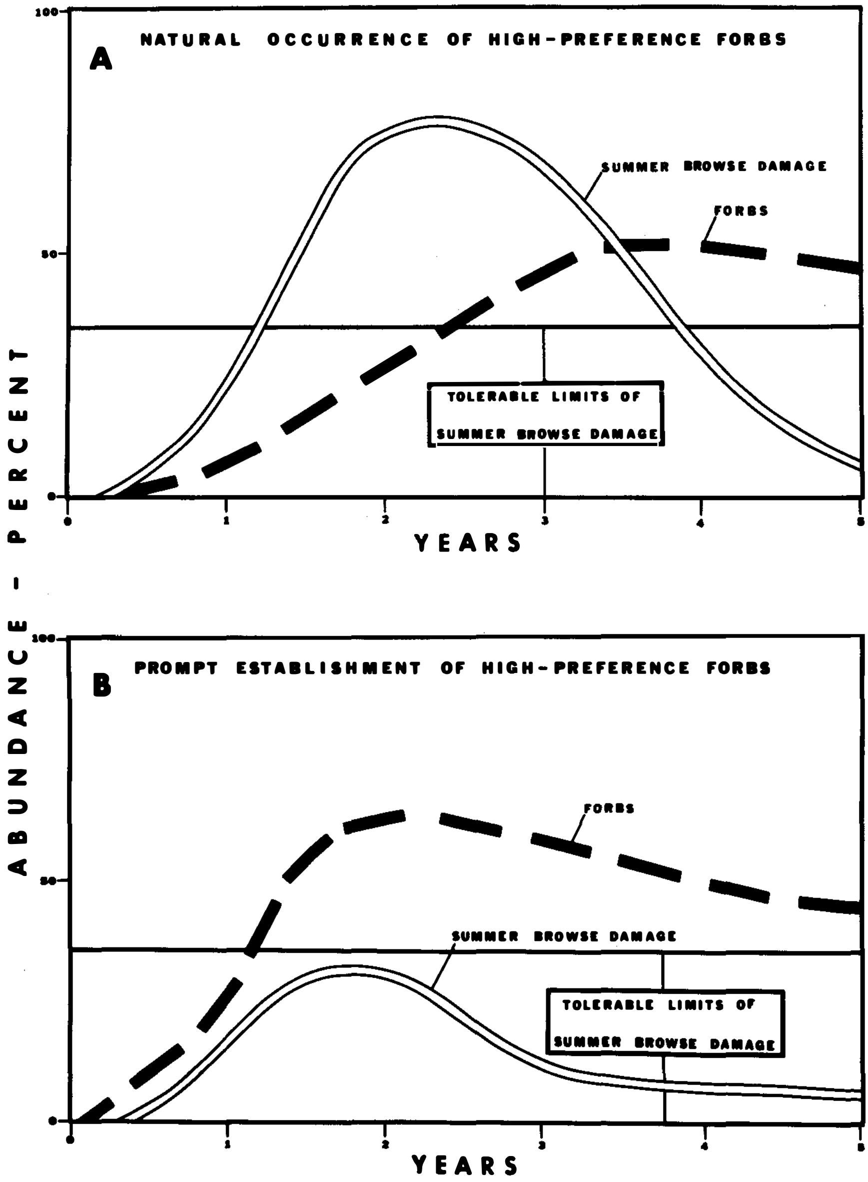

Figure 1. Patterns of summer browsing on Douglas-fir seedlings in new clearcuts: (A) when forbs preferred as browse by black-tailed deer and elk appear and grow naturally; and (B) when preferred forbs are artificially established the first year.

The study, using paired treated and untreated plots, started in 1972 and is on schedule. Our timetable is as follows:

1972 -Develop methodology and evaluate the feasibility of establishing selected forbs on small plots in representative tree-planting sites in western Washington.
1973 - Seed larger plots and evaluate the natural spread of the plants and their use by deer.
1974 - Seed entire clearcuts and begin an evaluation of damage patterns until Douglas-fir seedlings are beyond the serious damage stage (100 cm tall) or for 4 years.

Our test sites include newly logged, slash-burned, or machine-scarified clearcuts planted with Douglas-fir. The sites are in western Washington and encompass a full range of summer browse damage sites, from high Cascades to coastal forests, at elevations of 300 to 1500 m.

The plants being studied are indigenous to western Washington and were selected on the basis of documented preference by deer and elk, availability, high seed production, adaptability, and low competition to Douglas-fir seedlings. Thus far, nine forbs have been tested for early summer use by deer and elk; later, other types of browse plants may be tested for other seasons. Species with particularly high potential are catsear (*Hypochaeris radicata),* a hybrid fleabane (*Erigeron sp.)* hawksbeard (*Crepis capillaris*), and phacelia (*Phacelia nemoralis*).

Clearcuts were partially seeded with preferred forbs in the fall of 1973 and entire clearcuts were seeded in the fall of 1974. At least 3 or 4 years are needed for full evaluations. The results should give us a better read-out on whether rapid establishment of preferred foods alone will alleviate damage, or if the Douglas-fir seedlings will still have to be made less available or less palatable to deer and elk. In any case, however, habitat improvement will result.

Habitat improvement plus a potential for damage control should particularly fit National Forests with unit management or specific wildlife management programs. National Forest policy calls for separated, small clearcuts. These areas generally experience greater big game pressure per unit area than the large clearcuts often used by private industry. Establishment of preferred foods in some or all of them could at least decentralize browsing pressure, as well as improve the food supply.

Seeding for early establishment of preferred forbs should not disrupt natural succession during forest regeneration. All of the species under consideration appear naturally in clearcuts (sometimes quite rapidly), increase in abundance, and are eventually controlled by successional processes, particularly canopy closure. Any sustained abundance would occur because the canopy was reopened, as from forest thinning (a bonus to big game populations), and not because early abundance had been induced.

Care has to be exercised, however, in establishing certain combinations of preferred forbs to avoid displacements in the biotic community. For example, dense stands of oxeye daisy (*Chrysanthemum leucanthemum*), a tall forb occasionally used as winter browse, provide excellent cover for snowshoe hares (*Lepus americanus washingtonii).* Catsear, an important summer browse species highly preferred by deer, is also relished by hares. An abundance of both oxeye daisy and catsear could increase the generally low expansion rate of hare populations and create another damage problem. Oxeye daisy was not seeded after initial field establishment tests.

Our selection of plants agrees with current North American wildlife policy against the use of exotics (Allen 1973). Prompt establishment of these and other indigenous wildlife forage plants has widespread implications, not only for reforestation, but for reclamation and rehabilitation, soil stabilization, natural weed control by plant competition, and other land management and conservation programs.

In conclusion, we feel that the technique we are studying is on target with policy, will not disrupt the ecosystem, and will fit current and projected wildlife management needs in forests and the timber industry in the Pacific Northwest and elsewhere.

Acknowledgements

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Discussion

DISCUSSION LEADER TOMBAUGH: Thank you very much, Dan. Before getting into the questions, I would sure like to thank the panelists for their fine presentations and for the privilege of being able to serve on the Panel with them and likewise to the audience for being such a responsive one today.

MR. COWEN [Michigan]: I would like to ask if these improved areas proved an attraction to the elk—whether or not they increased the concentration on areas and, if so, would this cause any more damage in the way of trampling than you might normally get?

MR. CAMPBELL: That is a good question and should be handled cautiously. The basic principle in these regions, these Douglas-Fir sites, regardless of whether or not anything is planted on them, is that these animals funnel into these clearcut units. So regardless of whether anything is planted, they will be there and the chances appear to be that they will be more inclined to browse the trees if there is nothing else to browse.

MR. GEORGE DELLINGER [Missouri]: We have attempted to generate native species like this and always run into the bottleneck of mulchings. I wonder if you can comment on how you break through this barrier?

MR. CAMPBELL: I would say that we have not broken through the barrier entirely. We have utilized what manpower we have with regard to some of these collections. However, the techniques for use of these composite species have not been well worked out. They can be readily collected, but the timing has to be right. One composite species can be collected too early and you cannot list other composites by just collecting the seed, because they mature at different times. Therefore, we do use the manpower we have to collect them and we are in the process right now of trying to develop commercial sources through SCS and organizations like this.

MR. BRYAN GATES [British Columbia]: I was wondering if in your studies you considered the economics of your program, whether you have estimated the cost for this planting program and have considered comparing it with the economic losses, if any, that might occur by leaving these clearcuts for an extra two to five years so that the native grasses will invade on their own?

An example of this is in British Columbia, particularly in relation to some of the islands, where there is no natural predation, and high deer numbers are indicated. Forest Service replanting of clearcuts after looking at the slash leads to a high percentage of loss. In this respect, our recommendations have been that the planting be delayed for two to five years in order to enable the plants and native shrubs to invade. Are you prepared to compare the economics of the costs of your program with the losses that are suffered naturally?

MR. CAMPBELL: There is a study that has been going on for about ten years on a random selection clearcut throughout the Pacific Northwest. The previous history of planting clearcuts has been to let them go for two to five years or whatever and see whether or not there is regeneration. The problem is that you are usually talking about multiple wildlife species causing damage on these plantations and if you let the clearcuts go, the habitat becomes suitable for animals like hare and beaver who move in and then virtually destroy the plantations, especially if the trees are not protected.

The economics involved is basically to protect the seedlings and you can figure out several hundred feet per acre increased heighth growth per year immediately after planting. The losses there, I would say, are still being worked out, but the cost of normal protection, whether it is a repellent or some protective device on it, generally runs from thirty to well over a hundred dollars per acre just to protect the seedlings. Our experimental costs on seedlings averages out to about $25.00 an acre.

CHAIRMAN SEVERINGHAUS: I wish to thank the audience for their participation all the way through. This has been a very remarkable change insofar as I am concerned and one that looks forward to a very good future. For example, I can remember the problems of some thirty-odd years ago when wildlife biologists were talking about the concept of "we hope." For some years back now they have been talking about the process, "we can." Today you have seen the difference that has come about over a period of thirty years, for now we are talking about, "what we have done." It is a definite change in the way our philosophies have been developing.

Improving Management of River Systems

Chairman:
EDWIN H. GLASER
Planning Officer, Missouri Department of Conservation, Jefferson City

Discussion Leader:
LEO W. EISEL
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The Geomorphic and Hydraulic Response of Rivers

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The importance of water resources and the increasing interest in conserving and improving our environment has identified an urgent need for methods to predict river response due to various changes resulting from proposed water resource planning. River response is an unsteady phenomenon in nature. To study transient pheonomena in natural alluvial channels, the equations of motion and continuity can be used. These equations are powerful analytical tools for the study of unsteady flow problems. The potential of numerical mathmatical models for flood and sediment routing, degradation and aggradation studies and long-term channel development studies is now being realized. The understanding of physical process governing the river response is the first step toward successful water resources utilization and management.

Dynamics of Alluvial Rivers

Frequently, environmentalists, fish and wildlife scientists, river engineers, and others concerned with transportation, navigation, and flood control consider a river to be static, i.e. unchanging in shape, dimensions, and pattern. However, an alluvial river generally is continually changing its position and shape as a consequence of hydraulic forces acting on its bed and banks. These changes may be slow or rapid and may result from natural environmental changes, from man's activities or a combination of both.

It must be stressed that a river through time is dynamic, that man-induced changes frequently set in motion a response that can be propagated for long distances. Evidence from several sources demonstrates that river channels are continually undergoing changes of position, shape, dimensions, and pattern and in time these changes can accumulate to dramatic proportions.

Rivers are broadly classified as straight, meandering or braided or some combination of these classifications, but any changes that are imposed on a river may change its form. The dependence of river form on the slope which may be imposed independent of the other river characteristics is illustrated schematically in Figure 1. By changing the slope, it is possible to change the river from a meandering one that is relatively tranquil and easy to control to a braided one that varies rapidly with time, has high velocities, is subdivided by sandbars and carries relatively large quantities of sediment. Such a change could be caused by a natural or artificial cutoff. Conversely, it is possible that a slight decrease in slope could change an unstable braided river into a meandering one.

Based on research results of Lane (1955), (1957), Santos-Cayado and Simons (1972) and Schumm (1971), the following general statements concerning a river's response to altered water discharge and sediment load can be made:

1) Depth is directly proportional to discharge and inversely proportional to the bed-material discharge.
2) Channel width is directly proportional to discharge and to sediment load.
3) Channel shape (width-depth ratio) is directly related to sediment load.
4) Meander wavelength is directly proportional to discharge and to sediment load.
5) Gradient is inversely proportional to discharge and directly proportional to sediment load and grain size.
6) Sinuosity is proportional to valley slope and inversely proportional to sediment load.

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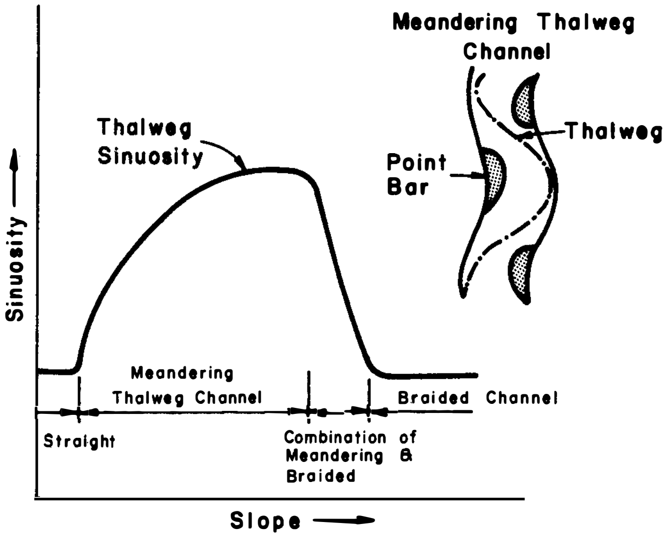

Figure 1. Sinuousity vs. slope with constant discharge (after Khan, 1971).

In the above statements, stream gradient is considered to be a dependent variable in that a river can reduce the gradient by becoming more sinuous. It is important to remember that the relations given above pertain to natural rivers and not necessarily to artificial channels with bank materials that are not representative of sediment load; however, the relations help to determine the response of any water conveying channel.

The significantly different channel dimensions, shapes, and patterns associated with different quantities of discharge and amounts of sediment load indicate that as these independent variables change, major adjustments of channel morphology can be anticipated. Further, if changes in sinuousity and meander wavelength as well as in width and depth are required to compensate for a hydrologic change, then a long period of channel instability can be envisioned with considerable bank erosion and lateral shifting of the channel before stability is restored.

Changes in sediment and water discharge at a particular point or reach in a stream may have an effect ranging from some distance upstream to a point downstream where the hydraulic and geometric conditions can have absorbed the change. Thus, it is well to consider a channel reach as a part of a complete drainage system. Artificial controls that could benefit the reach may, in fact, cause problems in the systems as a whole. For example, flood control structures can cause downstream flood damage to be greater at reduced flows if the average hydrologic regime is changed so that the channel dimensions are actually reduced. Also, where major tributaries exert a significant influence on the main channel by introduction of large quantities of sediment, upstream control on the main channel may allow the tributary to intermittently dominate the system with deleterious results. If discharges in the main channel are reduced, sediments from the tributary that previously were eroded will no longer be carried away and serious aggradation with accompanying flood problems may arise.

An insight into the direction of change, the magnitude of change, and the time involved to reach a new equilibrium can be gained by studying the river in a natural condition, having knowledge of the sediment and water discharge, being able to predict the effects and magnitude of man's future activities, and applying to these a knowledge of geology, soils, hydrology, and hydraulics of alluvial rivers.

Effects of Man's Activity on Alluvial Rivers

Man's activity can have significant general and local effects on the morphology and hydraulics of river systems. Often, in planning works on alluvial rivers, it is necessary to consider induced short- and long-term responses of the river and its tributaries, the impact on environmental factors, the aesthetics of the river environment and short- and long-term effects of erosion and sedimentation on the surrounding landscape, side channels and the river. The biological response of the river system may also need to be evaluated and considered.

Short-term Responses

In the preceding paragraphs we indicated that local changes made in the geometry or the hydraulic properties of the river may be of such a magnitude as to have an immediate impact upon the entire river system. More specifically, works leading to contraction of channels generally cause general and local scour, and sediments removed from this location are usually dropped in the immediate reach downstream.

As a consequence of construction, many areas become highly susceptible to erosion. The transported sediment is carried from the construction site by surface flow into the minor rills which combine within a short distance to form larger channels leading to the river. The water flowing from the construction site is usually a consequence of rain. The surface runoff and the accompanying erosion can significantly increase the sediment yield to the river channel unless careful control is exercised. The large sediment particles transported to the main channel may reside in the vicinity of the construction site for a long period of time or may be slowly moved away. On the other hand, the fine sediments are easily transported and generally pollute the whole cross section of the river. The fine sediments are transported downstream to the nearest reservoir or to the sea. The sudden injection of the larger sediments into the channel may cause local aggradation, thereby steepening the channel, increasing the flow velocities and possibly causing instability in the river at that site. Over a long period of time after the injection has ceased, the river should return to its former geometry.

The suspended fine sediments can have very significant effects on the biomass of the stream. Certain species of fish can only tolerate large quantities of suspended sediment for relatively short periods of time. This is particularly true of the eggs and fry.

Long-term Response of Rivers to Development

In addition to possible immediate responses, there may be important delayed responses of rivers to development.

Often river training works are used; for example, to favorably align the flow with respect to a bridge opening. When such training works are used, they generally straighten the channel, shorten the flow line, and increase the velocity within the channel. Any such changes made in the system that cause an increase in velocity increases local and general scour with subsequent deposition downstream where the channel takes on its normal characteristics. If significant lengths of the river are trained and straightened, there can be a noticeable decrease in the elevation of the water surface profile for a given discharge in the main channel. Tributaries emptying into the main channel in such reaches are significantly affected. Having a lower water level in the main channel for a given discharge means that the tributary streams entering in that vicinity are subjected to a steeper gradient and higher velocities which cause degradation in the tributary systems. In extreme cases, degradation can be induced of such magnitude as to cause failure of structures such as bridges on the tributary systems. In general, any increase in transported materials from the tributaries to the main channel cause a reduction in the quality of the environment within the river. More specifically, as degradation occurs in the tributaries, bank instabilities are induced and the sediment loads are greatly increased. Increased sediment loads usually result in a deterioration of the given environment.

Cutoffs may develop naturally in the river system or they may be constructed by man as part of river development projects. The general consequence of cutoffs is to shorten the flow path and steepen the gradient of the channel. The local steepening can significantly increase the velocities and sediment transport. Also, this action can induce significant instability such as bank erosion and degradation in the reach. The material scoured in the reach affected by the cutoff is probably carried only to the adjacent downstream reach where the gradient is flatter. In this region of slower velocities the sediment drops out rapidly. The deposition can have significant detrimental effects on the downstream reach of river, increasing the flood stage in the river itself and increasing the base level for tributary stream, thereby causing aggradation in the tributaries.

Another common case occurs with the development of reservoirs for storage and flood control. These reservoirs serve as traps for the sediment normally flowing through the river system. With sediment trapped in the reservoir, essentially clear water is released at the dam site. This clear water has the capacity to transport more sediment than is immediately available. Consequently, the channel begins to supply this deficit with resulting degradation of the bed. This degradation may significantly affect the safety of structures in the immediate vicinity. Again, the degraded main channel causes steeper gradients on tributary streams in the vicinity of the main channel. The result is degradation in the tributary streams. It is entirely possible, however, that the additional sediments supplied by the tributary streams would ultimately offset the degradation in the main channel. It must be recognized that downstream of storage structures, the channel may either aggrade or degrade and the tributaries will be affected in either case.

There are important responses induced within and upstream of reservoirs as well as downstream. When the stream flowing into a reservoir encounters the ponded water, its sediment load is deposited, forming a delta. This deposition grows with time, ultimately filling the pool or reservoir. This depostiion in the reservoir flattens the gradient of the channel upstream. The flattening of the upstream channel induces aggradation causing the bed of the river to rise, threatening structure installations and other facilities.

The clear-water diversion into South Boulder Creek in Colorado is a typical example of river development that affects bridge crossings and encroachments as well as the environment in general. Originally the North Fork of the South Boulder Creek was a small but beautiful scenic mountain stream. The banks were nicely vegetated, there was a beautiful sequence of ripples and pools which had all the attributes of a good fishing habitat. Approximately ten years ago, water was diverted from the Western Slope of the Rockies, through a tunnel, to the North Fork of the South Boulder Creek. The normal flow in that channel was increased by a factor of four to five. The extra water caused significant bank erosion and channel degradation. In fact, the additional flow gutted the river valley changing the channel to a straight raging torrent capable of carrying large quantities of sediment that was subsequently deposited downstream. Degradation in the upper part of the system had reached as much as 15 to 20 feet before measures were taken to stabilize the creek.

Stabilization was achieved by flattening the gradient, by constructing numerous drop structures and by reforming the banks with riprap. The system was stabilized, but it is a different system. The channel is straight, much vegetation has been washed away, the natural sequence of ripples and pools has been destroyed. The valley may never again have the natural form and beauty it once possessed. It is necessary for us to bear in mind the diversions to or from the natural river system can greatly alter its geometry, its beauty, and its utility. The river may undergo a complete change giving rise to a multitude of problems in connection with the design and maintenance of hydraulic structures, encroachments and bridge crossings along the affected reach.

Qualitative Prediction of Alluvial River Response

Many rivers have achieved a state of practical equilibrium throughout long reaches. For practical purposes, these reaches can be considered stable and are known as "graded" streams by geologists and as "poised" streams by engineers. However, this does not preclude significant changes over a short period of time or over a period of years. Conversely, many streams contain long reaches that are actively aggrading or degrading.

To predict the response to channel development is a very complex task. There are large numbers of variables involved in the analysis that are interrelated and can respond to changes in a river system in the continual evolution of river form. The channel geometry, bars, and forms of bed roughness all change with changing water and sediment discharges. Because such a prediction is necessary, useful methods have been developed to predict the response of channel systems to changes both qualitatively and quantitatively.

Variables Affecting River Behavior

Variables affecting alluvial river channels are numerous and interrelated. Their nature is such that, unlike rigid boundary hydraulic problems it is not possible to isolate and study the role of any individual variable.

Major factors affecting alluvial stream channel forms are:

1) Stream discharge
2) Sediment load
3) Longitudinal slope
4) Bank and bed resistance to flow
5) Vegetation
6) Geology including types of sediments
7) Works of man
8) Seepage forces

The fluvial processes involved are very complicated and the variables of importance are difficult to isolate. Many laboratory and field studies have been carried out in an attempt to relate these and other variables to the present time. The problem has been more amenable to an empirical solution than an analytical one.

In an analysis of flow in alluvial rivers, the flow field is complicated by the constantly changing discharge. Significant variables are, therefore, quite difficult to express mathematically. It is desirable to list measureable or computable variables which effectively describe the processes occurring and then to reduce the list by making simplifying assumptions and examining relative magnitudes of variables, striving toward an acceptable balance between accuracy and limitations of obtaining data. When this is done, the basic equations of fluid motion may be simplified (on the basis of valid assumptions) to describe the phenomenon.

Relations Defining River Geometry at a Cross Section

Relations defining the channel cross section have been proposed by various researchers. Theoretical relations similar to those proposed by Leopold and Maddock (1953) have been derived at a section and show that:

$$W \sim Q^{0.24} \tag{1}$$
$$Y_o \sim Q^{0.46} \tag{2}$$
$$S \sim Q^{0.00} \tag{3}$$
$$V \sim Q^{0.30} \tag{4}$$

Equation 1 implies that slope is constant at a cross section. This is not quite true. At low flow the effective channel slope is that of the thalweg that flows from pool through crossing to pool. At higher stages the thalweg straightens somewhat, shortening the path of travel and increasing the local slope. In the extreme case, river slope approaches the valley slope at flood stage. It is during high floods that the flow often cuts across the point bars developing chute or flow channels. This path of travel verifies the shorter path the water takes and that a steeper channel prevails under this condition.

Relations Defining River Geometry Along the Channel

In addition to the at-a-station hydraulic geometry, relations identifying the variations of hydraulic geometry in the downstream direction were developed using the bank-full geometry and bank-full discharge. These derived relations are based on the basic equations of fluid mechanics and are almost identical to empirical relations proposed by Leopold and Maddock (1953). The derived relations are:

$$W_b \sim Q_b^{0.46} \tag{5}$$
$$Y_b \sim Q_b^{-0.46} \tag{6}$$
$$S \sim Q_b^{-0.46} \tag{7}$$
$$V_b \sim Q_b^{0.08} \tag{8}$$

Here the subscript "b" indicates the bank-full condition. These relations indicate how bank-full depth, velocity, slope and width vary as one moves from the headwaters of a channel downstream.

River Conditions for Meandering and Braiding

In the preceding examples it was shown that changes in water, sediment discharge or both can cause significant changes in channel slope. The changes in sediment discharge can be in quantity, Q_s, or caliber, D_{50}, or both. Often such changes can alter the plan view in addition to the profile of a river.

Figure 2 illustrates the dependence of river form on channel slope and discharge. It shows that when

$$SQ^{1/4} \leqslant 1.7 \tag{9}$$

a sandbed channel meanders. Similarly, when

$$SQ^{1/4} \geqslant 10.0 \tag{10}$$

the river is braided. In these equations, S is the channel slope in feet per thousand feet or meters per kilometer and Q is the mean discharge in cfs. Between these values of $SQ^{1/4}$ is the transitional range and many of the U.S. rivers, classified as intermediate sandbed streams, plot in this zone between the limiting curves defining meandering and braided rivers. If a river is meandering but its discharge and slope borders on the transitional zone, a relatively small increase in channel slope may cause it to change with time to a transitional or braided river.

Relations Between Channel Morphology and Sediment Load

Sediment bed material transport (Q_s) can be directly related to stream power ($\tau_o V$) and inversely related to the fall diameter of bed material (D_{50}).

$$Q_s \sim \frac{\tau_o VW}{D_{50}/C_f}, \tag{11}$$

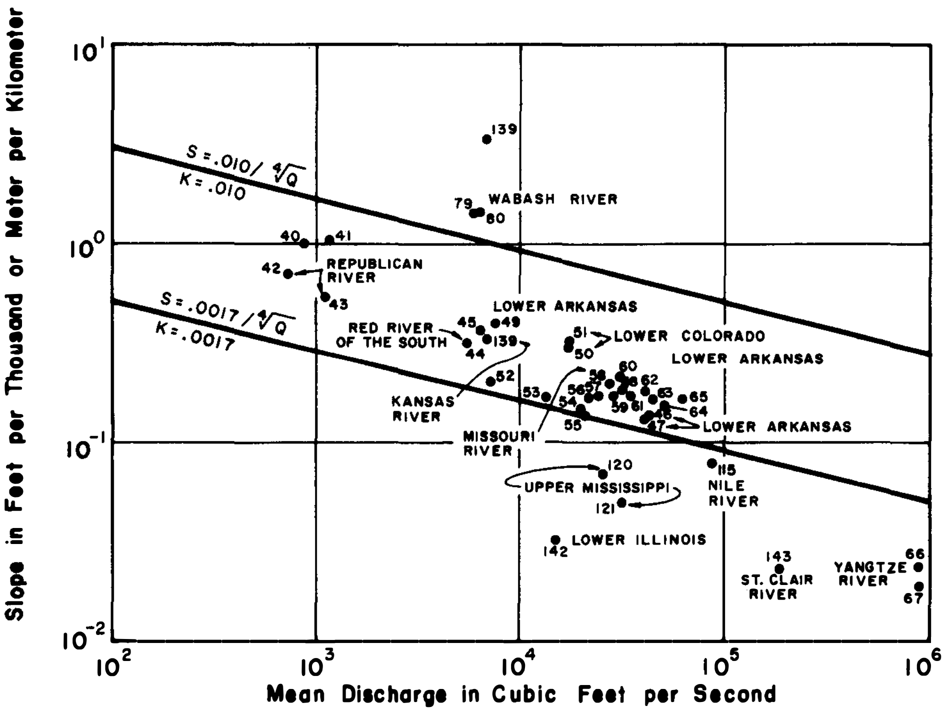

Figure 2. Slope-discharge relation for braiding or meandering in sandbed streams (after Lane 1957).

Here γ_o is the bed shear, V is the cross-sectional average velocity, W is the width of the stream and C_f is the fine material load concentration. Equation 11 can be written as

$$Q_s \sim \gamma \frac{y_o SWV}{D_{50}/C_f} = \gamma \frac{QS}{D_{50}/C_f} \tag{12}$$

If specific weight, S, is considered constant and the concentration of wash load C_f can be incorporated in the fall diameter, D_{50}, the relation can be expressed as

$$QS \sim Q_s D_{50} \tag{13}$$

which essentially is the relation originally proposed by Lane (1955). Equation 13 is very useful to qualitatively predict channel response to climatological changes, river development or both.

Consider a tributary that is relatively small but carries a large sediment load (see Fig. 3) entering the main river at point C. This increases the sediment discharge in the main stream from Q_s to Q_s^+. It is seen from Equation 3 that, for a significant increase in sediment discharge (Q_s^+), the channel gradient (S) below C must increase if Q remains constant. The line CA (indicating the original channel gradient) therefore changes with time to position C'A. Upstream of the confluence, the slope will adjust over a long period of time to the original channel slope. The river bed will aggrade from C to C'.

Those working with river systems are also interested in quantities in addition to directions of variations. The geomorphic relation $QS \sim Q_s D_{50}$ is only an initial step in analyzing long-term channel response problems. However, this initial step is useful because it warns of possible future difficulties in designing channel improvement and flood protection works. The prediction of the magnitude of possible errors in flood protection design, because of changes in stage with time, requires the quantification of changes in stage. To quantify these changes it is necessary to be able to quantify future changes in the variables that affect the stage. In this respect, knowledge of future flow conditions is necessary.

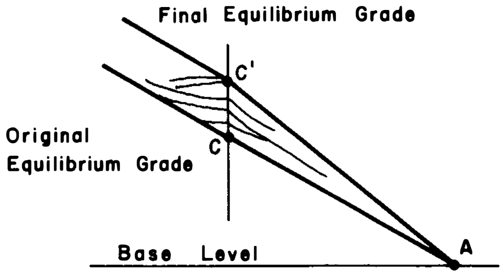

Figure 3. Changes in channel slope in response to an increase in sediment load at point C.

Prediction of Channel Response to Change

In the section *Relations Between Channel Morphology and Sediment Load* it was illustrated that Equation 13 could be used to predict changes in channel profiles caused by changes in water and sediment discharge. It is now possible to talk qualitatively about changes in channel profile, changes in river form and changes in river cross section both at a section and along the river channel, using the other relations presented above.

An increase in discharge may affect the river form, energy slope, stability of the channel, cross-sectional area and river stage. Equations 9 and 10 (or Fig. 2) show that an increase in discharge could change the channel form in the direction of a braided form. Whether or not the channel changes form would depend on the river form prior to the increase in discharge. According to Equation 3, the channel slope could not change. However, a slight increase in slope could occur as a consequence of a slight straightening of the flow caused by the increased discharge. The stability of the channel would be reduced according to Equation 6, which indicates an increase in velocity. On the other hand, this prediction could be affected by changes in form of bed roughness that dictates resistance to flow. This effect is discussed later.

The wash load increases the apparent viscosity of the water and sediment mixture and makes the bed material behave as if it were smaller. In fact, the fall diameter of the bed material is made smaller by significant concentrations of wash load. With more wash load, the bed material is more susceptible to transport and any river carrying significant wash load will change from lower to upper regime at a smaller Froude number than otherwise. Also, the viscosity is affected by changes in temperature.

Seepage forces resulting from seepage outflow help stabilize the channel bed and banks. With seepage inflow, the reverse is true. Vegetation adds to bank stability and increases resistance to flow, reducing the velocity. Wind can retard flow, increasing roughness and depth when blowing upstream. The reverse is true with the wind blowing downstream. The most significant of wind effect is wind generated waves and their adverse effect on channel stability.

In many instances it is important to assess the effects of changes in water and sediment discharge on specific variables such as depth of flow, channel width, characteristics of bed materials, velocity, etc. For this type of analysis we can use Equation 13 and Equations 1 to 8 inclusive. Also, Equation 13 can be written in terms of width, depth, velocity, concentration of bed material discharge, C_s, and water discharge, Q, or

$$QC_sD_{50} \sim VY_oW_S \tag{14}$$

and

$$C_sD_{50} \sim S \tag{15}$$

These equations are helpful for detailed analysis.

The change in river form as a response to various changes imposed on an alluvial river can also be qualitatively predicted.

Conclusion

This paper has presented elements of fluvial geomorphology and hydraulics that are related to the interpretation and modeling of response of alluvial rivers to natural and man-made causes. The responses of alluvial rivers to changes imposed by natural phenomena or man's activities are complex. Therefore, any interpretation of alluvial rivers needs to be preceded by a qualitative analysis. The qualitative analysis can indicate the direction in which various changes in the elements of the river will take place. Information presented herein should be adequate to carry out the qualitative analysis in most cases. The next step in the analysis of alluvial river response would be the quantitative evaluation of channel response and water and sediment routing using theory supplemented by physical and mathmatical model studies of the system.

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Discussion

MRS. VIRGINIA TERPENING [Illinois]: When the locks and dams were put in on the Mississippi River in St. Louis and marshes and backwaters were created which were beneficial to wildlife, this was all fine and good. However, right now this is all very rapidly closing in. Therefore, what I would like to ask is this—when will the stabilization point be reached?

MR. SIMONS: I am not sure I understand your question, but if I do not give an answer specifically I will get together with you later.

Certainly, as we look at the development of rivers and the operation of locks and dams, you can see that we maintain a higher flood level and these, of course, do induce degradation and this may extend some distance upstream. They could have a significant effect. However, this is a case where we have been doing some work to assess the effect of higher pool levels on the tributary and certainly it is possible to predict with reasonable accuracy how much degradation would occur and how it would affect all the systems.

Evaluation Models for Public Management of Freshwater Wetlands

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Introduction

State statutes protecting the public values of freshwater wetlands have been in effect for nearly 10 years in several northeastern states. Early versions of the statutes gave the responsibility of administering these laws to a state natural resource agency. As experience has been acquired, the tendency has been to shift this responsibility to local agencies, such as Town Conservation Commissions. These are local boards like health and planning boards, and they are responsible for regulating the use of wetlands. In some cases they are empowered to acquire land for conservation purposes.

In Massachusetts alone, 351 separate local commissions and one state appeal agency are examining requests to alter or destroy wetlands. Many commissions are buying wetlands to protect their natural values. In each case value judgements are being made and priorities are being set. There exist few guidelines for evaluation of freshwater wetlands and as competition for land in highly urbanized states grows keen, the criteria used to justify protection of a wetland are being examined critically by developers and natural resource agencies alike.

This report presents highlights of results of a team research effort at the University of Massachusetts to develop an improved basis for decision making in wetland preservation and to attach economic values to freshwater wetlands. Early progress of our work was reported to the Thirty-Sixth North American Wildlife and Natural Resources Conference (Larson 1971) and this is a summary of our completion report (Larson 1975).

The author served as principal investigator and subproject leader for wildlife biology. Dr. Ward S. Motts, Geology; Dr. Julius Gy. Fabos, Landscape Architecture and Regional Planning; and Dr. John H. Foster, Food and Resource Economics were subproject leaders in their respective fields. This work was supported by funds provided by the U. S. Department of the Interior, Office of Water Resources Research, as authorized under the Water Resources Research Act of 1964 (P. L. 88-379).

General Approach

A principal assumption at the outset was that there exist specific physical attributes or characteristics that give rise to the public values freshwater wetlands provide in their natural state. We set out to identify and quantify these characteristics and to evolve a system whereby a public agency could use them to evaluate a wetland and form some rational basis for deciding whether to allow it to be destroyed, to be altered in part, or to insist on full protection. Wherever possible and appropriate we translated the relative values calculated by our system into economic terms.

Our general assessment model consists of three Levels. Level I identifies characteristics that in and of themselves are so important that wetlands having these attributes should be totally preserved in their natural state. These we term outstanding wetlands. Their value is so evident that an attempt at economic justification is not appropriate.

Level II of the general model is applied to wetlands which do not have the outstanding attributes identified in Level I. At this second level the model employs a submodel for wildlife value and one for visual-cultural value, each of which produces a relative numerical score for that value in a given wetland. The Level II geology submodel identifies those wetlands which have potential as sites for municipal groundwater supplies.

Level III translates the wildlife and visual-cultural scores into economic values based on wetland purchases by public wildlife agencies and town conservation commissions. Groundwater values are based on the economics of municipal water supply systems. Flood control values are derived from the role of wetlands as natural flood reservoirs and the economic damages avoided downstream when wetlands serve in this capacity.

The specific details and justification for the characteristics in the general model, submodels and economic evaluations appear in the several technical publications cited below and are summarized in greater detail in our final report (Larson 1975). This paper presents the characteristics which we propose as the keys to evaluation of freshwater wetlands in the glaciated northeast. We suggest that many of these will be equally important in other regions, some will have different significance outside of the northeast and some not listed here would be included in other regions. The primary purpose is to present the concept, give a skeleton outline of our approach and report the highlights of our results.

Level I—Outstanding Wetlands

We suggest that northeastern wetlands which have any one of the following attributes are by definition wetlands which should be preserved (no order of importance is implied in the list):

1. Rare, restricted, endemic or relict flora or fauna
2. Flora of unusually high visual quality and infrequent occurrence
3. Flora or fauna at, or very near, the limits of their range
4. Juxtaposition, in sequence, of several seral stages of hydrarch succession
5. High production of native water, marsh or shorebird species
6. Use by great numbers of migratory water, marsh and shore birds
7. Outstanding or uncommon geomorphological features
8. An established record of scientific research on the site
9. Known presence of archeological evidence
10. Wetlands which are integral links in a system of waterways, or whose size dominates a regional watershed.

Level II—Wetland Evaluation

The main basis for evaluation of wetlands which do not meet the Level I criteria is the wetland classification system for the glaciated northeast (Golet and Larson 1974). This system places wetlands in a series of classes and subclasses.

Classes are synonymous with the wetland types in the national system of Martin *et al.* (1953) and subclasses are the different life forms of vegetation which are found within classes. To apply the Level II evaluation the wetland is first classified and additional descriptors of the wetland and the surrounding landscape are collected in the field or from available maps and aerial photographs.

Wildlife Evaluation Submodel

Ten characteristics (Table 1) were identified as the key criteria that determine wetland wildlife value. In this study, high wildlife value is equated with maximum wildlife production (total numbers) and diversity (different species). Each characteristic is not equally important to wildlife, so for each we assigned a significance coefficient ranging from a high of five to a low of one. Each characteristic varies as it occurs in the field, so to recognize this variation, ranks from three to one were also assigned to each characteristic. For example, wetland size is one of the three most important characteristics. It carries a significance coefficient of five. Since size of wetlands in our region varies from less than 10 acres to over 500 acres, we grouped wetland sizes into five categories, giving the 500-plus category a rank value of five and a rank of one to the less than 10 acre category. To obtain a subscore value for this or any other of the 10 important characteristics we multiply the significance coefficient by the rank value. The sum of the 10 subscores is the total wetland score for wildlife value.

Table 1. Characteristics which determine wildlife value of freshwater wetlands in the Northeast.

Characteristic	Significance Coefficient	Definition
Class richness[1]	5	Number of wetland classes on the site
Dominant class	5	Wetland class occupying the most area
Size	5	Acreage of the wetland
Subclass richness[2]	4	Number of wetland subclasses on the site
Site type	4	Upland, bottomland, associated water bodies
Surrounding habitat	4	Adjacent land use and vegetative types
Cover type	3	Ratio of vegetative cover to water on site
Interspersion	3	Amount of edge between subclasses
Juxtaposition	2	Location relative to other wetlands
Water chemistry	1	Total alkalinity or pH at the site

[1]Classes are the same as wetland types of Martin *et al.* (1953).
[2]Subclasses are the different life forms of vegetation found within classes.

The score itself has no importance. It is a relative value to be used to compare several wetlands in a trade-off situation, or to compare wetlands within a town, county, region or state. The score will have different meaning to different decision makers, depending on their frame of reference. A wetland which scores relatively low on a statewide scale may be the highest scoring wetland in a town.

This might indicate that while protection may be important to the town, the state may not show much interest and the appropriate level of investment, if any, is local. Table 2. illustrates the use of the system on a hypothetical wetland. Detailed discussion of the wildlife submodel has been described by Golet (1972 and 1973).

Table 2. Example of scoring a freshwater wetland for wildlife value.

Characteristic	Significance Coefficient	Rank[1]	Subscore
1. Class Richness	5	2.0	10.0
2. Dominant Class	5	3.0	15.0
3. Size	5	2.5	12.5
4. Subclass Richness	4	2.5	10.0
5. Site Type	4	2.0	8.0
6. Surrounding Habitat	4	3.0	12.0
7. Cover Type	3	2.0	6.0
8. Vegetative Interspersion	3	1.0	3.0
9. Juxtaposition	2	2.0	4.0
10. Water Chemistry	1	3.0	3.0
Total Wetland Score			83.5

[1]Based on fictitious data

Groundwater Submodel

While wetland deposits themselves are not sources of groundwater, about 50 percent of the wetlands in Massachusetts, a cross-section of the northeastern physiographic regions, occur over surficial geologic deposits which are potential groundwater aquifers (Motts and Heeley *in* Larson 1973). Some 60 Massachusetts cities and towns have municipal water wells in or near wetlands. The groundwater submodel is a check list of surficial deposits which are likely to produce wells sufficient to supply municipal or industrial needs. Existing surficial geology maps can be used to make a preliminary determination. Table 3 shows the relationship between surficial deposits and water supply potential.

This submodel consists of three steps. The first is the initial determination of the deposits under the wetland. The second and third are sequential steps in exploratory drilling and test pumping. We recommend that all wetlands which occur over promising deposits be preserved from any alteration until the actual groundwater yield can be determined by the final two steps. Detailed data on the relationships between wetland, surficial geology and groundwater appears in Heeley (1973) and Heeley and Motts *in* Larson (1975).

Table 3. Groundwater potential of geologic deposits beneath freshwater wetlands of the Northeast.

Groundwater Potential	Geologic Deposits Beneath Wetland
High	Stratified drift of ice contact and outwash origin
Low	Glacial till, bedrock
Special[1]	Lake-bottom deposits

[1]Can be high locally if underlain by porous deposits.

Table 4. Characteristics which determine visual-cultural value of freshwater wetlands in the Northeast.

Characteristic	Significance Coefficient	Definition
Visual Characteristics		
Landform diversity	6	Number of landforms surrounding wetland
Water body diversity	6	Number of water body types in wetland
Landform contrast	3	Relative landform relief around wetland
Edge complexity	3	Wetland edge development relative to area
Class diversity	3	Number of wetland classes present on site
Water body size	2	Amount of canoe-navigable water present
Land use diversity	2	Adjacent land use and vegetative types
Land use contrast	1	Wetland-adjacent land use height contrast
Internal contrast	1	Contrast of class heights within wetland
Wetland size	1	Acreage of wetland
Cultural Characteristics		
Accessibility	3	Number of means for human access
Ambient quality	3	Number of water, air, noise or visual pollution problems present on site
Educational proximity	1	Distance to schools and colleges

Visual-Cultural Submodel

This model identifies and scores the characteristics of wetlands which are the basis for the visual and cultural impact a freshwater wetlands has on an individual viewer and the community. The basis for the visual impact lies in those physical characteristics which influence visual contrast and visual diversity. We identified 10 visual characteristics and three cultural (Table 4). As in the wildlife submodel, each of these is given a significance coefficient, in this case from six to one. Each characteristic is also ranked from one to five. Subscores for each characteristic and a total score are computed in the same manner as in the wildlife submodel.

The use of the score here is the same as in the wildlife submodel. We considered the desirability of summing the total scores of the wildlife and visual-cultural submodels and establishing cut-off points below which we would suggest that a wetland need not be preserved. We concluded that there was no basis for summing dissimilar values and that the independent values would be more useful tools for the land manager. The concept of cut-off points has validity only within a defined frame of reference. Any cut-off is a political decision which the manager cannot avoid, but one which is not appropriate for us to suggest. Detailed development of the visual-cultural submodel and its application appears in Smardon (1972, 1975) and in Larson (1975).

Level III—Economic Valuation

Wetlands are not bought and sold in the real estate market for their natural values. Selling prices are based on alteration for alternative uses. Usually these alterations impair or eliminate the natural value of the wetland and generate high selling prices. We found freshwater wetlands selling for as high as $70,000 for an industrial site in eastern Massachusetts and the minimum price in urban areas was about $300 per acre.

The annual economic rent from or opportunity cost of preserving a wetland valued at $70,000 per acre, using a seven percent interest rate, is $4,900, while at $300 per acre it is $21. The basic criterion proposed by our economists for preservation or alteration of a wetland was that the social value or return to society from a preserved wetland must be equal to or greater than the economic rent from the wetland in an alternative use (Gupta and Foster *in* Larson 1975). In any case, the identified social value of annual benefits must be treated as a public loss or cost in deciding whether or not a wetland should be altered.

Since the marketplace does not provide an indicator to social values we turned to our three submodels of Level II and the records of public purchases of wetland and open space in Massachusetts. Wetlands that were purchased by the Massachusetts Division of Fisheries and Game and the U. S. Fish and Wildlife Service were wetlands which scored high in our wetland submodel. The purchase price of wetlands bought by the state was accepted as the politically established value for wildlife. We took the average purchase price of $190 per acre, added annual management costs, and used a 5.375 percent capitalization rate to calculate a capitalized value for the best wildlife wetlands of $1,300 per acre.

For visual-cultural values, we again turned to the political system and examined the record of open space land purchases by 29 Town Conservation Commissions. These commissions purchase wetlands and other open space with local funds in order to maintain the aesthetic character of a community and to obtain many non-marketable social benefits which accrue from publicly owned open space. The most valuable of those purchased, from the point of view of our visual-cultural submodel, were also among those for which the highest prices were paid. The capitalized value of the best purchases, from a visual-cultural viewpoint, was $5,000 per acre.

Because water is a product which has an established market price (at least for the delivery system), our approach was to compare the cost of obtaining municipal water from a surface water supply with the cost of water from drilled wells.

In the northeast, the savings from a well supply over surface water amounts, in annual terms, to $28 per 1,000 gallons per day. Assuming that a ten acre wetland well site is capable of producing one million gallons per day, the annual benefits of the well water supply are $2,800 per acre. Using a 5.375 percent rate of capitalization, such a wetland would have a water benefit capitalized value of $52,000 per acre.

Flood control benefits were estimated from a U.S. Army Corps of Engineers (1971) study of the Charles River Basin in metropolitan Boston. The study recommended preservation of 8,422 acres of mainstream wetlands which provide natural flood storage and estimated that by the year 2000, the annual average flood control benefits (avoided losses) would be $647,000 per year. This produces a capitalized value for flood control of $1,488 per acre.

Details of the economic aspects of our study are contained in Gupta (1972, 1973) and Gupta and Foster (1973, 1975).

Summary

Public agencies charged with regulation of freshwater wetlands are making decisions without the benefit of standard guidelines for evaluation of natural and social wetland values. We suggest that specific physical features which can be identified and measured in the field, or on maps and aerial photographs, hold the key to wildlife, visual-cultural and groundwater values of freshwater wetlands. Our system identifies these features. We have indicated the level and range of importance these hold by assigning relative numerical values to them. We associate these values with public land purchase costs and water supply economics.

This paper does not permit detailed discussion of the justification and rationale for our rating systems and we suggest that interested readers consult the cited technical publications for these data. Our intent here is to stimulate consideration of this approach as an improved basis for decisionmaking, recognizing full well the pitfalls involved.

We expect general acceptance of the important characteristics of wetlands, but anticipate much discussion over the assignment of specific values to these. We are also aware that there are those who hold that numerical and economic value systems are incompatible with natural resource values.

Our response is that wetland alteration is proceeding while we strive to quantify values and this activity will not wait for us to find unanimity. Natural resource agencies are each day making decisions, setting priorities and buying wetlands, in many cases without the aid of systematic evaluations of their own. We have taken the position of consultants asked to construct a logical wetland evaluation procedure based on available published information and drawing on the accumulated pragmatic experience of wetland managers, and to display the components of the procedure.

We are not comfortable with the concept of a digitized environment, but we suggest that resource managers have not made the most effective use of available information on freshwater wetlands. This approach is offered as a first step toward a more critical and effective use of information and to provide a sharper tool in the hands of land managers.

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Discussion

DISCUSSION LEADER EISEL: This paper is now open for discussion. Are there any questions or comments? The first speaker spoke about large systems and now we have come down to the wetlands, so perhaps some of the questions can be tied to these two speakers. Who has the first question?

MR. PHILIP ALKON: Could you expand a little bit on the criteria used in assigning rank to some of these wetlands?

MR. LARSON: There are two values in there. For example, we rank the characteristics in the first column and then we ran some significant coefficients. Is that what you are talking about? Of course, it would be hard to cover all of that from both the wildlife and the visual cultural effect in a couple of minutes.

From the wildlife point of view, we were making the assumption that the goal was to obtain the largest number of species and as many representatives of each species as possible and look at the physical characteristics which essentially would provide or influence the diversity of environment for wildlife. This is a compromise because you are always confronted by the consideration of factors that are important to you and which are not going to be the same, for example, for the fellow interested in the muskrat. Therefore, we have compromised and essentially come up with a ranking which will satisfy no one particular user but speak toward producing a diversity which will end up in a great number of animals with as many different species as possible represented.

The literature in this area is very meager. There is a lot of pragmatic experience and what we have tried to do is quantify the best of what has been published and the best experience we can come up with. Insofar as the numbers are concerned, we have displayed the system and if others wish to adjust the numbers, they are free to do so. However, at least the procedure is laid out.

I will not say anything about the visual factors because we would get into more than we have time for. I have detailed all of this in the paper and there are two pages of references of published works out of this project which can provide the details.

MR. JOSEPH BACHANT [Missouri Department of Conservation]: I gather that you have had an array of local communities working in relation to the assessment of these wetlands. Do you feel that these lay people will be able to use your model for making value judgments in relation to their decisions?

MR. LARSON: What we have attempted to do is produce a model that does not require an expert and to use measurements that can be made in the field. This could be done, essentially, by a lay individual. As a matter of fact, I have been working with a couple of extension people who have been applying this to the communities in their area in working with planning boards. However,. there are other parts of this that are complex and need to be ironed out a little more simply. But generally, this is something which an extension agent, without particular training, can do quite easily and I think probably a reasonable interested layman can do it also.

DISCUSSION LEADER EISEL: Do you have any details at present in relation to dollar values?

MR. LARSON: We have one town evaluation which comes up with a figure of about three million dollars for the value of the wetlands and we are looking back now to see what that means and how it contrasts with assessed valuation and purchase records. We do find a lot of interest in this. I think we are going to see some of this. I don't know, however, how well this data will stand up at a town meeting.

MR. PHILIP ALKON: Can you comment a little bit about the rating system in relation to the various species, the abundance or under-abundance, differences in use made of the areas in relation to where the species breed or perhaps on some other basis?

MR. LARSON: Basically, the assumption is that the diversity of the site is going to influence the rating. We also take into consideration the high use by migratory birds, but the documentation, species by species of the breeding density, ets., as you know, is not well documented for very many species. So, again we are trying to quantify the unquantificable but we are forced into it.

MR. GRANT ASH [Corps of Engineers]: I am interested in your system but I have not gotten from your talk just how you do these evaluations. Does this mean, for example, you go into the wetlands and subjectively write everything down with a team of people, or do you go in and take samples and bring them back to the laboratory and then make counts and distributions? Can you give me a physical picture of how you go about doing this and what kind of team you use to do it?

MR. LARSON: Well, most of the characteristics that we feel underly the values are characteristics which can be measured on an aerial photography and maps with the exception of water chemistry and subclass diversity. The area of subclass has to be determined in the field but other features can be determined on maps. Very little field work actually needs to be done insofar as applying this system.

Time Trends in Riverbed Sediment Composition in Salmon and Steelhead Spawning Areas: South Fork Salmon River, Idaho

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The Watershed

The South Fork Salmon River (SFSR) is a major tributary of the Salmon River. It drains a 1,270-square-mile watershed representative of much of the forested mountainous terrain found in central Idaho (Fig. 1). Watershed elevations range from 9,000 feet at the headwaters to 2,100 feet at the mouth of the river. The terrain is steep, with most hill slope gradients between 40 to 70 percent. The river channel is about 100 miles long, from the headwaters to the mouth, and averages 75 feet wide and 2 feet deep. About two-thirds of the river is riffles; the remainder is pools (Platts 1970). Waters draining from the watershed are low in mineral content (averaging about 60 ppm total dissolved solids) because of the granitic bedrock in the watershed (Platts 1974).

The SFSR watershed is located within the 16,000-square-mile Idaho Batholith, an area of granitic bedrock much of which is characterized by steep slopes, highly erodible soils, and high climatic stresses. Soil disturbances, such as those associated with logging and road construction, have the potential for accelerating soil erosion many times over natural rates on such lands.

History of Land Use and Rehabilitation

According to Arnold and Lundeen (1968), worsening environmental conditions in the SFSR from 1950 to 1966 were caused primarily by accelerated logging and road construction on high erosion hazard lands.

Before 1950, most logging and road construction in the Idaho Batholith was confined to the limited areas with gentle slopes where soil erosion hazards were low. However, to continue logging it became necessary to harvest timber on the higher hazard lands, such as those commonly found in the SFSR watershed. By 1965, 15 percent of the lands within the watershed above (south of) the confluence of the Secesh River had been included in logging sale boundaries. In addition, 622 miles of roads had been constructed, most in conjunction with timber sales. Seventy-eight percent of the logging and 69 percent of the road construction were on fluvial lands, the least stable of all the lands in the drainage.

Severe storms in 1962, 1964, and 1965 on the newly disturbed lands accelerated soil erosion rates tremendously, particularly on logging roads (Megahan and Kidd 1972). Arnold and Lundeen estimated that, by 1967, accelerated soil erosion in the watershed above the Secesh River had increased sediment loads in the river by 350 percent as compared to conditions before 1950.

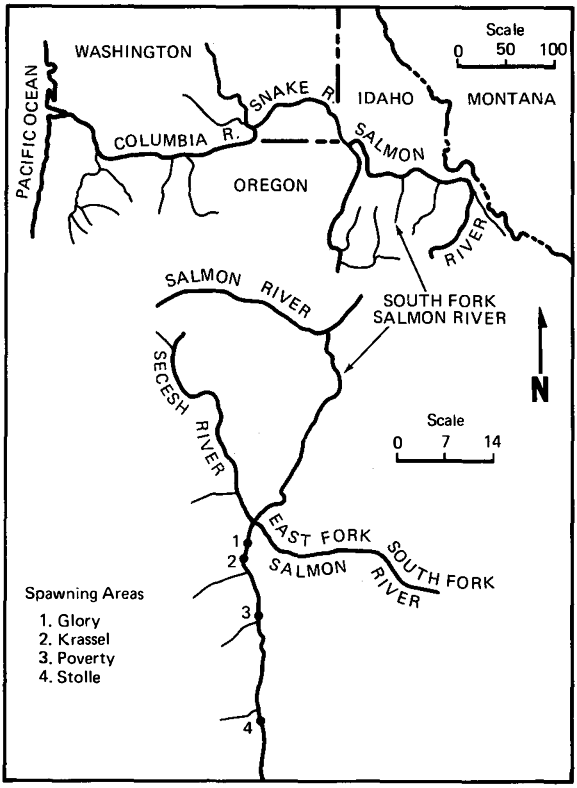

Figure 1. Location of the South Fork Salmon River and the spawning areas studied.

The coarse texture (mostly coarse sands) of the soil material eroded from the watershed resulted in excessive bedload sedimentation that dramatically altered the size composition of the riverbed. Sediment caused severe damage to chinook salmon spawning areas (Platts 1970), burying the newly constructed chinook salmon and steelhead trout redds under thick blankets of sand (Fig. 2 and 3).

Concern arose over the degraded river conditions and the U.S. Forest Service took several actions to remedy the situation: (1) a moratorium on logging and road construction was declared in the upper half of the watershed containing the chinook salmon spawning areas; (2) a watershed rehabilitation program was initiated in 1965; (3) aquatic environment studies were initiated in 1966. The aquatic habitat studies evaluated the effect of the past watershed disturbances on the river and tributary environments and monitored the river over time to determine the response to improvements in watershed conditions.

The Fishery

The SFSR historically contained Idaho's largest salmon run which is composed entirely of summer chinook salmon, a race now reduced in abundance in the Columbia River system (Richards 1963). Before the mid-1960's, the river pro-

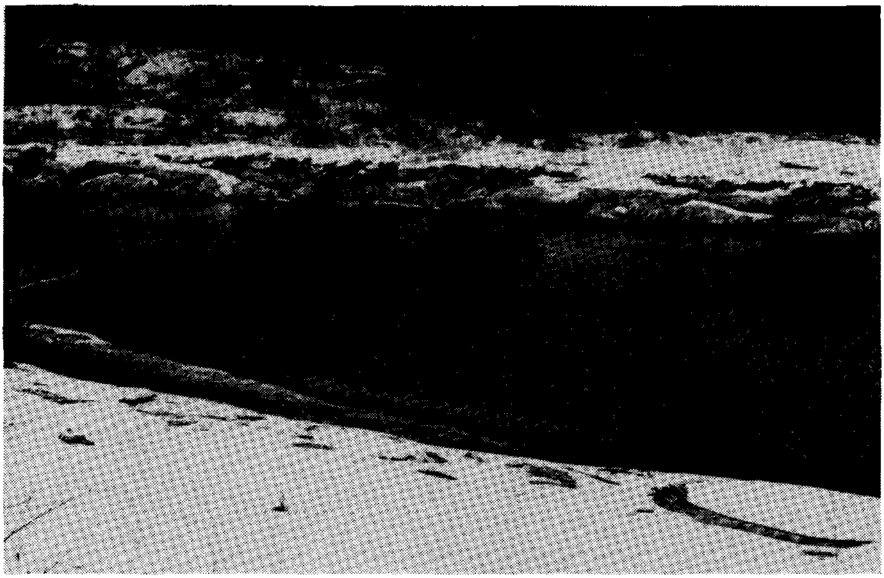

Figure 2. By 1966 excessive deposition of fines in the Poverty spawning area caused dunes to form on the channel bottom. Only the tails (downstream end) of some of the chinook salmon redds remained exposed.

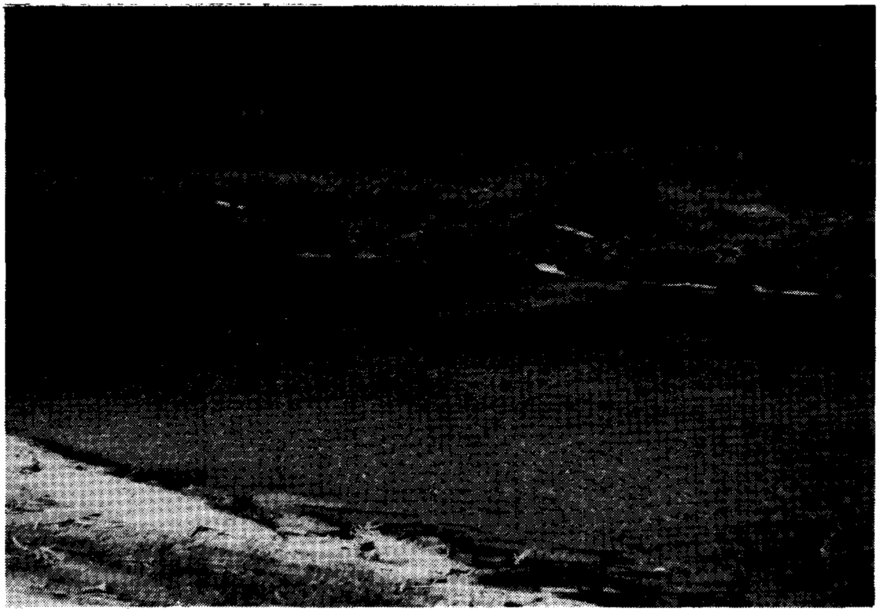

Figure 3. By 1972, only light fines deposition was occurring in the Poverty spawning area.

duced about 30 percent of Idaho's chinook salmon harvest and accounted for 20 percent of the chinook salmon redds counted in Idaho. The SFSR also supports an anadromous steelhead trout population. Most of the chinook salmon spawn in the main stem of the river; steelhead trout spawn in both the main stem and its tributaries. Since 1940, during years with open seasons, both the chinook salmon and the steelhead trout have received heavy fishing pressure. Rainbow trout, cutthroat trout, Dolly Varden, and mountain whitefish also inhabit the river and are subjected to light fishing pressure (Table 1).

The number of returning adult summer chinook salmon and steelhead trout entering the SFSR has steadily declined during the past 17 years (U.S. Army Corps of Engineers 1965-1974). The declining chinook salmon runs started leveling off from 1969 to 1973, but 1974 runs into the SFSR were the lowest on record. Most of the decline is attributed to stress on chinook salmon and steelhead trout migrants as they pass or attempt to pass downstream hydroelectric structures and impoundments in the Snake and Columbia Rivers. Upriver environmental degradation has also influenced the decline of anadromous fish populations in Idaho (Mallet 1974).

A variety of aquatic environment studies have been conducted over the past 10 years. However, because of space limitations, this report is limited to a description of temporal trends in riverbed material size composition in the four major spawning areas of the main river channel (Fig. 1).

Procedures

Groups of channel cross sections were located within the major spawning areas (Fig. 1) to determine sizes of riverbed surface materials. The procedures used were similar to the techniques described by Herrington and Dunham (1967); modifications were made to increase sample sizes.

A permanent reference point was located at each spawning area. The distance along the channel from the reference point to the first cross section in the spawning area was recorded. Additional cross sections were located throughout the spawning area at 50-foot intervals in the Krassel and Glory spawning areas and at 300-foot intervals in the Poverty and Stolle spawning areas. Ten cross sections were used in each of the Krassel, Glory, and Poverty spawning areas; 20 cross sections were used in the Stolle spawning area. Cross sections ran from bank to bank perpendicular to the centerline of the stream. The composition of riverbed surface materials was determined from waterline to waterline along each cross section. This was done by visually projecting each 1-foot division of a measuring tape to the streambed surface and assigning the observed sediment to one of four sediment size classes (Table 2).

All cross sections were measured annually, except in 1969 when no data were collected and 1966 when only the Krassel and Glory sections were read. The fieldwork was conducted during late summer when river flows were low, thus assuring shallow water depths for wading, clear water for direct measurement, and maximum stability of channel sediment.

Results

Eight years of data have been collected, covering a 9-year time span from 1966 to 1974. We found considerable variation in riverbed sediment size composition

Table 1. List of fish species[1] present in the study area with population abundance rating.

Common name	Scientific name	Population rating		
		Abundant	Common	Low
Cutthroat trout	*Salmo clarki* Richardson		x	
Dolly Varden	*Salvelinus malma* (Walbaum)		x	
Rainbow trout	*Salmo gairdneri* Richardson		x	
Mountain whitefish	*Prosopium williamsoni* (Girard)		x	
Chinook salmon (summer chinook)	*Oncorhynchus tschawytscha* (Walbaum)		x	
Steelhead trout	*Salmo gairdneri* Richardson		x	

[1]Scientific names according to the American Fisheries Society (1970) list of common and scientific names of fishes.

Table 2. Size classification of riverbed materials.

Particle diameter	Classification
12 inches or over (304.8 mm or over)	Boulder
3 to 11.9 inches (76.1 to 304.7 mm)	Rubble
0.19 to 2.9 inches (4.7 to 76.0 mm)	Gravel
0.18 inch and less (less than 4.7 mm)	Fines (Sand)

among cross sections measured in any one year at various locations in the river. However, the data are adequate to illustrate that considerable changes in size composition of spawning area materials have occurred since 1966.

All Spawning Areas Combined

The percentage of the total riverbed surface occupied by each sediment size class (fines, gravel, rubble, and boulder) in the spawning areas varied non-linearly over time. The percent of fines decreased while the percentages of gravel and rubble tended to increase. The statistical significance of the trend was tested by fitting a hyperbolic regression model of the form $y = a + b/t$ to the transect data. In this model, y is the percentage of substrate composition within each size class, t is time in years since 1965, and a and b are constants to be determined. The results of the analyses are summarized in Figure 4. The average percentage of each sediment size class each year also is plotted on the graph to illustrate data trends.

As expected, the error bands for each relation are wide, as indicated by the low ratios of variance accounted for by regression (r^2). The important fact is that the fitted regression coefficients a and b are significant at the 95 percent level in all cases. Thus, it is very likely that a real time trend does exist (as indicated by the b coefficients) and that the percentage composition for each substrate size class will tend toward a constant value (as represented by the a coefficient).

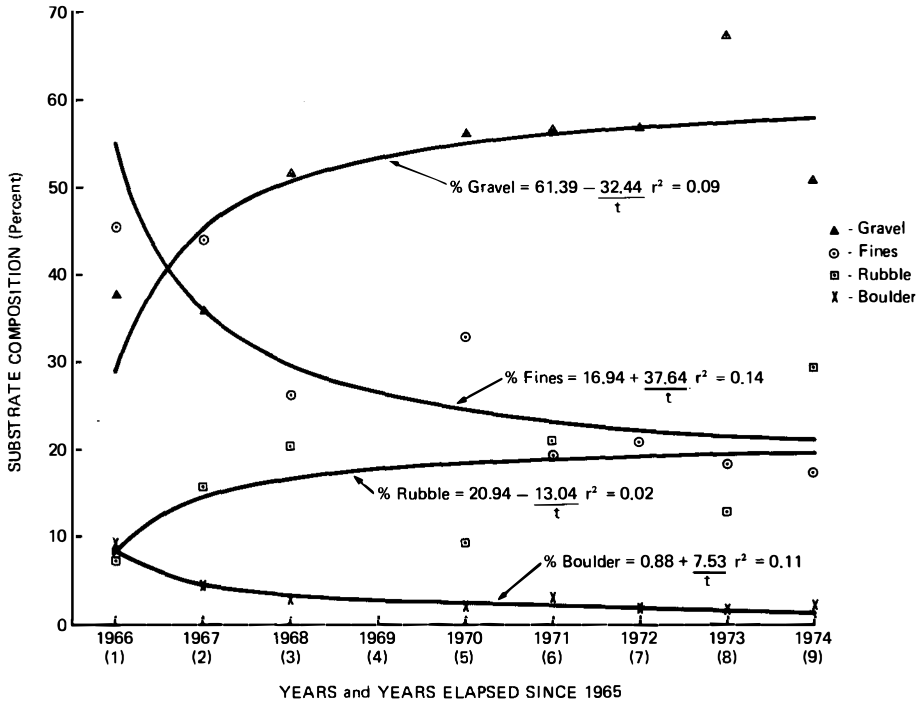

Figure 4. Trend in size composition of the substrate surface in spawning areas.

The most important riverbed surface relationship concerns fines. We estimated from the fitted regression that fines made up 55 percent of the surface materials in year one (1966). Nine years later (1974) only 21 percent of the surface materials was fines. Most of this decrease in fines was accompanied by an increase in the percentage of gravel and, to a lesser degree, rubble. These changes were also apparent in field observations (Fig. 1 and 2).

Individual Spawning Areas

Analyses, similar to those used for grouping all spawning areas, were made for each of the four individual spawning areas and results were similar to those for the combination. Percent fines decreased and gravel and rubble increased. In addition, interesting spatial trends in fines developed among individual spawning areas as illustrated in Figure 5.

The *b* coefficients are greater than zero at the 95 percent level of significance for all four spawning areas, indicating that real time trends probably occurred at all locations. All four curves have similar shapes, but vary in elevation. There are no statistical differences between the *b* coefficients for the four equations, indicating no differences in shape. However, there are differences in graph elevation as indicated by the *a* coefficients for the Poverty and Stolle spawning areas, which are significantly greater than those for the Krassel and Glory spawning areas. The two higher curves are probably caused by a combination of greater initial sediment supplies (resulting from excessive erosion on a burned area in the immediate vicinity of the Poverty spawning area) and less river energy available to transport sediment. Sediment transport energy was evaluated by estimating stream power at bankfull flow for each spawning area. Stream power for the four spawning areas, ranked in ascending order, was Poverty, Stolle, Glory, and Krassel.

Discussion

Large increases in sediment loads in stream channels can create intolerable changes to material size composition of salmonid spawning areas. This is particularly true in the Idaho Batholith where most of the eroded watershed material consists of fine and coarse sands (classified as fines in this report). Channel bottom materials should contain no more than 10 to 15 percent fines for successful spawning (McNeil 1964). However, excessive fines are particularly deleterious because they can blanket over or infiltrate into spawning channel materials and cause considerable mortality to embryos, alevins, and fry still in the gravel. Excessive fines kill embryos, alevins, and fry within the channel substrate by decreasing permeability of the gravel to water (shutting off oxygen sources), concentrating metabolic wastes to toxic levels, and forming a block between the intra-gravel fry and surface waters, which eliminates or reduces their chance for emergence. The effect of increasing fines on reduction of permeability and water interchange through spawning channel materials has been demonstrated repeatedly (Cooper 1959; Cordon and Kelly 1961; Phillips and Cambell 1961; Peters 1962; and Vasil'en 1964).

Fines initially (1965) made up a very large proportion of the streambed materials in salmon spawning areas in the SFSR. Fortunately, the percentages of fines decreased rapidly with time after logging was restricted. Reduction of fines was

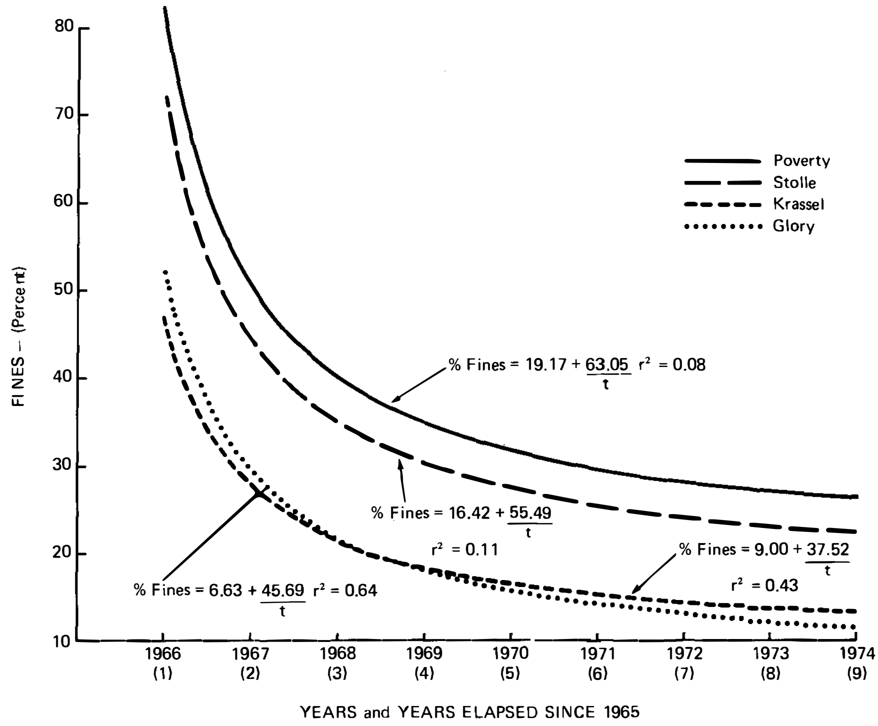

Figure 5. Trend in percent fines in spawning areas over time.

accompanied by increases in gravel and rubble, materials which are required for a successful spawning environment. Individual spawning areas varied considerably in their response to containment and elimination of fines. Some spawning areas started (1965) with a much higher percentage of fines than others. However, all spawning areas had similar time trends toward improved spawning materials. Presently, the Krassel spawning area contains 12 percent fines and the Glory area contains 13 percent. These areas are well within the optimum spawning range of from 10 to 20 percent fines. The Poverty (26 percent fines) and Stolle (23 percent fines) areas slightly exceed the optimum range in fines.

What caused the observed changes in aquatic environment conditions in the SFSR? This question can be answered by considering basic sedimentation principles: (1) deposition occurs if the sediment supplied to the river exceeds sediment transported out of the system by available river energy; (2) material is removed from the stream channel if sediment transport energy exceeds sediment supply. Before 1965, the former situation existed because accelerated soil erosion associated with logging and road construction was occurring on constantly expanding areas of the watershed. After 1965, sediment supplied to the river was reduced and the river was able to cleanse itself as transport energy exceeded sediment supply.

A number of factors assisted the reduction of sediment flows into the river. By far the most influential factor was the U.S. Forest Service moratorium on logging and road construction in the upper SFSR drainage. This moratorium was important because it eliminated new sources of accelerated surface and landslide erosion. Watershed studies in the area have demonstrated that accelerated soil erosion following soil disturbance decreases rapidly over time. Megahan and Kidd (1972) found that surface erosion on logging roads decreases rapidly over time after the initial disturbance. Rehabilitation team members used this erosion time trend to estimate the sediment supplied to the river from surface erosion on logging roads in the SFSR (Fig. 6). Sediment supplied to the river from surface erosion was drastically reduced within a few years following the cessation of logging and road construction. Additional factors that helped reduce sediment flows into the river included the watershed rehabilitation program initiated in 1967, and the fact that climate and erosion hazard conditions were not conducive to creating excessive landslide erosion after 1965.

Once sediment flows into the river were reduced, the energy available for sediment transport in the river was adequate to begin removing excess sediment from the system. River flows from 1966 to 1970 were not particularly high, yet considerable sediment flushing occurred. High river flows in 1971, 1972, and 1974 continued to flush sediment from the channel system (Table 3).

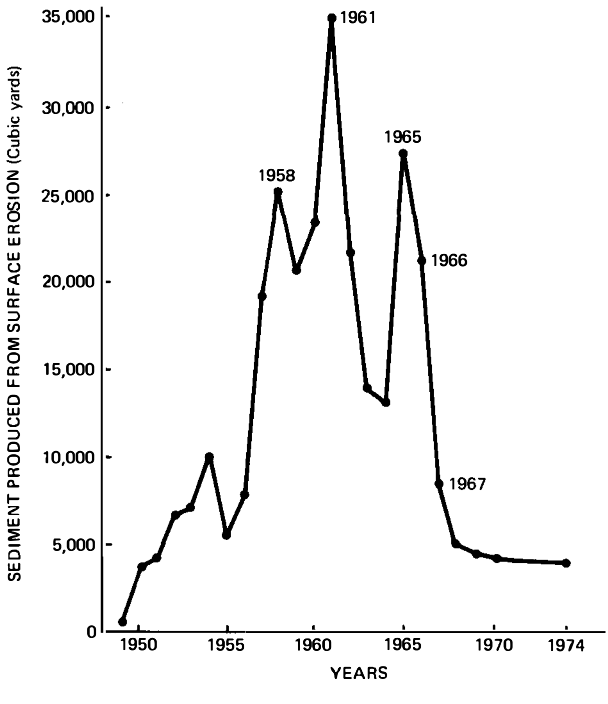

Figure 6. Estimated cubic yards of annual sediment production from surface erosion on temporary logging roads in the South Fork Salmon River watershed.

Table 3. Total annual water yield and annual peak flow for the South Fork Salmon River near Krassel Ranger Station.[1]

Water year	Total yield	Peak flow
	(inches)	(ft^3/sec)
1960	19.3	3,100
1961	19.4	3,840
1962	21.2	3,300
1963	27.9	4,140
1964	21.0	3,770
1965	34.8	5,270
1966	15.4	2,160
1967	22.2	3,840
1968	17.6	2,450
1969	25.1	3,740
1970	24.3	4,720
1971	33.9	5,070
1972	26.2	5,630
1973	14.1	2,460
1974	—	7,500

[1]Data before 1967 estimated from a regression relation developed with data from a nearby stream.

Conclusions

Riverbed surface conditions deleterious to fish spawning may result if soil disturbances from logging and road construction are allowed to progress without restriction on steep mountain lands in the Idaho Batholith. The percentage of fines in the four individual spawning areas studied ranged from 45 to over 80 percent in 1966. Presently, the size composition of bottom materials is at or near optimum levels in the individual spawning areas, where fines range from 12 to 26 percent; these values should decrease even further in the future. These results show that streams similar to the SFSR can recover in time if sediment flows into the stream resulting from accelerated erosion on watershed lands are reduced to levels below the capacity of the stream to flush fines from the system.

The SFSR experience demonstrates that land uses in sensitive areas must be carefully planned over both time and space to avoid overloading the system to the point that sediment supplies exceed sediment transport capacities. Only by using a system of programmed land uses is it possible to avoid degradation of the aquatic environment such as occurred in the SFSR.

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Dynamics of Marsh Land Formation and Succession Along the Lower Colorado River and their Importance and Management Problems as Related to Wildlife in the Arid Southwest

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Historically, the Colorado River has been a dominant feature of the Southwest, first as an inroad for exploration and a source for beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) pelts, and later as a major avenue of transportation of people, goods and ores to and from the gold, silver and copper mines of adjacent mountain ranges. Army personnel stationed at forts guarding strategic river crossings or exploring along the river in the nineteenth century made general collections which yielded insight into vertebrate and plant species composition, but gave little consideration to the significance of the river and its riparian habitats for terrestrial vertebrates. Today the lower Colorado River, with three major dams, is quite different than the ever-fluctuating, silt-laden river of previous centuries with its broad, meandering channels (Sykes 1937). Although important studies, modern surveys (Grinnell 1914; Phillips *et al.* 1964), too, have lacked the depth needed to assess the importance of the river and its riparian communities to wildlife. We are still far from understanding these riparian plant communities and their importance to wildlife, but the results of 2 years of field research compared with available historical records indicate that the same physiochemical components are continuing to shape the plant and animal communities of the lower Colorado River.

Isolated backwaters along the lower Colorado River system have been and still are important breeding, foraging, and loafing sites for wildlife. The life expectancy of these backwaters is quite variable and depends on freshwater input either through surface flow or ground-water movement. Water gains are frequently offset or even negated by high evaporation rates during the hot dry months of spring, summer and fall. Strong surface winds are common during these periods and relative humidities seldom exceed 20 percent. Surface flow is related to annual rainfall (4 inches or less) and flooding by the river, but today the latter is improbable with the construction of the major dams. Ground-water flow is related to soil characteristics, proximity of backwaters to mountain drainages and distance of the impoundment from the river. Both types of input may operate concomitantly to sustain backwaters for maximum longevity.

This paper reports on some of the larger and more important (most commonly mentioned) historical and present-day backwaters and their probable and known value to selected wildlife species. Dates of formation and disappearance of selected historical backwaters will be discussed along with surviving accounts of associated vegetation.

Historical Backwaters

The historical backwaters (Figure 1) discussed in this section were all present prior to the operation of the first major dam (Hoover, 1935) on the river. Table 1 lists the larger and/or more permanent backwaters along with dates of formation and disappearance. Surface acreage and other physical characteristics are included where data were available. Backwaters were formed in the Palo Verde and Yuma Valleys, but these areas were not heavily settled and only Olive Lake was given a lasting name.

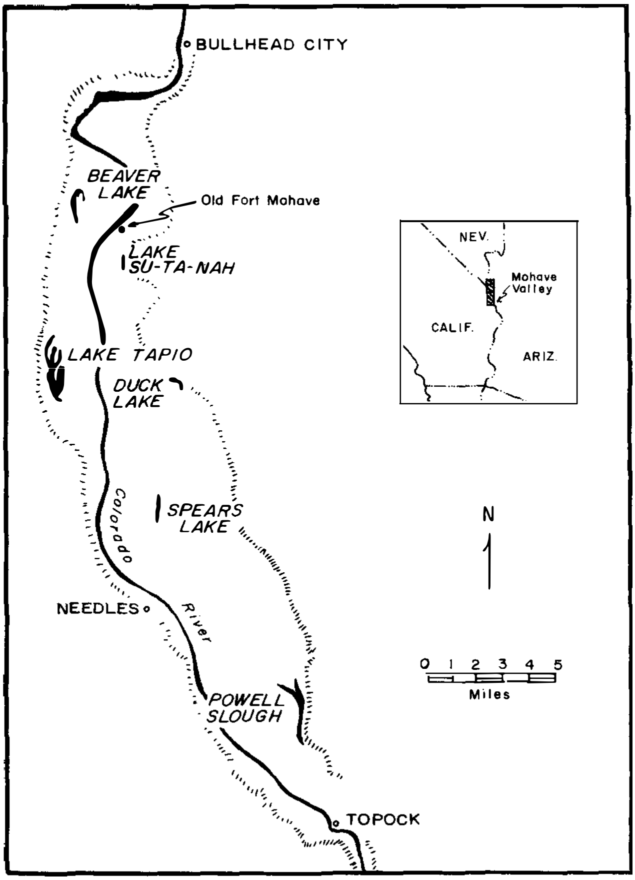

Figure 1. Location of historical backwaters in the Mohave Valley.

Table 1. Date of formation, disappearance, surface area and other physical data of selected historical backwaters on the lower Colorado River.

Historical Backwater	Date of Formation	Presence	Date of Disappearance	Surface Area (acres)	Volume (acre-feet)	Source
Beaver Lake	after 1857	—	—	—	—	Ives (1857)
		1859	—	—	—	Biven (1859)
		1865	—	—	—	Coues (1865)
		1869	—	32	—	Wheeler (1870)
		1883	—	33	—	Phister (1883)
		1890	—	—	—	Stanton (1890)
		1902-03	—	160	—	USGS (1927)
		—	1903-1928	—	—	Blout (1931)
Powell Slough	after 1890	—	—	—	—	Rowe (1940)
		1903	—	234	700	Martin (1910a)
		1902-03	—	—	—	USGS (1927)
		—	flooded 1938	—	—	this paper
Lake Su-ta-nah		1903	—	116	500	Martin (1910a)
		—	flooded 1938	—	—	this paper
Duck Lake		1903	—	121	400	Martin (1910c)
		—	flooded 1938	—	—	this paper
Spears Lake		1903	—	420	1,500	Martin (1910d)
		—	flooded 1938	—	—	this paper
Lake Tapio	1904-1921	—	—	—	—	USGS (1927) and Chapin and Ihrie (1924)
		1928	—	1,314	—	Blout (1931)
		—	1958	—	—	this paper, river channelized, Bureau of Reclamation

Beaver Lake was located on the Nevada side of the river approximately 3 miles north-northwest of the old military base, Fort Mohave. The lake was crescent or horseshoe-shaped, and the longest arm paralleled and was cradled by the pediment of the mountains. It appears to have been formed by vertical scouring as the river was laterally contained by the western mountain pediment. The deep scouring effect was adequate to preserve a lake either when the river began shifting eastward again or possibly when an oxbow cut was formed. Ives (1857), in his personal field notes, made a vegetation type map of the entire lower river and did not show any evidence of Beaver Lake. The lake was first mentioned on April 21, 1859 by Biven, a Colorado correspondent. He described "a swamp or pond of water in the form of a crescent, being from one-quarter to three-quarters of a mile distant to the river and about 3 miles in length . . . beaver and duck being abundant." He did not mention any trees or shrubs (important for shade and usually noted) around the water which possibly indicates the backwater had not persisted long enough for vegetation to mature. The Colorado River at this location and time had an east bank "high perpendicular and caving; whilst the west bank is low . . ." (Biven, April 21, 1859) indicating the river was cutting eastward and depositing alluvium on the west bank. The lake was next mentioned in 1865 by Coues (October 30, 1865), who wrote, "I went 3 miles to some water called Beaver Lake;..." Wheeler (1870), in his 1869 survey showed Beaver Lake as a crescent and about 1.5 miles from the river ferry landing. North to south the lake was about 0.25 miles long and each arm was about 350 feet across. Phister (1883) mapped the lake about 1.25 miles from the ferry landing. The lake was about 1 mile long from north to south and each arm was about 1,000 feet wide. Stanton (April, 1890) only mentioned the backwater. The 1902-03 Colorado River map published by the U. S. Geological Survey (1927) showed the lake less than 1/2 mile from the river and covering about 160 acres. In August 1907, following the big flood of 1905, the river had moved to the eastern mountain pediment (Robinson, 1907) isolating the lake from the river by about 3.5 miles. The 1928 map by Blout (1931) showed the river had moved about 0.5 miles back toward the west, but there was no trace of Beaver Lake. Today the former lake is a depressed area supporting stands of mesquite and salt cedar.

Lake Su-ta-nah, Duck Lake, and Powell Slough were all located in the Mohave Valley between Needles, California, and Topock, Arizona. They ranged in distance from 1 to 3 miles from the Colorado River near the eastern mountain pediment in Arizona. The date of formation has only been determined for Powell Slough. The pertinent old maps are involved in a law suit, but Rowe (1940; 14), who had studied them, stated, "greatest change (since 1869) was in first 6 miles below Fort Mohave, river now being east of the center of the bottoms instead of near the west side. Shows Powell Lake, which was formed after the railroad grade was abandoned in 1890." All the above lakes were north-south oriented and linear in shape, indicating they were probably formed as a result of deep scouring and isolation as the river cut from east to west. These lakes were once envisioned as future reservoirs to be interconnected by an extensive labyrinth of canals. The Cotton Water and Irrigation Company planned to convert the valley into an agricultural community with a town, Cottonia, at the heart of the district opposite Needles, California (Martin 1910e).

The Public Land Office surveyed the Mohave Valley in 1905. The original field notes of the survey (Fisher 1905) indicate the bottom lands were vegetated by large mesquite trees (*Prosopis juliflora*) intermittent stands of cottonwood (*Populus fremontii*) and willow (*Salix* sp.). Arrowweed (*Pluchea* sp.) formed the understory. A common notation by Fisher (1905; Book 2130, Page 7) was as follows: "land level, subject to overflow, covered with scattering Mesquite and Willow Timber and dense undergrowth of Arrow wood." Six- to 10-inch diameter mesquites were frequently used as witness points. The nature of the vegetation (i.e., old mature honey mesquites) indicates this region was primarily an area of periodic flooding and was only infrequently subjected to the meanderings of the river. The presence or absence of tracts of emergent vegetation was related to the stability of water levels in these backwaters and the intensity of grazing by domestic livestock. Cattle, in sufficient densities, will crop cattail stands to ground level, and domestic pigs root and feed extensively in cattail marshes. The stock from the numerous small ranches in the valley would have concentrated in these riparian sites to feed on mesquite and emergent vegetation, since the surrounding desert-scrub vegetation was composed primarily of the unpalatable creosote bush (*Larrea divaricata*). Domestic pigs, gone feral, still thrive in Topock Marsh, the successor of Powell Slough.

Topock Marsh on the Havasu National Wildlife Refuge (U. S. Fish and Wildlife Service) came into existence after the Parker Dam went into operation; water level rose 6 feet at the gauging station just below Topock, Arizona, and led to flooding of the lowlands upstream. Subsequent sedimentation behind Parker Dam and in the vicinity of Blankenship Bend (Figures 2a and b) caused a further rise of more than 7 feet at the gauging station (Sharpe and Deason, ms). Dikes have now been installed to preserve Topock Marsh. Skeletons of drowned mesquites persist throughout the marsh, attesting to the past vegetation. More importantly, these old trees form one of the few remaining rookeries for Great Blue Herons on the lower Colorado River and provide the only known nesting sites for Double-crested Cormorants on the lower river.

Lake Tapio formed sometime between 1904 and 1921 as evidenced by the 1902-03 maps published by the U. S. Geological Survey (1927) and the 1922-23 survey by Chapin and Ihrie (1924) and the 1928 survey by Blout (1931). The first survey shows low areas but no standing water, whereas the last two surveys show water in the area known as Lake Tapio. The field notes of Chapin and Ihrie (1924) indicate water depth was from 3 to 6 feet and had existed for several years. They stated the lake was full of rushes and dead timber. Kunkel (1970; 18) in attempting to date the formation of Lake Tapio, personally interviewed Mr. Sherman Graves, the oldest Indian resident of the Fort Mohave Indian Reservation (born April 16, 1894). Graves said that his father had moved the entire family to the west side of the river to avoid a smallpox epidemic. The new living site was a ranch in the vicinity of Lake Tapio. However, Graves had no memory of Lake Tapio as a permanent body of water, but recalled a few cottonwoods and dense mesquites in the area. The Indians harvested the annual bean crop from the mesquites for food. Prior to 1913, a Mr. Frank Harper ran cattle in the lowland area of the future Lake Tapio.

Present-Day Backwaters

Time-lapse photography for two present-day backwaters clearly shows the process of formation, filling, and disappearance which has formed the life cycle

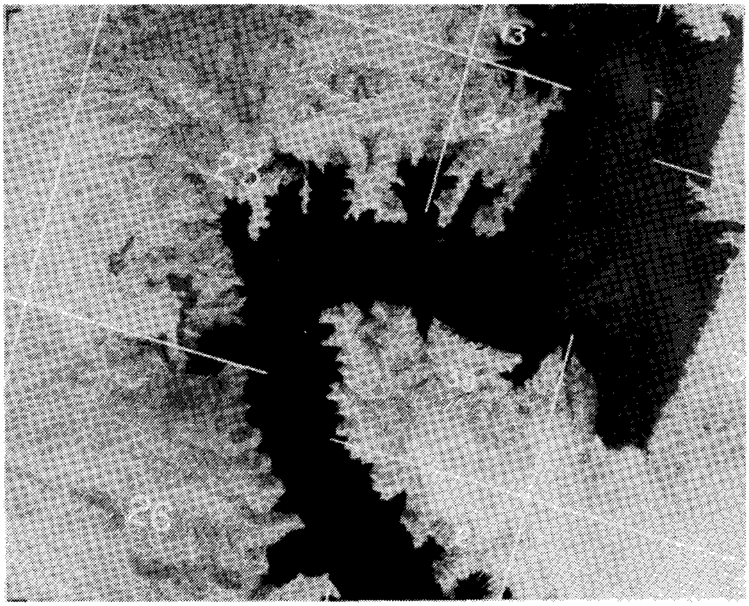

Figure 2a. Blankenship Bend above Lake Havasu in 1953, 15 years after the operation of the Parker Dam. Note siltation that has occurred.

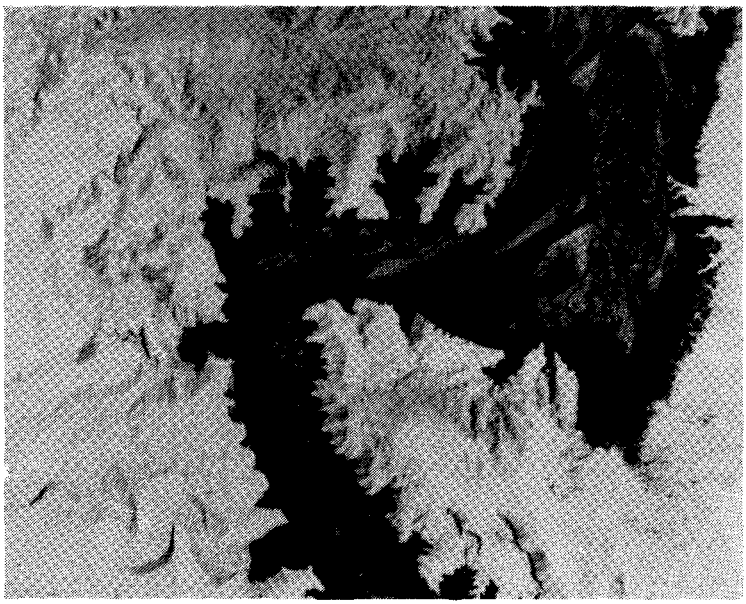

Figure 2b. Blankenship Bend in 1973. Approximately 123 acres of marsh vegetation has developed since 1953.

of all backwaters. The depression filled by the Three Finger's Lake, located between Blythe and Walter's Camp, California, was scoured out along the western mountain pediment sometime between 1910 and 1930 (Figures 3a-c). Shortly thereafter the backwater was completely cut off from the river, and by 1973, the area was almost dry. Relocation of the river channel and some lowering of the bed reduced the normal life expectancy of this backwater. Freeland (pers. obs.) estimated a reduction of 5 to 10 years, but others have contended it was reduced by a longer period. Only a thin line (2 to 10 feet) of cattails (*Typha* sp.) and bulrush (*Scirpus* sp.) ringed the open water as salt cedar (*Tamarix pentandra*) replaced the marsh vegetation in the progression of xeric succession (Figure 3c). Today this area has little value for species requiring marsh habitat.

The formation of Hunter's Hole as the river scoured while being laterally contained by the man-made levee is shown in Figures 4a-c. As the river began to cut away from the scoured area, the depressions held water to form the backwater complex. In 1953, the surface acreage of the backwaters was approximately thirty acres, and in 1973, about twelve. A rapid invasion of emergent vegetation is occuring as silt and organic debris accumulate, reducing water depth. Water continues to enter this backwater complex laterally through subterranean movement from farming activities. Even though the river flow has decreased between 1953 and 1973, net flow is out of and not into the backwater.

Figure 3a. Three Finger's Lake in 1930. Probably only 3 to 5 years after its genesis.

Figure 3b. Three Finger's Lake in 1960.

Figure 3c. Three Finger's Lake in 1973. Note the new river channel in the bottom right.

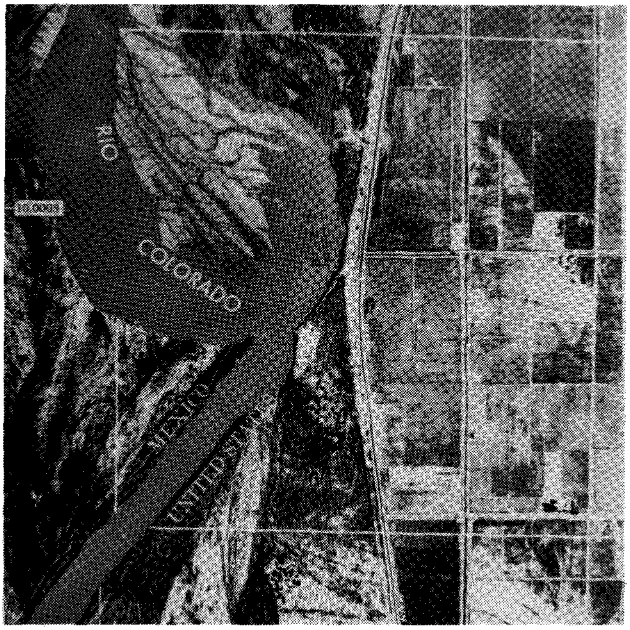

Figure 4a. Hunter's Hole complex formation south of Yuma, Arizona, in 1950.

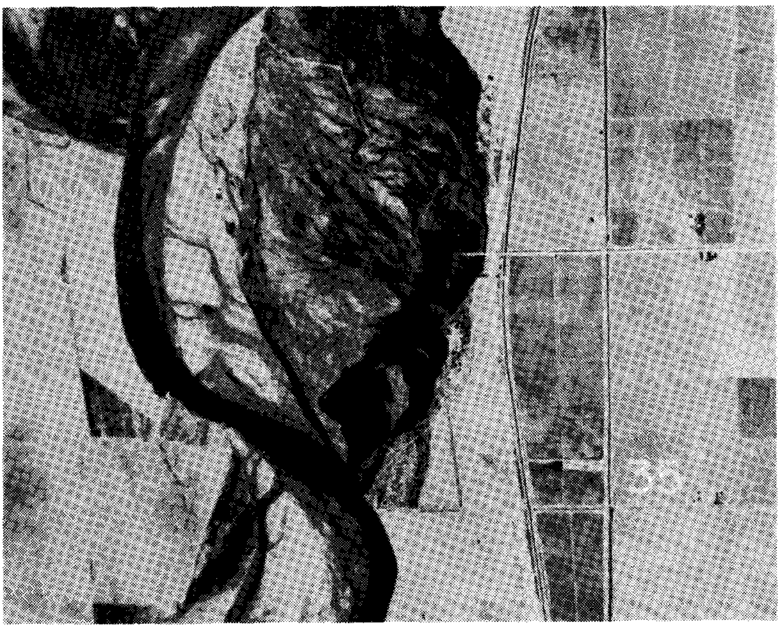

Figure 4b. Hunter's Hole complex in 1953. Approximately 30 acres of surface water.

Figure 4c. Hunter's Hole complex in 1973. Approximately 12 acres of surface water.

A number of vertebrates breed primarily in cattail and bulrush habitats, which form around backwaters as well as on the deltas at river mouths (e.g. Bill Williams River) and the heads of lakes (e.g. Blankenship Bend at the head of Lake Havasu). As the water is slowed, sedimentation occurs to create sandbars, which eventually support luxuriant growths of cattail and bulrush. Approximately 123 acres of marsh have formed in 20 years in the Blankenship Bend area as shown in Figure 2b.

In Las Vegas Wash (near Las Vegas, Nevada) which feeds into Lake Mead, Miller (1974) found that the shrub-woodland marsh community had the highest primary productivity as compared to desert and riparian (no standing water) habitats, and supported the most breeding (50) and nonbreeding (73) avian species. The latter figure is biased due to the presence of Lake Mead. Miller did not discriminate between avian species normally using the habitat and those deepwater species attracted by and dependent on Lake Mead. Nevertheless, his data support unpublished findings from farther south on the Colroado River (Anderson and Ohmart, MS).

Lower Colorado River backwaters support two breeding species thus far not found at Las Vegas Wash: the Clapper Rail (*Rallus longirostris yumanensis*) and the Black Rail (*Laterallus jamaicensis*). The former prefers light stands of cattail or bulrush in shallow water situations near high ground (Smith 1974). There, crayfish, the most common food item of Clapper Rails on the lower Colorado River (Ohmart and Tomlinson, ms), reach their highest densities. Mean territory size for 8 pairs was 3.04 acres (Smith 1974). Black rails prefer areas that are constantly wet, but not inundated, such as occur with lateral seepage from canals or the slight circadian rise and fall of the water level produced behind Imperial Dam. Black Rails usually inhabit dense stands of three-square bulrush (*Scirpus olneyii*), where rail densities approximate 1 to 1.5 pair per 2.5 acres (Repking and Ohmart, ms).

Backwaters are extremely important today for migrating, resting, and feeding waterfowl and shore birds. Emergent plant communities around backwaters and behind dams also are important for resting and wintering avian species. Some of the more common species are: Great Blue Heron (*Ardea herodias*), Least Bittern (*Ixobrychus exilis*), American Bittern (*Botaurus lentiginosus*), Virginia Rail (*Rallus limicola*), Sora Rail (*Porzana carolina*), American Coot (*Fulica americana*), Long-billed Marsh Wren (*Telmatodytes palustris*) and Yellowthroat (*Geothlypis trichas*). Transient waterfowl use these areas for feeding and loafing.

Some mamalian species also are quite dependent on backwater habitats. Along the lower Colorado River, beavers and muskrats attain some of their highest densities in these marsh situations. The bulbs of cattails are a major source of food for these animals, although other plant species are important as well. The striped skunk (*Mephitis mephitis*) reaches its greatest numbers in these areas and depends on this habitat for water as well as food (Sturla, ms in preparation). Large mammals such as deer (*Odocoileus hemionus*), burros (*Equus asinus*), and coyotes (*Canis latrans*) forage and loaf in these relatively cool moist areas during the hot summer months.

Natural backwater formation has been essentially stopped because of bank stabilization projects and large dams below major drainages into the Colorado River. However, current river management theory promotes the inclusion of artificial backwaters in construction projects. Until recently, though, ignorance of the habitat requirements of species inhabiting backwaters has not allowed design recommendations to be engineered into these construction projects. A pioneering effort is being made in Topock Marsh. where dredging will enhance a part of the Havasu National Wildlife Refuge for marsh birds. New knowledge will allow better design of future backwaters to increase the use value for many wildlife species.

Conclusions and Recommendations

Historical evidence indicates backwater marsh situations were never very extensive or enduring (50 to 70 years) along the lower Colorado River (delta excluded). These backwaters have been and remain important habitats for many forms of wildlife. Unmanaged, xeric succession occurs through evaporation, siltation, and organic deposition. These backwaters may become useless to some forms of wildlife in a few years because of salinization and anoxia.

Placement, succession, and longevity of present-day backwaters are very similar to those of historical ones. This is supported by Grinnell (1914), who collected birds, mammals, and plants during the three months in 1910 that he floated from Needles, California, to Yuma, Arizona. He stated, "The river's habit of overflow would be expected to result in rather extensive tracks of palustrine flora. As a matter of fact, however, marshes were few and of small size. This was probably due to the rapid rate of evaporation of overflow water so that favoring conditions did not last long, and also to the rapid silting-in of such water basins as ox-bow cutoffs. As a result there were either almost lifeless alkali depressions, or lagoons practically identical in biotic features with the main river. But in a few places there were well-defined palustrine tracts kept wet throughout the year, chiefly by seepage. These were always located back from the river near the outer edges of the broader valleys, where they were least affected during flood time. They were marked by growths of tules, sedge, and saltgrass, sometimes the latter alone, and were usually surrounded by arrowweed or willow association."

Future backwaters intended for wildlife should be constructed to contain gently sloping shorelines to support emergent vegetation, yet have deepwater areas to prevent high water temperatures in summer months. Small islands with gentle slopes are desirable for feeding and loafing sites. Some type of water exchange with the river is required to provide freshwater and a cool inflow.

Increased access to the river through the development of roads and the increased navigability of the river due to regulated flow and improved boat design has allowed people to invade the river and its backwaters ubiquitously and to disrupt wildlife feeding and nesting activities. The creation of three Federal refuges on the river (Imperial, Cibola, and Havasu) has eased conditions somewhat, but deleterious human impact is still widespread. Enhancement of backwater habitats for wildlife must be a consideration in future construction projects along the river. Following construction, access roads should be completely closed to public use to at least one-quarter mile and preferably one-half mile from the marshes. A significant amount of area along the river should be preserved primarily for wildlife use.

Backwaters must be managed to prevent silt and organic accumulation which eventually reduces the general wildlife use value. Precision dredging or draglining appears to be the best method currently available.

In Topock Marsh, immediate consideration should be given to reinforcing the old rotting trees with steel or cement, or to experimenting with artificial supports and platforms acceptable to herons and cormorants for nesting. Otherwise, as these supports disappear so may nesting cormorants on the river, and we may see one of the few remaining heron rookeries lost.

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Acknowledgments

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Discussion

DISCUSSION LEADER EISEL: Thank you for that presentation. Those desiring to ask questions, will you please come to the microphones, identify yourself and then ask your question.

MR. ROY TOMLINSON [U. S. Fish and Wildlife Service]: Do you suppose we could get the pictures back up there in relation to 1952? I have not seen any of these up until this time, Wayne, but in this 1952 picture, I don't believe any dredging nor soil deposition has been done along the river, is that correct?

MR. DEASON: That is correct.

MR. TOMLINSON: Then, let us go on to 1953. Has any been done here?

MR. DEASON: No. It is still fairly large.

MR. TOMLINSON: Okay, right here, I believe the Bureau has gone along and dredged the river and made soil depositions on both sides of the river. Now, my question is this—what effect has that had on the loss of that marsh in this area?

MR. DEASON: The border patrol has, on practically a yearly basis, gone into that area and kept it clear in relation to immigrants crossing the river—cleared the area on both sides. This is a part, as a matter of fact, of the international boundary and to our best knowledge we cannot find where that has had any specific effect on this particular situation.

MR. TOMLINSON: In effect, then, the major filling in of that marsh occurred after there was some disturbance factor along the river itself?

MR. DEASON: In relation to these pictures, Roy, I have gone from 1938 to 1973 and in each progressive year you can see a very definite increase in the filling in of vegetation around the particular complex. Of course, the river has been dammed up above and we are not anymore having the scouring effect of the river moving down the channel. More than likely, if the major dams had not been in the river, we would not have this situation today. With the river under control, as it is today, this particular habitat is probably going to stay there for a good number of years, unless, of course, the vegetation comes in and chokes it off. This is why a wildlife management plan needs to be undertaken in this particular area. If that doesn't answer your question, we can talk afterwards about it.

MR. DARYL SIMONS [Colorado State]: I have had some involvement in relation to that stretch of river through the international boundary over a long period of time. I guess the only thing I would say is that when we look from one photo to the other we emphasized the greater viability of the stream in the 1973 photo you saw there. There is one thing that has been of great interest to me down there and that is, as a consequence of the upstream development, from the viewpoint of environment, you do have some basically stable flows throughout the year. In other words, it does not necessarily go totally to zero.

DISCUSSION LEADER EISEL: Thank you very much. Are there further questions? If not, this gives me an opportunity to ask one. I would like to hear a bit more about the water access path essentially building some of the marsh area. You mentioned one to the back marsh.

MR. DEASON: This came into existence as the water backed up behind the Parker Dam, creating that lake that you saw. In fact, it created about 46 miles of very excellent marsh. The water there is fairly shallow and offers excellent habitat for numerous shore birds. The Fish and Wildlife Service has requested that the Bureau of Reclamation move into the marsh and dredge channels through the marsh to increase the surface or movement of water through it so that it can supply the cooler and better quality water. Also, at the same time, they requested that dikes be built to help the endangered species in there as well as building small islands throughout the marsh which will revegetate with cattails. As a matter of fact, this program has been going on now for close to a year and the results are nothing short of fantastic. The revegetation process has been extremely rapid in this particular type of environment and, as members of the recovery team, we are looking for good success to come from this.

MR. ROBERT OHMART: In response to Mr. Tomlinson's critically looking at these photos, the object was to indicate, from these slides, that this was a succession of situations occurring. The thing we are looking at is how long these backwaters are going to persist under somewhat natural conditions. Obviously, of course, we cannot go back and photograph every lake, but, in relation to some of these areas, we would look at the problems of evaporation, silt deposition and organic accumulation as it occurs in these backwaters. We are trying to get some idea of how long these things persisted. We have historical data and now we have some current information on the backwaters, which are going through normal successional aspects. Because of low relative humidities and high ambient temperatures this is going to occur and only through keeping the areas open and providing fresh water sources we are going to be able to maintain these areas for longer than what normally would be 70 years, when they would close up, completely seal off and become useless for habitat.

MR. TOMLINSON: The point I want to make, however, is that this was not a natural succession. I think you mentioned the wrong one here because this particular one was not a natural succession. It was due to man-made factors. That is the point I wanted to make.

DISCUSSION LEADER EISEL: I think we will now proceed with the next presentation.

CHAIRMAN GLASER: I think the thing we have to recognize here is that we do have a lot of tools that we can use on rivers and river systems. I think the questions that are being asked involve legal tools, and actual physical tools, getting to know what we are trying to manage, etc. This is the purpose of this session—to try to point them out.

Living With a River in Suburbia

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A characteristic of modern America has been a movement of population to the major urban regions. This trend is very evident when one considers that, according to the 1970 census, 73.3 percent of the population is classified as urban and 68.7 percent of the population is located in metropolitan areas. As the metropolitan areas take in more and more land area, the role of the suburban area in relation to the center city becomes more significant, for the 1970 census also shows that 54.2 percent of the population in metropolitan areas lived in suburbia.

With this type of phenomena taking place, it is common to find entire drainage basins which exist within the built-up suburban area. Thus a program must be formulated to allow us to live with a river in suburbia. Because the entire basin is suburbanized, there are no rural upstream reaches of the stream where traditional flood control reservoirs could be constructed, nor is there a downstream rural area into which floodwaters can be channeled for downstream storage. Thus, the management of the floodwater must take place entirely within the urbanized area. Suburban floodplain management emerges from such a situation. It differs from the traditional flood control approaches because of the intense competition for land. This competition makes it difficult to allocate vast land areas for single-purpose uses.

The finite amount of land in an urban region dictates that land must serve a variety of purposes. Single-purpose flood-plains are as difficult to justify as single-purpose reservoirs. In this context, urban floodplain management becomes more complex. Because the entire drainage basin lies within the urbanized area, there is neither an upstream for storage or a downstream for discharge. Thus the planning effort must seek to keep the water where it falls. This concept was clearly expressed in 1961 at the first conference on Environmental Engineering and Metropolitan Planning. A. L. Tholin, Administrative Engineer, City of Chicago stated:

> Detain stormwater near the origin, where possible; next in the neighborhood, or finally in the valleys but for the good of our pocketbooks and our downstream neighbors, hold all we can as long as we can.

However, such an approach is difficult to apply in an urbanized area and there are few examples where the approach has been implemented successfully.

The first promising sign has been a recognition of the approach in the courts. The Illinois Supreme Court rendered an opinion in the case of *Templeton V. Huss et. al*, 45758 (Ill. 1974) on March 29, 1974 which challenges a person's right to increase the flow of surface waters onto another man's land beyond a point which could be considered reasonable. The opinion stated:

> It is obvious, however, that the natural drainage pattern may be substantially altered by surface and subsurface changes which interfere with the natural seepage of water into the soil of the dominant estate .... the principle that would prevent unreasonable changes in the natural lateral drainage flow should also apply, in our opinion, to a change which would unreasonably interfere with drainage through natural seepage.
>
> The question which must be confronted is whether the increased flow of surface waters from the land of the defendants to that of the plaintiff, regardless of whether it was caused by diversion from another watershed, the installation of septic tanks, the grading and paving of streets, or the construction of houses, basements and appurtenances, was beyond a range consistent with the policy of reasonableness of use which led initially to the good-husbandry exception. The judgment of the appellate court is reversed and the cause remanded to the circuit court of Mason County for proceedings consistent with the views here expressed.

The judicial recognition of the distinctiveness of flood-plains and wetlands is evident in other states. The Supreme Court of Wisconsin rendered the following opinion in the case of *Just v. Marinette County*, 56 Wis. 2d 7, 201 N.W. 2d 761 (1972):

> It seems to us that filling a swamp not otherwise commercially usable is not in and of itself an existing use, which is prevented, but rather is the preparation for some future use which is not indigenous to a swamp. Too much stress is laid on the right of an owner to change commercially valueless land when that change does damage to the rights of the public. It is observed that a use of special permits is a means of control and accomplishing the purpose of the zoning ordinance as distinguished from the old concept of providing for variances. The special permit technique is now common practice and has met with judicial approval, and we think it is of some significance in considering whether or not a particular zoning ordinance is reasonable.
>
> A recent case sustaining the validity of a zoning ordinance establishing a flood plain district is *Turnpike Realty Co. v. Town of Dedham* (Mass. 1972), 284 N.E. 2d 891. The court held the validity of the ordinance was supported by valid considerations of public welfare, the conservation of "natural conditions, wildlife and open spaces." The ordinance provided that lands which were subject to seasonal or periodic flooding could not be used for residences or other purposes in such a manner as to endanger the health, safety or occupancy thereof and prohibited the erection of structures or buildings which required land to be filled. This case is analogous to the instant facts. The ordinance had a public purpose to preserve the natural condition of the area. No change was allowed which would injure the purposes sought to be preserved and through the special-permit technique, particular land within the zoning district could be excepted from the restrictions.
>
> The Justs argue their property has been severely depreciated in value. But this depreciation of value is not based on the use of the land in its natural state but on what the land would be worth if it could be filled and used for the location of a dwelling. While loss of value is to be considered in

determining whether a restriction is a constructive taking, value based upon changing the character of the land at the expense of harm to public rights is not an essential factor or controlling.

Together, these court decisions suggest that floodplains and wetlands are distinctive physical phenomena and must be managed as such. When the floodplains fall within an urban area and are already partially urbanized, management becomes even more complex.

A Pilot Experiment

The management of such a floodplain in the Chicago area was the challenge undertaken by the Forest Preserve District of Du Page County in cooperation with the Du Page County Regional Planning Commission. These agencies carried out a unique experiment in freeing a penned-up river to serve, to enlighten, and inspire the people who live along and near its banks instead of frightening them, spoiling their houses, and offending their sensibilities as it has periodically done for years past. The captive stream is Salt Creek, a tributary of the Des Plaines River. The focus of the experiment is a 62.1 square mile drainage area that lies within Du Page County, Illinois, an urbanized county containing a population density of over 1,800 persons per square mile.

The experiment undertaken is unique because it takes place at two levels simultaneously. It is first of all a plan for treating a river as a living member of an ecological community; the community of Du Page County. In this context, flood control is a sub-system of a larger and more complex urban system. Secondly, while the plan develops, it unfolds into courses of actions moving towards the end of the plan. In essence, the plan is being implemented as it is being formulated.

To accomplish such an experiment, a policy framework must first be formulated. The policy framework used in the experiment was extracted from the Forest Preserve District's general land acquisition policies and the Regional Planning Commission's resources management policies. Together, the policies stress a concept of conservation of natural resources including improvement and maintenance of the quality of the land, air, and water resources. The resource base should be a principle determinant of the nature and extent of urban development. The policies stress that diversity is an essential ingredient in livability. Therefore, lands to be acquired by the Forest Preserve District include lands for watershed management to prevent flooding; for preservation of groundwater recharge areas; for isolation of flood prone lands that can be urbanized only at the price of ultimate disaster; for provision of surface storage and impoundments; and for water-oriented recreational opportunities. The preservation of natural wildlife, ecological and aesthetic values is explicit in the appeal that streams and other waterbodies, unique vegetation, and wildlife habitats be preserved in their natural states.

To make such broad policy statements operational, a more specific set of management standards needed to be formulated. These standards must provide specific guidelines for actions that will impact on water supply, water quality, and development and land use.

To illustrate the specific nature of the standards, those relating to development and land use are presented below. An effort was made to make these standards consistent with the court opinions discussed earlier.

1. All new developments shall provide for the containment of runoff from a 6-inch storm. Whenever practicable, release of the stored urban runoff shall be to a treatment facility.
2. All new developments shall provide for the recycling of the pollutants they generate or alternatively provide for confinements and containment of pollutants not recycled.
3. The channel capacity and storage capacity of all streams shall be preserved.
4. Wetlands and other natural areas of detention shall be preserved and, where possible, enhanced.
5. Stream sides shall be replanted and reforested to recreate, to the maximum extent possible, a natural state.
6. Hiking and bike trails, and other linear recreational uses shall be developed along watercourses; reasonable public access shall be provided.

The Results of the Experiment

An application of the policy set to the urbanized Salt Creek Basin produced some interesting results. Specifically, 15 acquisition areas were identified which comprise 3,497 acres with an estimated cost of $37,379,000. A breakdown of the resource values associated with each acquisition area is presented in Table 1. Table 2 tabulates a suggested cost allocation among the involved interests.

The Salt Creek plan is a most ambitious undertaking for Du Page County. However, the natural values inherent in the plan warrant the action. Contained within the 3,497 acres of land are 1,347 acres of floodplain, 431 acres of mature forest, 332 acres of wetlands, and 199 acres of surface water. With respect to floodwater storage, the plan preserves 4,920 acre-feet of natural storage and provides 1,840 acre-feet of reservoir storage. The total storage amounts to 6,760 acre-feet. Assuming an urbanized area value of $7,500 for an acre-foot of storage, the 6,760 acre-feet has a replacement value of $50,770,000.

The cost allocation presented in Table 2 breaks down in the following manner:

Forest Preserve District of Du Page County	26%
State/Federal	39%
Private Contributions	20%
Local/Miscellaneous	15%

The acceptability of the allocation is evident from the progress made in the implementation efforts. To date, more than $7,000,000 has been expended for the implementation of the plan—approximately 20 percent of the total.

Table 1. **Resource evaluation of forest preserve acquisitions in Salt Creek Basin, Du Page County.**

ACQUISITION AREA		WATER RESOURCE MANAGEMENT					WATER-ORIENTED RECREATION				LAND RESOURCES			URBAN. FORM		
Name	Total Area (acres)	Prime Natural Recharge	Wetland (acres)	Floodplain[a] of Record (acres)	Natural Floodwater Storage (acre-feet)	Flood[a] Storage Reservoir (acre-feet)	Shoreline (feet)	Lake Water Surface (acres)	Lake Fish Habitat Water Depth (feet)	Lake Fish Habitat Water Quality	Usable Sand & Gravel Deposits	Forest (acres)	Distinct Flora	Divides Urban Areas	Trail Linkages	Visual Relief (feet along highways)
Wood Dale/Itasca	600	yes	—	333	1,300	[b]	27,000	31[d]	15	good	yes	70	some oak	yes	yes	16,000
Medinah North	100	—	50	90	130	—	7,700	—	—	—	—	20	—	—	—	3,000
Roselle	500	—	—	10	50	—	3,000	—	—	—	—	—	—	yes	yes	34,000
Bloomingdale/ Roselle West	234	yes	30	130	400	640	13,000	30	50	good	yes	90	fine woodland	yes	yes	7,500
Bloomingdalê/ Roselle East	150	yes	—	90	300	1,100	24,000	81	20	good	yes	—	—	yes	yes	3,000
Itasca/Medinah	115	yes	—	70	450	—	10,000	—	—	—	yes	20	—	—	yes	6,800
Campbell Slough	675	—	70	—	—	—	—	—	—	—	—	—	good marsh	yes	—	23,000
Wood Dale Floodplain	—	—	—	6	40	—	4,800	—	—	—	—	6	—	—	yes	150
Addison/Lombard	300	yes	150	270	500	100	18,000	24	12	good	yes	5	good marsh	yes	yes	7,200
Addison Floodplain	20	yes	—	19	100	—	3,000	—	—	—	—	10	—	—	yes	500
Kingery West	190	yes	—	156	1,000	—	21,200	15	12	good	yes	20	—	yes	yes	9,600
Elmhurst/Villa Park	100	yes	—	80	350	—	21,000	—	—	—	—	50	—	yes	yes	6,000
Upper Sugar Creek	98	—	19	70	170	und.[c]	5,000	—	—	—	—	10	good marsh	—	yes	1,400
Hinsdale/Oak Brook	340	yes	13	17	100	—	12,800	18	und.[c]	good	-	80	-	yes	yes	16,000
Fullersburg Extension	75	yes	—	6	30	—	3'500	—	—	—	—	50	fine woodland	—	yes	3,000
TOTALS	3,497		332	1,347	4,920	1,840	174,000	199	109			431				137.150

[a]The floodplain of record is the area within the acquisition which was inundated by the August, 1972 flood of record. The natural floodwater storage is the maximum volume of flood water which was stored within the acquisition during the August, 1972 flood.
[b]Entirely dependent on future floodwater management in Cook County upstream.
[c]Und.—Undetermined at this time.
[d]The lake characteristics assume a major flood storage reservoir is not constructed.

Table 2. Suggested cost sharing for forest preserve acquisitions in Salt Creek Basin, Du Page County.

Acquisition Area Name	Acres	County	State[e] Conservation	State[e] Waterways	EPA	Townships	Private[f] Contribution	Miscellaneous[g]	Total
Wood Dale/Itasca	600	$1,500,000	—	—	$ 2,100,000	$200,000	$1,064,000	$1,000,000	$ 5,864,000
Medinah North	100	200,000	—	—	—	—	400,000	—	600,000
Roselle West	500	300,000	—	—	4,500,000	200,000	—	—	5,000,000
Bloomingdale/ Roselle West	234	1,150,000[a]	1,350,000	—	—	200,000	—	—	2,700,000
Bloomingdale/ Roselle East	150	1,000,000[b]	—	—	—	—	600,000	—	1,600,000
Itasca/Medinah	115	—	—	—	—	—	—	500,000	600,000
Campbell Slough	675	600,000	—	—	5,400,000	—	—	—	6,000,000
Wood Dale Floodplain	—	—	—	$500,000	—	—	—	—	500,000
Addison/Lombard	300	700,000	—	—	—	—	2,300,000	—	3,000,000
Addison Floodplain	20	120,000	—	—	—	—	80,000	—	200,000
Kingery West	190	3,500,000	—	615,000	—	200,000	—	—	4,315,000
Elmhurst/Villa Park	100	280,000	—	—	—	—	—	2,720,000	3,000,000
Upper Sugar Creek	98	300,000	—	—	—	—	—	700,000	1,000,000
Hinsdale/Oak Brook	340	[c]	—	—	—	—	[c]	—	[c]
Fullersburg Extension	75	—	—	—	—	—	3,000,000	—	3,000,000
TOTALS	3,497	$9,650,000[d]	$1,350,000	$1,115,000	$12,000,000	$800,000	$7,444,000	$5,020,000	$37,379,000

[a]$582,200 will be paid out over a 4 to 5 year period.
[b]This sum will be deferred until gravel is excavated from pit.
[c]No evaluation made of these lands; could continue as open space in the foreseeable future.
[d]When adjusted for the deferred payments, the County's share of the cost of the project amounts to $8,060,000; approximately the $8,000,000 the commissioners have pledged to be used in the Salt Creek Basin.
[e]Funds designated as State would include appropriate Federal participation.
[f]Private contributions take various forms ranging from gifts to dedication to easements to agreements to preserve open areas.
[g]Miscellaneous funds include Park District funds and other potential funds that have not been specifically identified.

Ingredients for Success

To live with a river in suburbia, a successful planning process is needed. (I am evaluating success in terms of fulfillment.) Such a successful process assumes certain characteristics. The first of these is *leadership*. Classical economic literature identifies this characteristic as entrepreneurship. Successful planning needs an entrepreneur. Although those who act as entrepreneurs open themselves to charges of elitism in planning, it must be recognized that leadership in planning is vital to the success of planning. In the Salt Creek basin, the Forest Preserve District provided leadership. In this capacity the District had to provide vision that saw beyond the immediate. By raising the sights of the people and describing the what-could-be, the District is meeting its obligation to the public that supports it. There cannot be a vision without a point of view. A public agency should not be in the position of the man who stood on a balcony watching a mob in the French Revolution and said to a fellow watcher: "I've got to go down there and see where the people are going because I'm their leader." Preparation of planning reports that can be used to support opposite positions certainly cannot be accepted as an appropriate means of expounding a vision.

Another characteristic of effective floodplain planning is *credibility*. Perhaps the erosion of confidence is our number one problem in America. Credibility in planning process can be assured by anchoring planning decisions firmly in established facts. A plan should reflect the natural environmental resources supporting it. Also, with each success story in terms of fulfillment, credibility increases. Careful planning and engineering has allowed the Forest Preserve District of Du Page County to succeed in many of its implementation efforts.

Still another characteristic of a successful planning process is *good coordination*. Too frequently, coordination means finding out what everyone else is planning to do and then tying all those other plans into a larger and usually more inefficient package. Successful planning requires a higher ordering, the conceptualizing of a framework within which parts can function well in relation to each other. If put in one word, the word is synthesis. Floodplains and the water moving onto and off them are among the greatest synthesizers in nature.

The best floodplain planning is characterized by the power to acquire land for public purposes as needed. Frequently, plans are criticized for failure to provide sites for critical public services: sanitary landfills, waste recycling facilities, space for stormwater management. It is in fact a rarity for a planning process to include the ability to acquire land; it is for this reason that many planning efforts fail.

Seed money, too, is a grossly neglected ingredient of planning. The old banker's saw that it takes money to make money applies somewhat to the planning process. The Forest Preserve District provided the seed money for Salt Creek when it earmarked $8,000,000 for the Basin. This has given the District a lever capable of prying loose funds for associated activities. Confidence in the whole enterprise is evidenced by the extent of participation by other interest groups—there is willingness to foot part of the bill.

This last observation brings me to the ingredient of *successful planning* that perhaps overshadows all the others in significance. I speak of the involvement of the private sector of the economy. Generally, planning is looked upon as a public activity, intended to regulate private interests in order to protect the public interest. Inherent in this view is the notion that public and private objectives cannot be identical. It neglects the basic truth that our society moves on the principle that private profit is desirable. "What is good for General Motors is good for the country" is, of course, an abused cliché. It attained its widest circulation during a period of time when many external costs were being left out of cost/benefit calculations. Currently, our country is involved in a widespread effort to identify and internalize all the costs of any given activity. Properly administered, the National Environmental Policy Act will assist in achievement of this goal. When external costs become internal costs, efficiency and the wise use of resources become imperatives of environmental systems whether the systems are developed by private or by public interests. Goals and aspirations of the public and private sectors of the society then merge, freeing the planner to abandon the old punitive regulatory philosophy and embrace a new philosophy of shared public and private pursuit of a common goal—living with a river in suburbia. Such a goal is being accomplished in the Salt Creek basin of Du Page County.

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Discussion

MR. RUEBEN JOHNSON [American Water Resources Association]: In traveling from DeKalb to Chicago, I noted that in a number of places around certain manufacturing plants, depressions had been placed. I was told these were for catching flood waters and that this was one means they were using in attempting to take care of some of the flood problems in that area. I did not hear you mention this in your talk and I was wondering, how widespread this was and whether or not it is effective?

MR. SHEAFFER: Well, that is a problem when you have a time constraint. I had mentioned it here in my paper, but had to skip over it. The policy we developed in relation to Salt Creek—well, let me read one of the statements in the Guidelines: "All new developments shall provide for the containment of run-off from a 6 inch storm. Whenever practicable, release of stored urban run-off shall be to a treatment facility." In other words, we are saying that you store the hundred year flood where it falls and because urban run-off tends to be polluted or, I should say, is polluted, we then call for the treatment of run-off.

These depressions that you are seeing, as a matter of fact, are becoming very effective. They store run-off from the site and, in many cases, are being used for multi purposes. Some of them, for example, have a permanent lake which serves as a heat exchange surface for the air conditioning system and some use them for water supplies in certain industrial processes. Therefore, on a general basis, they are working out very well.

DISCUSSION LEADER EISEL: Are there further questions? If not, this gives me an opportunity to ask one.

Jack, as you know, we have worked quite closely together for the past year and a half, therefore, let me ask you this—why doesn't the kind of thing that happened on Salt Creek happen in other areas? For example, as one drives across suburban Illinois one often finds the only natural areas left are very near stream corridors where we do have some natural vegetation. Yet, in many cases, we find we are also destroying this. Therefore, again, why isn't the type of thing that is happening on Salt Creek not happening in other areas?

MR. SHEAFFER: I feel it is leadership and leadership means the creation of a vision. I feel very strongly that the majority of the American public would like to have a better environment but they don't know how to get it and that is because those of us in this room don't really communicate it to them.

We have studied for many years as to what makes people willing to act and no matter what subject area we took, it always came down to efficacy. People had to feel they could be effective—that if they were going to embark on this kind of program, they were going to be successful and, further, success is related to a vision. People have to see what they are trying to accomplish and all too often our wildlife and our open space values are way out west where nobody lives, so people pretty much have given up the metropolitan areas.

However, if you can get a handful of people to say, "Look, this is what we can have—we can have green valleys and clean waters," you would be surprised how many people will come out of the woodwork to support such a program. However, you cannot get them to support a program when nothing has been formulated around which they can coalesce.

I have frequently said that you cannot organize around nothing and, therefore, when you have an urban area and there is nothing being presented as to what people can do, obviously they cannot organize around it and support it.

Leadership is the key—leadership presenting a vision which allows the area to organize and thus become willing to act.

Incorporating the Environmental Quality Dimension in Planning River Management

Gary L. Hickman
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The Federal Government's *Principles and Standards for Planning Water and Related Land Resources* set forth two national planning objectives: (1) National Economic Development, and (2) Environmental Quality. The Principles and Standards require that at least one Environmental Quality plan be formulated for each planning effort.

The National Environmental Quality Objective, as defined in the Principles and Standards, ". . . is enhanced by the management, conservation, preservation, creation, restoration or improvement of the quality of certain natural and cultural resources and ecosystems in the area under study and elsewhere in the nation. This objective reflects society's concern and emphasis for the natural environment and its maintenance and enhancement."

". . . the environmental objective reflects man's abiding concern with the quality of the natural physical—biological system in which all life is sustained."

The *Principles and Standards for Planning Water and Related Land Resources* requires the formulation of plans for *and* the evaluation of effects of alternative plans on the following Environmental Quality components:

A. Physical Land Resources
   1. Soil Stability
      As encompassed in the Environmental Quality Objective, land quality is enhanced by the prevention of erosion and restoration of eroded areas. Soil is valued as a basic national resource rather than its more traditional role as a primary production factor contributing to increases in national output.
   2. Geological Resources
      Includes caves, classic rock formations, classic stratigraphic rock section, minerals, palaeontological sites, and unique geological features such as natural bridges.

B. Air and Water Quality
   1. Air Quality Standards
   2. Water Quality Standards

C. Ecological Resources
   1. Terrestrial Ecosystems
   2. Aquatic Ecosystems
   3. Special Ecosystem Relationships and Irreversible Commitments of Ecological Resources
   4. Species Threatened with Extinction

D. Culturally Significant Resources
   1. Archeological Resources
   2. Historical Resources
   3. Areas of Natural Beauty

Plan Formulation

As a first cut in the plan formulation, a plan should be formulated for the *National Economic Development Objective* (NED). A separate plan should also be formulated for the *Environmental Quality Objective* (EQ) (Figure 1).

Complementary features of the opposing objective should be used in formulating both plans. For example, the EQ plan should have complementary NED features and the NED plan should have complementary EQ features. Once such an EQ plan and NED plan have been formulated, *then and only then* should mixed objective plan formulation, involving trade-offs between the two objectives, start. To collapse the planning process into mixed objective plan formulation from the beginning would not *give the decisionmaker any significant insight into the full range of potential alternative futures in terms of the two national planning objectives nor would it give the decisionmaker insight into the full range of trade-offs being made*. As the iterative planning process evolves, the NED and EQ plans may change some as additional information is generated and the understanding of problems and needs improves.

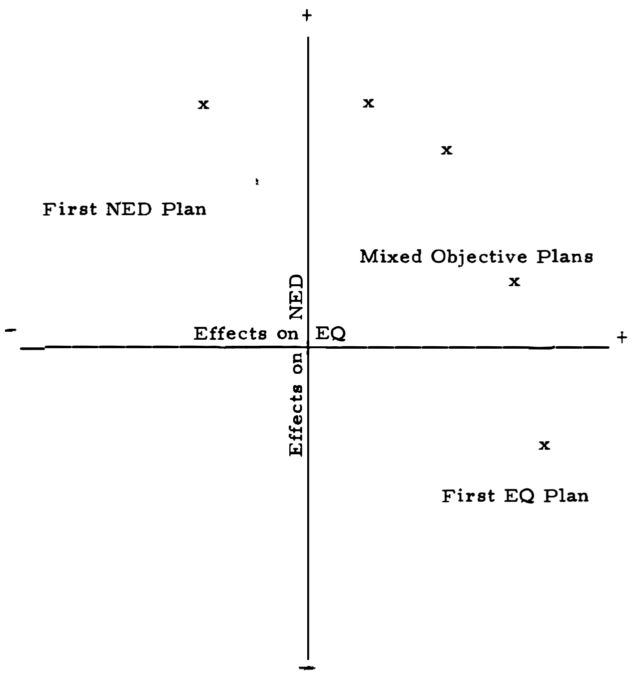

Figure 1. The formulation of alternative plans for National Economic Development and Environmental Quality.

Evaluation of Effects on Environmental Quality

The Principles and Standards also require the measurement of effects of each alternative water and land use plan on Environmental Quality, and the display of those effects in an EQ evaluation account (Figure 2).

Evaluation Accounts	Plans					
	NED		EQ		Mixed Objective Plans	
1. NED	B	A	B	A	B	A
2. EQ	+X	−X	+X	−X	+X	−X
3. RD						
4. SWB						

B: Beneficial effects of an alternative plan on each of the four evaluation accounts.

A: Adverse effects of an alternative plan on each of the four evaluation accounts.

NED Evaluation Account: Effects are measured only in monetary terms. The NED beneficial effects are the increases of the value of the output of goods and services and improvements in national economic efficiency. The adverse effects on NED are the economic value that these resources would have in their alternative uses—of course, the capitalization principle would apply on the measurement of NED adverse effects.

EQ Evaluation Account: Effects are increased only in quantitative, qualitative, nonmarket and nonmonetary terms. The effects are displayed as contributions to OR degradation of certain natural and cultural resources and ecosystems.

Regional Development Evaluation Account (RD): Effects are measured in both monetary and nonmonetary terms. The effects would be measured on a region's income, employment, population, economic base, regional aspects of the environment, and other factors.

Social Well-Being Evaluation Account (SWB): Effects are measured in both monetary and nonmonetary terms. The effects would be measured on income distribution, security of life, health and safety, opportunities for education, culture and recreation, emergency preparedness, and others.

Figure 2. A system of evaluation accounts displaying the effects of alternative plans on NED, EQ, RD, and SWB.

These effects on environmental quality are characterized by their nonmarket, nonmonetary nature, and they provide important evidence for judging the value of proposed plans. Beneficial effects displayed in the EQ evaluation account are contributions resulting from the management, preservation or restoration of one or more of the environmental quality components in a planning area or elsewhere in the nation. Adverse environmental effects—generally the obverse of beneficial environmental effects—are consequences of the proposed plan that result in the deterioration of relevant environmental characteristics of an area under study or elsewhere in the nation, for example, reductions in acres of open and green space, wilderness areas, estuaries, or wildlife habitat inundated or altered, or of lands experiencing increased erosion. Such adverse effects generally detract from or diminish the quality of life.

The measurement of Environmental Quality effects does not include human environmental factors such as the reduction in flooding of the human environment. These are benefits measured in dollars and shown under the NED account, or in other terms, under the SWB (Social Well-Being) account. In planning water and related land resources, beneficial and adverse effects of a proposed plan should be measured by comparing the estimated conditions resulting from the plan with the conditions expected without the plan. Thus, in addition to projecting the beneficial and adverse effects expected with the plan in operation, it is necessary to project the conditions likely to occur in the absence of a plan. Economic, social, and environmental conditions are not static, and changes will occur even without a plan. The projected future without-plan annalysis calculates the effects of future land use changes, human activities, plan community successions and aquatic ecosystem trophic succession on Environmental Quality components over the period of analysis. Only the new or additional changes that can be anticipated as a result of a proposed plan should be attributed as beneficial and adverse effects of the plan (Figure 3).

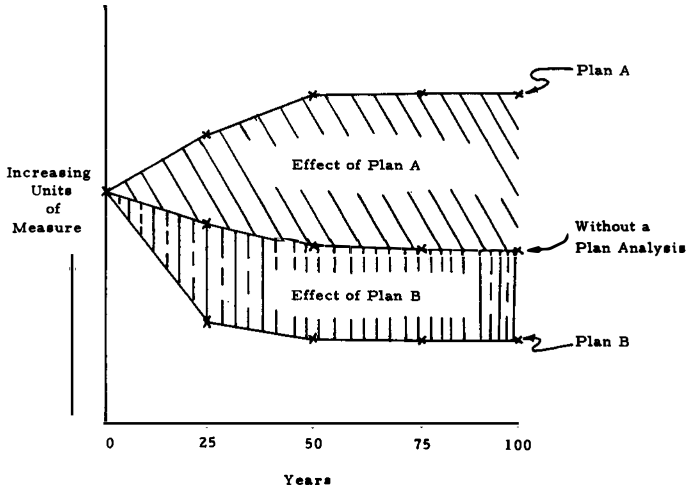

Figure 3. The with and without plan basis for measurement of effects of alternative plans on Environmental Quality.

An example of an Environmental Quality component evaluation procedure for ecological resources has been jointly developed by the U. S. Fish and Wildlife Service, the 50 state fish and wildlife agencies and private conservation organizations. Under these procedures, a common denominator called "Habitat Units" (HU) is recognized as the measuring standard for the terrestrial and aquatic ecosystems. Habitat units reflect the value of each habitat-type on a scale of 1 to 10 per acre for the full range of fish and wildlife. The effects of any proposed action can be evaluated in terms of habitat units lost or gained for the terrestrial ecosystem, based on projected habitat units over the period of analysis without the plan. A separate analysis is made of the aquatic ecosystem. During a field test in Northeastern Kansas, a comparison was made between alternative plans in terms of habitat units lost or gained (Figure 4).

For mitigation and compensation purposes, the total net effects have been annualized to show precisely the effort required on an annual basis to offset the adverse effect on the displaced resources, if any.

HABITAT UNIT SUMMARY COMPARISON TABLE

Planning Area Onaga Dam & Reservoir, Kansas

Date 4/19/74
Summarized by Joint Committee
Terrestrial [x]
Aquatic

Habitat Component by Alternative Plans	Effect of Plan			Compensation of Mitigation Area				
	Acreage	Net Habitat Unit Loss or Gain	Annualized Habitat Unit Loss or Gain	Acreage Proposed	*Mitigation Potential (Habitat Units/Acre)	Total Compensation Needed in Area	Percent of Loss Mitigated	Acres by Component Needed For Full Compensation
	(1)	(1a)	(2)	(3)	(4)	(5)	(6)	(7)
Alternative Plan A-NED								
Forestlands	4,277	- 1,539,850	- 15,399					
Croplands	7,700	- 2,917,563	- 29,176					
Brome Pasture	1 167	- 185.875	- 1.859					
Native Prairie	8.151	- 651.663	- 6.517					
Rivers & Streams	117	- 41,025	- 410					
** Total	21,412	- 5,335,976	- 53,361	12,426	3.2	16,675	75%	4,249
Alternative Plan B-EQ								
Forestlands	12,662	+ 3,681.265	+ 36.813					
Croplands	14,779	+ 2,982,300	+ 29,823					
Brome Pasture	0	- 881.600	- 8.816					
Native Prairie	32,[illegible]98	+ 7,348,325	+ 73,483					
Rivers & Streams	193	+ 9.600	+ 96					
** Total	59,732	+ 13,139,890	+ 131,399					
Alternative Plan C-EQ								
Forestlands	4.277	+ 256.600	+ 2.566					
Croplands	6,819	+ 1,390.300	+ 13.903					
Brome Pasture	0	- 525 200	- 5 252					
Native Prairie	10,199	+ 2,529,725	+ 25,297					
Rivers & Streams	117	+ 5,900	+ 59					
** Total	21,412	+ 3,657,325	+ 36,573					
Alternative Plan D-Mixed-Objective								
Forestlands	4,096	- 1,415,750	- 14,158					
Croplands	7,313	- 2,629,063	- 26,291					
Brome Prairie	441	- 99.075	- 991					
Native Prairie	9,455	- 205,138	+ 2,051					
Rivers & Streams	107	- 38,500	- 385					
**Total	21,412	- 3.977.250	- 39,773	12,426	3.2	12,426	100%	

*Potential mitigation value per acre is the difference between the existing value and the value of 10 (increased value possible through management).

**The component habitat unit values are only additive for the calculation of mitigation needs when one of the following conditions exists: (1) An exception to the General Policy of mitigation in-kind or (2) The frequency distribution of habitat components in the lands proposed for mitigation purposes are comparable to those in the project area where the losses occurred.

Figure 4. A display of the effects of alternative plans on terrestrial ecosystems.

To compensate for terrestrial habitat losses requires an increase in the habitat carrying capacity of a like kind of habitat (compared to that lost) to offset all habitat units lost. The existing habitat production on lands proposed for mitigation or compensation does not offset any of the calculated losses, because it would be there without the project. It is the additional increment in habitat carrying capacity that can be added to the existing that offsets the losses on a habitat unit by unit basis.

In this field test example, the proposed lands for compensation of the habitat unit losses occurring in Plans A and D had an existing value of 6.8 HU/acre. The maximum value in terms of HU/acre is 10. Therefore, the maximum number of HU that the proposed mitigation lands can be raised is 3.2 HU/acre. The total acreage needed to fully compensate for the HU loss in Plan A can be calculated by dividing the total HU loss by the potential habitat management increment (3.2 HU) on the proposed lands for mitigation or compensation. Plan A would require 16,675 acres of the proposed land for mitigation to fully compensate for all terrestrial losses caused by Plan A *and* 12,426 acres to fully compensate for all terrestrial losses caused by Plan D.

This same evaluation concept and procedure is used for the aquatic ecosystem (Figure 5).

In addition to this display of HU lost or gained, a narrative treatment will be made on special ecosystem relationships and irreversible commitments of ecological resources, and species of animals or plants threatened with extinction.

Public Participation

Public and interagency participation in the planning process is paramount in incorporating the Environmental Quality dimension in planning river management. In general, the public and interested governmental agencies should be notified immediately upon the initiation of each planning effort. The planning process under the Principles and Standards as well as the mechanics of public participation during the planning process should be explained. It is my view that the lead planning agency should secure commitments for resource inventory and capability evaluation from the interested public and agencies for each of the EQ component areas. The findings for each of the component areas should be available before any alternative plans are formulated.

As a minimum, a citizen advisory committee (CAC) or some equivalent group should be organized with representation equally divided and co-chaired between the two national planning objectives (NED and EQ). The CAC should be appointed before any alternative plans are formulated. The CAC should function as a communication link in public participation, *not* a substitute for it.

With the participation of the CAC and interested agencies, an optimized plan should be formulated and evaluated for the EQ and NED objectives, respectively. Outlines of mixed objective plans reflecting trade-offs between the optimized NED and EQ plans should be developed and presented for public review and comment.

The CAC and interested agencies should participate in the formulation and evaluation of the mixed objective plans. A recommended plan should be tentatively selected. All plans, including the recommended plan, should be presented to the public for their review and comment. All plans should be presented for

HABITAT UNIT SUMMARY COMPARISON TABLE

Planning Area Onaga Dam & Reservoir, Kansas

Date 4/19/74
Summarized by Joint Committee
Terrestrial
Aquatic [x]

Habitat Component by Alternative Plans	Effect of Plan: Acreage	Effect of Plan: Net Habitat Unit Loss or Gain	Effect of Plan: Annualized Habitat Unit Loss or Gain	Compensation or Mitigation Area: Acreage Proposed	*Mitigation Potential (Habitat Units/Acre)	Total Compensation Needed in Area	Percent of Loss Mitigated	Acres by Component Needed For Full Compensation
	(1)	(1a)	(2)	(3)	(4)	(5)	(6)	(7)
Alternative Plan A-NED								
Channelized	14.2	+ 710.0	+ 14.2					
Unchannelized	67.9	- 26,240	- 262.4	48.3	4.3	61.0	79%	12.7
Tributaries	136.2	- 8,880	- 88.8	19.3	4.6	19.3	100%	-
Reservior	5,320.0	+ 2,061,600	+ 20,616.0					
Farm Pond	1.0	- 100	- 1.0	-	-	-	-	-
Total*	219.3							
Alternative Plan B-EQ								
Channelized	14.2	+ 425.0	+ 8.5					
Unchannelized	67.9	+ 4,495	+ 44.9					
Tributaries	136.2	+ 6,810	+ 68.1					
Farm Ponds	127.0	+ 6,350	+ 63.5					
**Total	345.3							
Alternative Plan C-EQ								
Channelized	14.2	+ 425	+ 8.5					
Unchannelized	67.9	+ 4,495	+ 44.9					
Tributaries	136.2	+ 6,810	+ 68.1					
Farm Ponds	1.0	+ 50	+ 0.5					
**Total	219.3							
Alternative Plan D-Mixed								
Channelized	14.2	+ 710	+ 14.2					
Unchannelized	67.9	- 20,780	- 207.8	48.3	4.3	48.3	100%	-
Tributaries	136.2	+ 1,120	+ 11.2					
Reservoir	6,320.0	+ 2,516,870	+ 25,169.0					
Farm Ponds	1.0	- 100	- 1.0	-	-	-	-	-
Total*	219.3							

*Potential mitigation value per acre is the difference between the existing value and the value of 10 (increased value possible through management).

**The component habitat unit values are only additive for the calculation of mitigation needs when one of the following conditions exist: (1) An exception to the General Policy of mitigation in-kind or (2) The frequency distribution of habitat components in the lands proposed for mitigation purposes are comparable to those in the project area where the losses occurred.

*** Does not include reservoir acreage.

Figure 5. A display of the effects of alternative plans on the aquatic ecosystem.

consideration along with the recommended plan at all levels of the decisionmaking process, including final consideration by Congress where it is appropriate.

Value of EQ evaluation account

What does a detailed evaluation procedure such as the one described mean to the people interested in environmental quality in water and related land use planning?

A. *It Aids in the Scoping and Formulating of Alternative Plans*: The resulting displays in an EQ evaluation account provide a barometer of the beneficial and adverse effects of each alternative plan on the natural environment. This will specifically help at Step No. 5 in the plan formulation process where the planner is to review and reconsider, if necessary, the specified components for the planning area and the formulation of additional alternative plans as appropriate or the modification of the alternative plans already formulated.

B. *Compares Alternative Plans*: The evaluation accounts will display the full range of trade-offs within and between alternative plans. This will:
   1. Allow the public to make a more informed choice or expression of preference.
   2. Provide a better frame of reference for the decisionmakers in the selection of a recommended plan or for Congressional authorization of an alternative plan.
   3. Document tradeoffs made in plan selection and authorization.

C. *Develops Data Needed for Environmental Impact Statement.*

Conclusion

The *Principles and Standards for Planning Water and Related Land Resources* offer an unprecedented opportunity for the incorporation of the Environmental Quality dimension in planning for the management of our nation's rivers. The environmental community should be prepared to meet this challenge in a positive manner, lest it fall by the wayside as exemplified by the treatment of Environmental Quality after the issuance of Senate Document 97.

Discussion

MISS SHARON SAARI [Virginia]: You equated cropland with rivers and streams. Did you make any attempt to weight one value versus another?

MR. HICKMAN: The weighting takes place during the basic evaluation. The forms I displayed were the last of the six forms that are necessary to identify the value of each habitat type by sampling nine differenct species in groups across the wildlife spectrum, not giving any particular weighting to any species group. There are, for example, five game and four non-game. That is the way the value of each habitat-type is set up. Generally, the habitat-types are additive at the end. It is hard to visualize the total evaluation process unless you go through all six forms and to do this would take about eight hours.

MR. CHARLES NEWLING [Southern Illinois University]: I can't see how your system here can apply in any situation, but let's suppose we have a situation of some unique species, say a wintering ground for migratory waterfowl where you want to channelize the river running through this area. You may have ten times the amount of land area available, but, the area we want to use, for example, is the only area that can be used for that particular wildlife resource. Now, in relation to this example, does your system enable you to pick out this area as being unique and thus, through legal means, insure that the area would be saved?

MR. HICKMAN: I mentioned right at the beginning that the habitat unit system involves a narrative description of unique things—special ecosystems relationships, irreversible commitment of resources and endangered species. As far as the particular example of waterfowl wintering areas is concerned, most of these would come under the Environmental Quality aspect of the Regional Development Account because, generally speaking, it is an inter-regional transfer. However, as I understand your question, you are really speaking about some unique feature that we need to treat. On that basis, it would be narratively treated and, insofar as compensation is concerned, it would probably be treated in the capacity of a like kind of area compensation requirement.

I hope I have answered your question. At least that is the best I can do at this point.

MR. LOUIS CLAPPER: [National Wildlife Federation]: Could you explain something about the upcoming hearings that the Water Resources Council is having on the Section 80 study and the threat of perhaps losing some of the environmental quality factors?

MR. HICKMAN: The hearings were concluded a week or two ago. I think it might be more appropriate to address the question to the gentleman following me, who represents the Department of the Army.

MR. ROLLIN SPARROWE: [Missouri Wildlife Research Unit]: I would like to know what you mean by saying that the environmental community should be ready to give a positive response to the Principles and Standards?

MR. HICKMAN: I think that the Principles and Standards offer an unprecedented opportunity for public involvement in the public planning process itself. In the past, a lot of the environmental community has said "No," because, in essence, there was only one plan offered. However, the Principles and Standards offer an unprecedented opportunity for public involvement in the public planning process. In the past, a lot of the environmental community has said "No," because in essence, there was only one plan offered. However, the Principles and Standards require the formulation of NED and EQ plans plus mixed objective plans. In other words, the environmental community should be able to opt for one of the alternative plans and they should support whichever one they want, but, on the other hand, they also should be willing to make some trade-offs in mixed objective plans during the planning process.

MR. SPARROWE: What I am getting at is that the Habitat Unit System has the potential for being applied to every water resource project in the country, involving every state fish and game agency, Fish and Wildlife Service and various water development agencies. In other words, the procedures that you have outlined can have a profound influence on water resource planning and developments.

MR. HICKMAN: Let me say that these are the procedures of the Fish and Wildlife Service and the State Fish and Wildflife agencies at this point. They are being taken over to the Water Resources Council for consideration by other member agencies.

COL. JOHN WALL [Corps of Engineers]: I want to congratulate you for your very fine presentation. I don't really have a question, but I thought it might be of interest to indicate that the Corps of Engineers and the Fish and Wildlife Service are meeting on how to define mitigation and how to deal with mitigation of fish and wildlife project induced losses. I think that the methodology you have suggested does have some application and we are going to consider it very seriously in evaluating the effects of alternative plans that we in the Corps will be formulating in relation to water resources planning and development.

Also, there is one other point that I would like to make and that is I believe if you mitigate, you have to mitigate fish and wildlife loss before you have gone too far. Therefore, I would suscribe to what the gentleman before me said—we want to use this early in the planning process. That is where we need to get the environmental quality highly visible, so that we can make these trade-offs.

Effect of New Legislation on Management of River Systems

Charles R. Ford
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There are several new laws pertaining to water resources planning and development which will have a major impact on the management of river systems. The Water Resources Development Act of 1974 (P.L. 93-251) contains several important provisions; the most promising is Section 73 which reflects the endorsement by the Congress of non-traditional consideration in flood-related planning. The 93d Congress took corollary actions having the same philosophy and objectives in the Flood Disaster Protection Act of 1973 (P.L. 93-234) amending the National Flood Insurance Act; the Disaster Relief Act Amendments of 1974 (P.L. 93-288); and the Housing and Community Development Act of 1974 (P.L. 93-383). Several provisions of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) may also prove to be important in the management of flood plains.

These laws give the Federal agencies charged with water resources planning new and improved authorities for the accomplishment of multiple purposes with multiple means. As a result, the public can look forward to improved approaches to planning for the management, conservation and best use of the Nation's natural resources

A brief summary is given of the parts of these acts relevant to adjustments to flood hazards as component actions in improving the management of river systems, of particular importance in urbanizing areas. Opportunities afforded for improving the urban environment, preserving green space and wetlands, and conserving and enhancing wildlife are also summarized.

Participation by non-Federal governments and agencies, private organizations, and conservation interests in the planning and support of sound management programs for river systems will be important in achieving full and timely implementation of the intent of the laws. The current Federal effort in implementation of the new authorities is progressing and the public will be further involved in developing the necessary guidelines.

Summary of New Legislation

Water Resources Development Act of 1974 (P.L. 93-251)

Section 73(a) requires that any Federal agency planning projects involving flood protection shall consider non-structural alternatives in determining the economically, socially, and environmentally acceptable means of reducing or preventing flood damages. Alternative non-structural measures considered may include, but not be limited to, flood-proofing of structures, flood plain regulation, relocation, and acquisition of flood plain lands for recreational, fish and wildlife, and other public purposes. Innovative ideas such as replacement of storage and infiltration capacity lost to pavements and buildings, and use of small impoundments for storm runoff on parking lots, athletic fields, and rooftops will be important in preventing increased runoff and new flood problems associated with new urban developments.

Section 73(b) provides that non-Federal participation in the costs of recommended non-structural alternatives shall be comparable to the value of lands, easements, and rights-of-way which would have been required for a local-protection-type project, but not to exceed 20 percent of the project costs. This is interpreted to mean not to exceed 20 percent of the total costs of non-structural measures included in the plan.

Section 84 approves a project for flood protection on Four Mile Run in the suburbs of Washington, D.C. Of particular interest is paragraph (b) (7) of that Section which provides that local interests shall agree to develop a land management process for the entire watershed to insure that future development in the basin will not result in increased runoff which would impair the effectiveness of the flood control improvement. Similar provisions could become standard requirements of local cooperation in local-protection flood control projects.

Flood Disaster Protection Act of 1973 (Public Law 93-234)

Section 102(a) of the act requires the purchase of flood insurance, in communities where such insurance is available, in connection with receiving any form of Federal "financial assistance for acquisition or construction purposes" for use in any area that has been identified by the Secretary of the Department of Housing and Urban Development as having special flood hazards.

Section 102(b) of the act directs each "Federal instrumentality responsible for the supervision, approval, regulation, or insuring of banks, savings and loan associations, or similar institutions" to issue regulations requiring that persons receiving mortgage loans must also purchase Federal flood insurance if the property securing the loan is to be located within an identified special flood hazard area of a community where flood insurance is available.

Section 201 of the Act requires the Secretary of the Department of Housing and Urban Development to notify all known flood-prone communities of their identification as such, and to give them an opportunity either to enter the flood insurance program or to establish that they are not flood-prone. The Secretary has the option of holding a public hearing where conflicting data exist, but his determination in the matter is final, subject only to judicial review under title 5, Chapter 7, U. S. Code.

As information becomes available to the Secretary concerning other flood-prone communities, he will notify them of their condition and give them a similar opportunity to refute his initial determination. However, once the Secretary has made a final determination, flood-prone communities are expected to enter the National Flood Insurance Program by July 1, 1975, or within one year after notification, whichever is later; or else they will be subject to sanctions.

Section 202 of the Act sets out these sanctions. Its purpose and effect is to deny both Federal financial assistance for acquisition or construction purposes and Federally-related financing by private lending institutions for use in areas identified by the Secretary as having special flood hazards, unless the community in which the area is located is by then participating in the national flood insurance program.

Disaster Relief Act Amendments of 1974 (Public Law 93-288)

Section 314 of the 1974 Disaster Relief Act also adopted the concept of sanctions in requiring that "to the extent it is reasonably available, insurance must be obtained that is adequate to protect against future loss, any disaster-damaged property which has been replaced, restored, repaired or constructed with Federal funds under the disaster relief law. Moreover, unless such insurance is secured, no applicant for Federal assistance can receive aid for any damage to his property in future major disasters."

Housing and Community Development Act of 1974 (Public Law 93-383)

Section 816 amended the Flood Insurance Act and requires that all institutions providing Federally insured loans and other financial instruments for property in special flood hazard areas, as defined under P.L. 93-234, notify purchasers of the hazards. It also provides that eligibility for subsidized flood insurance should ensue on the construction of a flood protection system that will afford protection for the 100-year frequency flood.

Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500)

Section 201 lays out the purpose of the Act and encourages the recycling of pollutants through the production of agriculture or other products, and waste treatment management which combines "open space" and recreational considerations. Section 212 defines the terms used in the Act. The definition of "treatment works" in paragraph (2) (A) includes ". . . site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment."

This authority, combined with the authorities of Section 73 of P.L. 93-251 for flood plain regulations and acquisition of flood plain lands for recreational, fish and wildlife, and other public purposes, could become powerful tools for an integral approach to waste treatment and flood problems.

Past Consideration of Non-Structural Measures

Since 1961, the Corps of Engineers' planning manuals have provided that consideration be given to a full range of alternative adjustments to flood hazards, such as flood plain regulations and evacuation, in addition to the usual flood-modifying structural works. As a result, planners began to consider such alternatives, which has culminated in recommendations for several projects featuring non-structural approaches. Prairie du Chien, Wisconsin featuring evacuation of the flood plain and relocation in flood-free areas, and the Charles River, Massachusetts plan to preserve natural storage areas are examples. The process has been slow, however, with little tangible result. A more successful approach could have been realized by eliminating or reducing arbitrary variations in cost sharing for different types of flood-hazard adjustment measures. Under past cost sharing policies, which require local interests to bear the cost burden of non-structural measures, they have had a strong incentive to choose the measures that will cost them the least, regardless of whether those measures made the greatest contribution to sound flood plain use. Cost sharing policy problems with regard to implementation of Section 73 will be discussed later.

Section 206 of the 1960 Flood Control Act, as amended, authorized the Corps of Engineers to make flood-plain hazard information available to local communities upon request. The Soil Conservation Service performs a similar task under Section 6 of Public Law 83-566, and the Tennessee Valley Authority and the United States Geological Survey under their organic Acts. Other agencies also furnish related services under their special authorities.

The Corps of Engineers has completed about 1,000 flood-plain information reports which affect about 3,000 communities. These reports and those of other agencies have been instrumental in a number of states and communities adopting flood plain regulation ordinances. A problem with these programs, however, is that by responding to individual community requests, they concentrate on parts rather than whole watersheds or river basins.

Implementation of Section 73

Planning Policy

The policy in Section 73 applies to any Federal agency that surveys, plans, or designs any project involving flood protection. The principal agencies involved are the Corps of Engineers, Soil Conservation Service, and Tennessee Valley Authority, but other agencies will be involved as their plans affect flood plains. Accordingly, the Water Resources Council is developing planning procedures under the general policy of Section 73 that can be applied consistently by all agencies. In the interim, under an agreement between the Water Resources Council and the Office of Management and Budget, the agencies are proceeding to develop their flood-protection plans incorporating non-structural alternatives on a case-by-case basis. The Corps of Engineers has also adopted evaluation criteria which requires that projections of future development of flood plains will be based on the requirements of eligibility for Federal flood insurance. And, of course, impact assessments will observe the requirements of the Water Resources Council's Principles and Standards and the requirements and objectives of the National Environmental Policy Act.

It is well known that drainage and stream modifications upstream have a definite hydrologic effect downstream. Ideally, then, flood-related planning in a major drainage area should take into consideration the future use of the land within the whole area and adjust the required river basin management techniques to accommodate the planned use. To test this concept of river basin management, the Corps of Engineers has initiated a "pilot" study in the Upper Oconee River Basin in Georgia. Issues to be addressed in the study include the economic and environmental consequences of flood plain use, and the hydrologic and sedimentation impact on the flood plain from developments in the drainage basin. Specific attention will be given to wetlands, species of flora and fauna, and eco-systems. The information gained should provide a better planning framework for considering the dynamics of flood plain use and adjustments to flooding. Other research and demonstration work will, of course, be needed to fully develop implementation procedures for the Section 73 policies.

Regulation of flood plains has not been widely resorted to in the past and cannot be completely effective unless reinforced by a land management plan for the entire watershed, such as that specified in Section 84 of P.L. 93-251 for the flood-control project on Four Mile Run. These requirements could be made a standard requirement of local cooperation as a condition for Federal participation. A problem in requiring non-Federal entities to regulate flood plain use and manage land use has been how to insure that promises to carry out these requirements would be kept over the years, since the Federal Government has no clear jurisdiction in land-use control. The new flood insurance requirements for eligibility for Federal programs may be a solution to the problem. The propriety of sanctions as recognized in these new Federal policies will be considered in the implementation of Section 73. In addition, Section 221 of the Flood Control Act of 1970 (P.L. 91-611) provides a powerful legal tool for follow-up where local project sponsors fail to keep their agreements. Section 221 requires that no Corps of Engineers project shall be commenced until a legally responsible non-Federal agency has entered into an agreement, which is enforcible in the appropriate district court of the United States, to furnish the required cooperation for the project. This can be construed to cover such requirements as flood plain regulation, land management plans and other land use adjustments as may be appropriate and required for proposed projects.

In summary, the Federal agencies are proceeding with implementation in planning studies of Section 73, but further work and research is needed to fully develop and articulate procedures deriving from its intent and policies.

Cost-Sharing Policy

Prior to enactment of Section 73, the Federal share in local flood-protection situations has been limited to those that provide structures to confine and control flood waters, with local interests providing the lands and operation responsibilities. When non-structural measures were included, the costs were considered a local responsibility. Under past policy, the local choice—not usually discouraged by the Federal agencies—almost invariably was the plan that minimized local financial obligations, which meant Federal structures rather than hazard adjustment. Impartial treatment of flood damage reduction measures, whether structural or non-structural, will permit Federal programs to resolve flood problems so that the current trend of ever-increasing flood damage can be reversed.

On the other hand, the Federal agencies are concerned with a sound interpretation of the cost-sharing formula in Section 73. Methods of estimating costs of flood plain regulation and procedures for monitoring the installation and maintenance of flood proofing measures are examples of detailed issues that will require resolution before the Section 73 cost-sharing can be implemented.

Section 80(c) of the Water Resources Development Act of 1974 requested that the President make a full and complete investigation of, among other things, the appropriate Federal and non-Federal cost-sharing for water resources projects. The President assigned responsibility to the Water Resources Council for the study, which was begun last month. In the meantime, the Federal agencies will continue their planning studies and take up interim questions with the Office of Management and Budget on a case-by-case basis.

Opportunities Offered by the New Authorities

Section 73 is a landmark piece of legislation. It is a broad authority providing a complete array of tools for a brand new approach to the management of flood waters and flood-prone lands. When taken in concert with the corollary actions of the 93d Congress, and other recent legislation, it opens the way for achieving a cooperative planning process which will produce realistic plans for solving regional water resource problems, and will have the potential to solve other related urban and rural problems. The trend will be toward solution of multiple problems with multiple means. The Senate Report 93-615, with regard to Section 73, stated, "This is one of the most important provisions in the bill, directing as it does, that a new approach to solving flood problems be undertaken on a broad front. It will encourage the wise use of flood-prone lands, the preservation of open space and the preservation and enhancement of the environment."

With the recognition in law of the value of natural storage and of on-site storage in new developments, new and greater attention will be focused on the preservation and creation of wetlands in the upper reaches of drainage basins and in areas off the flood plain. Properly planned, this trend can provide tremendous opportunities for wildlife preservation and enhancement. This impetus is strongly reinforced by the recently adopted evaluation Principles and Standards which require that environmental factors be given equal consideration with economic factors in planning for water and related land resources.

The authorities in P.L. 92-500 regarding the acquisition of sites for the land-treatment process for wastewater, when combined with the authorities of Section 73, offer an outstanding opportunity for multiple uses of flood plains while preserving green space and providing recreational opportunities. Why not use our flood plains in urban areas for crop production, golf courses, forests, and other uses which can capitalize on the nutrients in our wastewater and provide tertiary waste treatment at the same time? Such land-treatment sites can be located on the higher areas of the flood plains, but they can also be designed to store flood water when necessary without permitting the release of the stored water except through the soil filtration process.

These are but a few of the opportunities that are now readily apparent. An informed and alert citizenry working in cooperation with their elected officials, governmental agencies, and project sponsors will certainly discover many more through diligent scrutiny of the legislation as we enter into the implementation phase of these new laws.

Conclusion

The Congress has taken some bold steps which have provided new opportunities for improving management of river systems and have thrust Federal programs toward a new concept in resource management. Fragmented authority at the Federal and local levels will continue to be a problem, but a far greater problem are the fragmented concepts in resource planning. The fact should be recognized that we must live with all the consequences of our actions which effect the resources within our environmental system. Then we can approach "problems" such as flood plains, flood waters, pollutants, and new urban development as potential resources, which, given proper management, can work for the betterment of the environmental system.

Another serious problem which organizations represented at this conference can help resolve is the time perspective between planning and plan implementation. In areas which are rapidly urbanizing, the opportunities for keeping options open are often foreclosed before the cumbersome planning process of Federal agencies can reach the implementation stage. This is often the case in preserving natural wetlands and in coordinating the separate plans for flood control, highways, waste treatment systems, and new residential and industrial development. By working cooperatively with local governments and elected officials, in light of the new authorities discussed here, and by early and active participation in the planning process, citizen organizations can help preserve these options. On the other hand, Federal agencies must find ways to shorten the planning process and focus early on the opportunities for multiple-purpose solutions to regional problems.

Discussion

DISCUSSION LEADER EISEL: Maybe I can take the prerogative here and ask the first question. When can we expect some kind of final policy under Section No. 73?

MR. FORD: I have no way of answering the question as to when we will get a final determination, but the Section 80 study which is now underway is expected to be completed by the first of June. At that time the Water Resources Council will transmit it to the President with the Council recommendation and thereafter the President will transmit it to the Congress. That study should include in it procedures for cost sharing under the new authority in Section 73.

I would expect, assuming that the President forwards the recommendations directly on to Congress, we should have a final disposition on this by the Fall, when and if a new water resources bill comes out.

MR. JACK SHEAFFER [Chicago]: Public law 92-500 redefined navigable waters. I think it indicates that navigable waters were all waters in the United States including the coastal waters. Since the Secretary of the Army has had a lot of jurisdiction over navigable waters, does this mean there is going to be a new program that will help us implement these laws throughout the land, or what does it mean?

MR. FORD: We are not sure just what it means as yet. As you probably know, there have been a series of court actions beginning in 1970 that require the Army, acting through the Corps of Engineers, to no longer limit its review of permits to the construction of navigation. It required a broadened review—to look at the full impact of the over-all public interest, including economic, social and environmental impacts. At the same time, the courts, through another series of decisions, were extending the definition of navigability from the traditional coastal waters concept to one that included any water that has been, is now or will be subject in the future to reasonable improvement for commercial navigation. This was rather a broad extension.

Section 404 of the Water Pollution Control Act gave the Secretary of the Army the added authority of permitting filling and dredging and the Administrator of the EPA had authority to select sites for disposal in navigable waters. However, in the definition of navigable waters, it defined navigable waters as the waters of the United States, which includes all waters, including Beaver Dam. The question now before the Federal Government is whether or not to extend its pool of public interest into covering all water resources. This will involve quite a controversial step, so that issue is under discussion right now with the Department of Justice, the EPA, and the Office of Management and Budget. We cannot at this time say which way it is going to go.

MR. SPARROWE [Missouri]: Is it fair to say, based on some of the changes occurring in these laws, the impact of the National Environmental Policy Act, and some of the precedents set by things such as the Four Mile Project and also the new potential ecological evaluation procedure that Mr. Hickman was describing, that essentially we are going to have to take a new approach to planning with even the existing authorized projects or are they going to be exempted?

MR. FORD: Well, these different laws have different grandfathering aspects. The principles and standards have a rather elaborate grandfathering aspect. Now, we don't go back and start over on all projects under construction, so my guess would be, no, we will not go back and start over again on all of the projects under construction.

MR. SPARROWE: The projects under construction would fall under a different category, but I believe we were informed last year that the Corps of Engineers had fifty thousand authorized projects and most of these are not currently under construction. Therefore, at what point do we reasonably draw the line to say "these we will reconsider and these we will not"—because we seem to have a whole new ballgame with regard to legal restrictions, which now point to the development of flood plains and to construction of flood plain projects?

MR. FORD: I think on any project on which the planning is not completed, the new laws and authorities will apply.

MR. PAUL EASTMAN [Interstate Commission of River Basins]: Are there any examples in existence now of the Section 73 type projects in which the Corps of Engineers is involved on any facility?

MR. FORD: There are none involved on an 80-20 cost carrying basis. There have been no projects authorized under this cost sharing. There are a couple of projects that have recently been authorized that embody the principles of planning as set forth in Section 73. I think one of these was mentioned earlier—for example, the Charles River Basin in Massachusetts. However, the cost sharing provisions of Section 73 have not been part of these plans.

DISCUSSION LEADER EISEL: Do we have additional questions and discussions? If not, I will turn this back to our Chairman.

CHAIRMAN GLASER: You have been a good audience and I think we have, this morning, explored some quite interesting factors, especially in relation to this whole concept of water and land management. I think many of the people sitting here have been here throughout the morning and they are the people who are going to be the pushers and implementers of these things. The other side of the coin is that we will have a broad cross section of everything, from the interpretative to actual application of programs all across the country.

Migratory Birds: Inventories, Population Status, Research Needs, and Management Opportunities

Chairman:
JOSEPH J. HICKEY
Professor, Department of Wildlife Ecology, University of Wisconsin, Madison

Discussion Leader:
CHARLES J. HENNEY
Research Biologist, U. S. Fish and Wildlife Service, Denver, Colorado

Economic Values of Non-Game Birds and Some Urban Wildlife Research Needs

Richard M.DeGraaf and Brian R. Payne
U. S. Forest Service,
Amherst, Mass.

Perhaps the greatest opportunity for human enjoyment of wildlife exists for urban man in the observation of non-game birds. Most Americans now live in cities, where a relatively small percentage of residents have even occasional chances to enjoy wildlife by hunting or by viewing game species. But the potential for wildlife enjoyment through bird watching is enormous. Bird watching is already an extremely popular activity, and the enjoyment derived from observing non-game birds can be greatly increased through research on habitat requirements, human preferences, and methods of increasing human awareness of and contact with non-game species.

One measure of the importance of any activity is the amount of money spent by participants in that activity. Even though we recognize that the value of a product or service arises from its use or from its exchange for other products or services, we usually express this value in terms of dollars and cents. Economic value may be a crude and imperfect measure of worth, but it is a useful means for comparing different kinds of products and services.

By the measure of economic value, the enjoyment of non-game birds is already a big business, and that business is growing. We estimated the total direct expenditures associated with the enjoyment of non-game birds. Included in our estimate were total retail sales of birdseed, birdhouses and feeders, field guides, gift books, a portion of total retail sales of binoculars and cameras, and dues paid to representative professional societies.

We believe that our estimate is conservative and that it represents a minimum value of the economic importance of non-game birds. We have not attempted to measure willingness to pay for bird watching; we have estimated only what has actually been spent for the activity. Actual expenditures obviously must always be less than or equal to willingness to pay.

A common shortcoming of an expenditures approach to measuring the value of some activity is the tendency to over-estimate value by including indirect expenditures. For example, we did not attempt to estimate expenditures for transportation, lodging, food, or alcoholic beverages during bird watching expeditions. Although often associated with bird watching, these expenditures are made for their own sake and are not required for enjoyment of wildlife. Neither did we include the value of clothing worn by participants. The primary motive for wearing clothing has nothing to do with observing wildlife. The same is true for eating and drinking.

Expenditures for wild birdseed are directly attributable to enjoyment of non-game birds. There are virtually no uses for birdseed other than for feeding birds. Birdseed is purchased and consumed annually, and thus represents a measure of current interest in non-game birds. Our estimates ignore expenditures for wildlife foods other than birdseed, such as breadcrumbs, table scraps, suet, and grains purchased from feed stores, but not identified as birdseed. In dollar terms, we believe that this omission is of minor importance.

Bird houses and feeders are a second category of expenditure related directly to the enjoyment of birds. Houses and feeders last several years, so that growth in their sales is due primarily to purchases by households not previously feeding birds.

Expenditures for guides to field identification of birds are also directly attributable to non-game bird enjoyment. A few titles account for the great majority of sales. Because each book lasts for many years, growth in sales is attributable almost entirely to recruitment of new bird watchers.

Expenditures for gift books about birds are attributable primarily to wildlife appreciation, although some people may buy books as status symbols, or they may give them as gifts whether or not the receipient has any interest in wildlife. Although each book has a nearly indefinite life span, new titles are available each year, and people tend to collect them. In a sense, gift books are consumed annually, and the sales of the new books each year are a good measure of consumer interest to wildlife.

Membership dues paid to organizations such as the National Audubon Society are easily estimated and show a continuous record of growth in the numbers of people interested in non-game wildlife.

A portion of the annual retail sales of binoculars are directly related to wildlife appreciation. No serious bird watcher is without at least one pair of fairly expensive binoculars that he uses almost exclusively for identification and observation of birds. A good pair of binoculars lasts for decades, so that binocular sales to bird watchers, like sales of field guides, are usually sales to new bird watchers.

A portion of the market for photographic equipment is directly attributable to appreciative uses of wildlife. As with binoculars, the trick is to estimate what portion. Most serious bird watchers own one or more cameras; however, these probably are not used exclusively for taking pictures of wildlife. Cameras may be replaced more frequently than binoculars due to their greater complexity and continuing technological improvements. Because the market for camera equipment is huge, even a small percentage attributable to wildlife appreciation represents a large annual expenditure.

What are the annual expenditures for these categories, and how did we estimate them?

Several studies have contributed to our knowledge of the annual expenditures for birdseed. DeGraaf and Thomas (1974) found that 43 percent of households surveyed in Amherst, Massachusetts fed birds in 1972. A mail and telephone survey of Massachusetts residents (Massachusetts Audubon Society 1974) found that one-third of all households bought an average of 60 pounds of birdseed per year.A survey in Maine (Cross 1973) found one-third of households feeding nearly 125 pounds of birdseed per year. However, this survey was biased in favor of persons interested in birds. A study in 1972 by Agway (Bruce Dunning, personal communication) found that 24 percent of Boston households fed birds and that purchases by household averaged 70 pounds of seed per year. Table 1 shows comparable figures for five large U. S. cities.

Based on these studies and on communication with birdseed suppliers, we have concluded that approximately 20 percent of U. S. households purchase an average of 60 pounds of birdseed per year; furthermore, these figures have remained constant for several years. Assuming an average retail price of $18 per hundred-weight in 1974 and approximately 15 million households feeding birds, we estimate total annual retail sales in 1974 to be $170 million. In 1972, with fewer households and with birdseed selling for about half of 1974 prices, we estimated annual retail sales of nearly $80 million. Sales in 1969 were somewhat over $50 million.

Sales of birdhouses and feeders are more difficult to estimate accurately than sales of birdseed. Annual sales are much lower, and dozens of small companies make birdhouses and feeders. Based on annual sales and estimated market percentage of one large supplier, we estimated expenditures of $15 million for birdhouses and feeders in 1974. This figure does not include the cost of homemade houses and feeders.

Sales of field guides are dominated by two publishers. Based on communication with these publishers, we estimated total sales of five titles at $3 million in 1974.

Sales of gift books related to birds have grown steadily since 1970, according to figures that we obtained from a private market reserach firm. Sales in 1970 were approximately $1.5 million; but 1974 sales were slightly over $4 million.

Based on annual membership records, we calculated dues paid to the National Audubon Society and the Massachusetts Audubon Society from 1970 to 1974. The total obviously under-represents total dues paid to organizations primarily concerned with non-game birds, but the Audubon figures show an increase from $1.6 million in 1970 to $3.1 million in 1974. Thus, dues payments have doubled in only five years.

In 1974, approximately $115 million were spent by bird watchers for the purchase of binoculars. Bird watching accounts for between one-half and two-thirds of total dollar sales of binoculars. Bird watchers buy very few binoculars in lower price ranges, but may buy as much as three-quarters of the binoculars that cost more than $250. (These figures are based on warranty return cards and were adjusted for non-response in lower price ranges.)

Table 1. Birdseed purchases by percent of households in five major U. S. cities in 1972.

	Number of households	Percent of households that feed birds	Average annual seed purchase per household (pounds)
Milwaukee	442,804	19.4	64.5
Cleveland	659,487	24.7	57.6
St. Louis	750,164	19.8	64.5
New York	3,949,454	15.1	49.2
Boston	861,024	23.8	69.6

Data on camera sales attributable to non-game bird photography are extremely difficult to obtain, partly due to the large number of foreign and domestic camera makers and to the wide range of subjects photographed. The latest figures available showed total sales of cameras, lenses, film, and photo processing of about $3.7 billion in 1972. If we attribute only five percent of this total to photography of birds and other wildlife, we estimate an expenditure of $187 million.

Thus, the total direct expenditures attributable to the enjoyment of non-game wildlife in 1974 appeared to be about $500 million. Photographic equipment and services, birdseed, and binoculars account for 95 percent of this total. An additional three percent is contributed by birdhouses and feeders, with minor contributions from memberhsip dues, gift books, and field guides.

Our estimate of $500 million per year is both a conservative and an impressive indication of the economic importance of non-game birds. To help put this figure in perspective, it might be compared with the total expenditures of hunters, exclusive of transportation, lodging, food, and alcoholic beverages. According to the National Survey of Fishing and Hunting (USDI 1972), this total was $1.7 billion in 1970.

Comparing birding expenditures to expenditures of waterfowl hunters may be more appropriate. In 1970, waterfowl hunters spent $180 million, again excluding transportation, lodging, food, and alcoholic beverages (USDI 1972). Even if we allow for inflation and some increase in hunting by 1974, waterfowl hunting expenditures must not have exceeded $300 million, or 60 percent of birding expenditures for the same year.

Research needs concerning non-game wildlife have been proposed by DeGraaf and Thomas (1973 and 1974), who advocated a three-part program of determining habitat requirements, human preferences, and ways to increase human-wildlife interaction. Thomas and DeGraaf (1973) proposed specific studies within these problems areas.

The present discussion of research needs is broad, and may even be considered a *pot pourri* of problem areas. Some problems can be studied only by wildlife professionals: others require help from other professions.

The determination of the habitat requirements of non-game species is still a major research need because it is requisite to any management that we might propose. Not only are habitat determinations important, but methods for habitat analysis must be refined and simplified so that private organizations and laymen can apply them. Also, we need inventories of urban and suburban wildlife populations and sites which have potential for habitat management.

A second research need, especially in urban and suburban areas, is to identify our constituents. Who enjoys wildlife, when and how? We should not be satisfied with the commonly used "wildlife-oriented recreation day" approach. Also needed are studies of human preferences among species in order to establish management priorities. Such studies may require the input of recreation researchers if reliable data are to be gathered; wildlife biologists are too prone to assume public support for our programs. This attitude is typified by the statement: "Twenty percent of the populace feeds birds; therefore it must be good for them."

This suggests a most important problem area: a research effort to find out if there are real benefits, either mental or physical, from experiences which include wildlife. We would probably all agree that there are. That is why we're here. That is also why we need an objective study with the help of the medical profession. If such benefits were in fact demonstrated, we could link urban wildlife management efforts to larger programs with greater funding, such as those of the U. S. Departments of Housing and Urban Development, and Health, Education and Welfare, to help improve the lot of urban residents. A beginning in this type of research might be made by studying the effect of birds at window-sill feeders in hospitals or convalescent or nursing homes.

Two research areas would require help from the legal profession. The time may be at hand for treaties with Central and South American countries that are rapidly destroying the wintering habitat of many of our breeding species. More pragmatically, a model law might be proposed to allow tax deductions for money spent in the creation of residential or backyard habitat on the premise that the resultant production of wildlife represents a community good.

Enjoyment of non-game birds is an important activity in our society, economically as well as aesthetically. If we are to meet our professional responsibilities, we must devote greater effort to research and management of non-game species, with particular attention to urban and suburban habitats.

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Discussion

CHAIRMAN HICKEY: Thank you, Mr. DeGraaf.

I have one observation in relation to bird feeders in Germany. One time, I was able to count them in relation to balconies in a particular town and found that 25 percent of the balconies contained bird feeders in the urban area. As you can see, this is quite close to the figures presented by our speaker.

DISCUSSION LEADER HENNEY: I think it is no wonder that several authors have actually suggested that the range expansion of many species of birds in recent decades may be partially in response to these backyard bird feeders. As we can see from our talk today, the amount of feeding is indeed large.

I might ask the speaker if he has any feeling for the amount of feeding that may have been taking place a decade or two decades ago—has there been a rapid increase? Is there information available as to that aspect?

MR. DeGRAAF: Unfortunately, I do not have any data on what was going on a decade ago. Through my informants, I will try to find out and get some long term trends.

MR. STEWART FEFER: [Maine] I was wondering if you separated the money spent by duck hunters, such as for binoculars, bird books and cameras, from the non-game consumptive uses in terms of the figures you gave?

MR. DeGRAAF: No. There are, of course, some problems with this. It was difficult enough just getting dollar sales at all on the product and a finer separation is pretty difficult.

MR. FEFER: Therefore, within that $500 million figure, there was money spent by hunters in terms of binoculars?

MR. DeGRAAF: Undoubtedly, yes, there is money in there spent by hunters. I did not mean to imply that there was no contribution by hunters.

MR. TOM STOCKDALE [Ohio State University]: It seems to me there might be one other category which we may be overlooking at the present time and I think it falls in the same realm as books—and that is the whole mushrooming area of wildlife art and sale of art prints. This is a fantastic business today and one which I think we can attribute directly to non-consumptive interest in wildlife, is that correct?

MR. DeGRAFF: Yes I might say that we did consider this aspect of it but had no dealers that were really willing to give us any figures at all. I have already asked about it, asked people with displays if they had any indication of the market, either locally or nationally, and there was absolutely no indication given. I wonder how much of this art or art prints is bought for art's sake, even though some dealers contribute some of the sales toward management and research efforts. However, many do not. My point is that this may reflect, not an appreciation of wildlife but just of art. I would like to know if it does.

Undoubtedly, it is a large amount of money but I have no sources of information on this.

DR. GEORGE HULSEY [National Wildlife Federation]: Dick, do you view as a possibility here a taxable base where perhaps an 11 percent excise tax could be applied to packaged bird seed, the revenue from which could be applied to the management of non-game species?

MR. DeGRAAF: That was the unstated purpose of the whole project that I have been discussing here. It is why I mentioned that 95 percent of the estimated total resulted in binoculars, bird seed and camera equipment purchases. Any proposed tax would have to be on a product pretty directly related to the enjoyment of birds, such as bird seed. However, some $30 million would be needed soon for management and research on non-game species.

MR. DALE POTTER [Seattle, Washington]: Let me say that I particularly appreciated your paper here today. I believe it is very timely and I laud your efforts in this area. We very badly need some research in the urban areas.

It occurred to me as you were talking that you were thinking primarily in terms of the positive effects of feeding birds. I wonder if, in your thinking or in your program, you plugged in the possible potential negative effects of attracting birds? I am thinking particularly of the health problems that may arise from attracting larger populations of pigeons, for example—that feeding in the park, for example, will attract some undesirable species.

You did mention some possibilities of cooperation with the health people and perhaps this would be an extension of that program. Do you have any comments on that or do you see any of these negative effects?

MR. DeGRAAF: There is no question about it. I am not a pathologist and won't pretend to be. The only thing I can refer you to in relation to adverse effects, is the work by Locke. His paper talks about this and they talked about this at the Urban Wildlife Symposium held in Springfield, Mass. In that proceeding there is a discussion of some of the negative aspects of concentrating birds.

CHAIRMAN HICKEY: I believe an increase in bird food distributed officially has been fairly recent. This also involves sunflower seeds in Western Maine and Eastern North Dakota.

Insofar as health problems are concerned, I might say that some people to whom I have talked about health problems posed by the great concentration of blackbirds which we have seen something of in the press recently, say that these problems may be somewhat exaggerated by the press.

Population Trends in Nongame Birds in North America

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For many years, extensive efforts have been made to monitor in various ways the population changes in the major game species of birds and mammals in North America. Quantitative studies on nongame species, on the other hand, have been very few in number and limited in geographic extent. Special attention has been given to a few species that are now classed as endangered, such as the Southern Bald Eagle and Kirtland's Warbler. For the great majority of species, however, common ones as well as rare ones, only the general range has been documented; and whether a species has been increasing or decreasing has been a matter of conjecture based on those few local or regional studies that included actual population counts or estimates.

During the period 1966 through 1968, the U. S. Fish and Wildlife Service and the Canadian Wildlife Service initiated the North American Breeding Bird Survey. The principal purposes were to establish a quantitative data base with which subsequent surveys could be compared, to determine the normal year to year variation in continental and regional populations of most North American bird species, and to detect important trends in abundance, whether they be increases or decreases.

The techniques, which have been described in publications of both sponsoring agencies (Robbins and Van Velzen 1967, 1969; Erskine 1970, 1973), will not be discussed here except to review the method of data gathering. The Survey is a stratified random sample of roadside counts. All birds seen or heard within one-fourth mile of each of 50 three minute stops at one-half mile intervals along randomly selected routes are recorded one morning each year at the height of the nesting season starting 30 minutes before sunrise. About 1,700 of these routes are surveyed each season by hand-picked observers who recognize the various species by song and call notes as well as by sight.

The observations are submitted on standard forms, keypunched, and run through various editing programs. They are then summarized by State, Province, and Region, and the data for 120 species are subjected to a computer analysis program that detects year-to-year changes at the State-Province, regional, and continental levels. Thus, when a significant change occurs, it is an easy matter to determine the geographical areas or physiographic regions within which the increase or decrease took place. This in turn permits correlation of changes in abundance with changes in land use practices, unusual weather conditions, or other environmental changes.

The main purpose of this paper is to point out some of the bird population variations that are currently taking place and show how data compiled by the Survey are being utilized.

After the first 2 or 3 years it became apparent that populations of most species of nongame birds are relatively stable, especially on a continent-wide basis. There are considerable variations within an individual State or Province or within a group of States, but in most instances, a decrease one year is followed by an increase in the next year or two.

The most drastic departures from this typical pattern have involved certain introduced species. Since 1966, the Cattle Egret, which invaded the United States from South America, has been increasing in States east of the Mississippi River at an average rate of 12 percent per year. The Starling, which was introduced from Europe to New York City in 1890, is currently undergoing a population explosion in the Western States where it has shown an average annual increase of 16 percent since 1968. The House Finch, which was introduced in the New York City area in 1942, has now spread to most of the Atlantic Coastal States, and has shown an average annual increase of 22 percent in the Eastern States since 1966.

On the basis of the Breeding Bird Survey data, we can predict that the Starling will become a real menace to some of the agricultural interests in the West because of its extraordinarily rapid population expansion in that area and its known food habits. We can also anticipate a decline in the populations of several of the cavity-nesting species in the Western States as a result of competition from the newly arrived Starling. Such a decrease in breeding success of native cavity nesters has already been documented in British Columbia (Erskine and McLaren, ms).

Prominent among other species that have shown a substantial population increase since 1966 are the Red-winged Blackbird, Common Grackle, and Brown-headed Cowbird. All three species have apparently benefited from changes in agricultural practices and have shown highly significant increases in their continental populations.

Mayfield (1960), Walkinshaw (1974), and others have demonstrated the disastrous effect of the cowbird on populations of the endangered Kirtland's Warbler. A high percentage of the Kirtland's nests had been parasitized by cowbirds in recent years with the result that reproduction of Kirtland's Warblers reached a dangerously low level. Accordingly, a cooperative management program for Kirtland's Warbler presently includes large-scale trapping of cowbirds from the principal nesting areas of this warbler in central Michigan. A strong upward trend in cowbird populations in Michigan and nearby States and Provinces has continued through 1974. The effects of cowbird control have not been extensive enough to be reflected in the Breeding Bird Survey. In areas where there is no cowbird control, there are bound to be decreases in other songbird species as a direct result of the increase in cowbirds. One of these species is the Yellow Warbler, which has been showing a significant average decrease of 11 percent per year in the central States and Provinces since 1967.

Some population changes detected by the Breeding Bird Survey are easy to correlate with the factors that produce them. For example, when Hurricane Agnes, with its associated long period of rainfall, swept through the Appalachian States in June 1972, many observers reported 90 to 100 percent mortality in Purple Martin colonies. A sharp drop in the breeding population of martins, as reflected in the 1973 Breeding Bird Survey, corresponded closely with the area of heavy prolonged rainfall in June of the preceding year, indicating that this species has a strong tendency to return to the general vicinity of its nesting colonies rather than spreading out to fill the area from which the breeding birds had been depleted.

In the late spring of 1974, five consecutive days of cold, rainy weather in northern New England resulted in a massive and much publicized kill of Scarlet Tanagers, especially in Maine and New Hampshire, on the weekend of May 25-26. The Breeding Bird Survey showed declines of 30 percent in New Hampshire and of 50 percent in Maine from the previous summer's breeding population.

Believing that some of the less conspicuous migrants may also have been affected, weighted State and Provincial means for 16 other insectivorous species were examined. These showed a decline of 30 percent in the swallow population (Tree, Bank, Barn, and Cliff) of Nova Scotia, Maine, and New Hampshire, and an average drop of 25 percent in 8 species of breeding warblers in New Brunswick. In surrounding States and Provinces, the warbler loss averaged only 10 percent. Other insectivorous species such as the Red-eyed Vireo, Eastern Wood Pewee, and Alder Flycatcher, that are late migrants in northern New England, apparently arrived after the severe weather. Their populations were higher than in 1973 in almost all of the northeastern States and Provinces.

The Eastern Bluebird situation is more complicated because populations initially depleted by severe weather in the Southeast in the winter of 1957-58 (James 1962) were prevented from rapid recovery by a combination of circumstances including successive severe winters, competition with Starlings for nesting cavities, and loss of many thousands of birds in unprotected stove vents in tobacco barns in the Southeast. Local, regional, and continental trends of the Eastern Bluebird are now monitored annually by the Breeding Bird Survey. The downward trend from 1966 through 1969 has been reversed, and the population is now slowly recovering thanks to lack of severe winter weather in the Southeast, screening of the offending vent pipes, and the thousands of bluebird nest boxes erected by the public.

With 9 years of data now available for the Eastern States and Provinces, the more subtle long-term trends in populations of various species are becoming apparent. Yellow-shafted Flickers and Red-headed Woodpeckers are declining at an average rate of 3 percent per year, probably as a direct result of competition with the Starling for nesting cavities. Breeding Bird Survey counts indicate that, since 1966, the Black Tern, a marsh nesting species, has been decreasing at an average annual rate of about 15 percent in the eastern and central regions of the continent.

Breeding Bird Censuses conducted in New Jersey, Maryland, and other eastern States had shown a marked decline in populations of the Red-eyed Vireo, Ovenbird, and American Redstart during the early 1960's. These are some of the commonest breeding birds of the eastern deciduous forest. It is gratifying, therefore, to find that Breeding Bird Survey data for these species have shown an annual increase of between 8 and 11 percent from 1966 through 1974 on their nesting grounds in the Maritime Provinces. Johnston (1974) has examined DDT residues in 319 migrating songbirds of 10 species (7 warblers, 2 vireos, and Catbird) killed at a Florida television tower from 1964 through 1973 and has found a highly significant ($p < .01$) decrease in DDT derivatives in body fat of these species.

We receive inquiries from bird depredations and enforcement personnel regarding changes in populations of robins, crows, and other species causing local economic problems. In the Maritime Provinces of Canada, for example, where Robins are a real problem to blueberry growers, we are able to show that the population has shown no change rather than an upward trend and that the problem relates to local movements of birds rather than to a population explosion. With the recent protection of crows in the United States, there is some concern that populations of these species may increase, and here again the Breeding Bird Survey can be counted on to yield quantitative information on both short-term and long-term trends.

Although most of our attention during the first decade of the Survey has been directed toward the common species, we have now built up a sufficient backlog of data from nearly 1.5 million birds of 500 species per year so that we can also get some indication of trends among the rarer species. The Upland Sandpiper, for example, is now recorded on approximately 150 routes annually; an upward trend in its population has been continuing since 1969. The Mississippi Kite population, which is sampled in 13 States, has shown a substantial increase since 1967.

One by-product of the Breeding Bird Survey has been the ability to produce computer-generated maps showing not only areas of occurrence but relative abundance. Maps showing geographic areas of increase and decrease are an effective way to show population trends. Maps pinpointing centers of abundance are especially important for the scarcer species or those whose populations are dropping. Range expansions also are best shown by maps, either annually or by comparing maps for successive 3-year means. Such maps have shown dramatically the southward spread of the Barn Swallow (Bystrak, ms) in which the continental population has now reached the range of the Gulf Coast population which it will soon absorb. Similar documentation is available showing the spread of the Tufted Titmouse into the New England States during the late 1960's and early 1970's, and the spread of the breeding range of the eastern population of the House Finch.

The U. S. Air Force recently sponsored a project to utilize Audubon Christmas Bird Count data for mapping winter distribution and abundance of 143 bird species potentially hazardous to aircraft (Bystrak 1974). Therefore we now have available some maps showing relative abundance in winter that can be compared with the Breeding Bird Survey maps showing relative abundance during the breeding season. As more maps of both types become available, it should be possible to demonstrate visually the major seasonal population shifts that occur in populations of migratory species.

Analyses by Steven Peterson (Peterson, *et al.*, ms) have shown that Breeding Bird Survey data are remarkably consistent from year to year, that the physiographic regions that are used as a basis for stratifying the results for computer analysis are valid sub-divisions, and that both species totals and species diversity indices remain quite constant over a period of years within the same physiographic region. As would be expected, the average number of species per 50-stop route is lowest in the deserts and high plains of the western United States and in the Great Valley of California and increases eastward and northward until reaching a peak in the northern hardwood and spruce hardwood forests. Similarly, the species diversity index (H' of Shannon and Weaver 1963) is lowest in the same areas of the Southwest and increases northward and eastward. This index reaches its highest value in the Cumberland Plateau of Tennessee and Kentucky, followed closely by the northern hardwood forests, the Adirondack Mountains, and the Ozark Mountains.

In addition to providing information on a nation-wide and continent-wide scale, the Breeding Bird Survey fills ever increasing local needs for bird population information. The same methods have been applied more intensively on a local scale when there was a need to assess bird populations for a particular project and compare the results with a regional or continental standard.

Copies of State and Provincial summaries are provided annually to the State and Provincial coordinators, and a limited number of species summaries are available to research workers. Bound copies of all tabulations are available for use at Patuxent Wildlife Research Center, U. S. Fish and Wildlife Service, and Xerox copies of either detailed or summarized data can be supplied in small quantities.

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Discussion

CHAIRMAN HICKEY: One of the most interesting things about the new surveys on a national basis is the attempt to get population indicies of non-game birds. These have been going on now for only a few years and it is much to be regretted that we do not have information on a long-term basis. Tremendous changes have taken place in these species. Some of them have been induced by such artificial set-ups as bird feeding, about which we have just been talking. I think even the great change in the evening grosbeak populations in the last three decades is due to the use of sunflower seeds in our feeders. You can sense that this is important when you look at a flock of evening grosbeaks and invariably see one banded bird there. This is the only nongame species I can think of where some significant fraction of the total bird population is actually carrying bands.

DISCUSSION LEADER HENNEY: I have one question. Particularly in view of the reduction of DDT levels in recent years, is this continental survey sensitive enough to provide us full information on trends in various species such as raptors?

DR. ERSKINE: The numbers of raptors reported on in these surveys are very small, except in the prairie provinces, where the country is open and you can see them for a long way. We have not tried to do any analysis on the raptors.

MR. FRED GREELEY [University of Massachusetts]: Some years ago, Graber published a trend study of a variety of non-game birds, based, I think, upon the early 1906 study made in Illinois. I think you probably have some species in common there and although I know the method of gathering the data is different, I wonder if the trend at least shows anything either in common or different in your more recent study?

DR. ERSKINE: I am afraid I did not catch that.

MR. GREELEY: I was just exploring whether there were any similarities or differences in the trends between your studies and the Graber Illinois Study that was put out approximately 12 years ago? For example, they showed the considerable change in the amount of and distribution of plowed land that was affecting horned larks, causing changes in nesting bird habitats in that area and I just wondered whether your data showed anything comparable.

DR. ERSKINE: My study was not started until 1966 and this is not a very long period, especially when you start talking about widescale agricultural trends. I am afraid I cannot answer that.

MR. GREELEY: One thing that this study in Illinois showed was the total population of the state changed in fifty years and that the blackbird population has very definitely gone up. Of course, the population index reported here this morning also showed blackbirds going up and so this is picking up at least a part of the Illinois trend.

MR. FRANK BARICK [North Carolina]: I wonder if you have any information, not related to numbers of blackbirds, but as to whether there is some mitigating factor involved in this tremendous increase in terms of consumption of wheat seeds. Have any studies been made in this direction?

DR. ERSKINE: As to whether there has been any measure of the consumption of wheat seeds by some experiments, I am afraid that this measurement has not been made.

MISS JOHNSON: The mockingbird has been seen more often in Southern New York now. In your figures did you indicate a larger population with an extension of the range of these birds?

DR. ERSKINE: Range extensions do show up very nicely on these surveys. However, I am not sure how much the mockingbird has increased its range.

CHAIRMAN HICKEY: Thank you very much, Dr. Erskine. I am sure that the mockingbird will undoubtedly reflect that increase in Massachusetts, which has had one of the dramatic bird population changes of the last two decades.

Migratory Waterfowl Management Opportunities Provided by the Water Bank Program

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The influx of European settlers to the North American Continent brought great changes in the land, and aquatic habitats were particularly vulnerable to the early settlers' activities. Kenney and McAtee wrote in the 1938 Yearbook of Agriculture, *Soils and Men:*

> Among the assets of mankind, wildlife receives its true appraisal only in advanced stages of civilization when, owing to the heedless destruction of earlier times, it has been seriously if not irreparably reduced. Under pioneer conditions the rules for the treatment of wildlife are immediate exploitation of the useful and drastic destruction of the useless, and these rules tend to remain in effect long after the original motives are gone. In the earlier stages of settlement no one thinks of allotting any land for the use of wildlife; the effort is to wrest every possible acre from nature and make it yield an income. There is no vision to see, there is no time to learn, that land units with their natural occupants, as exemplified by a beaver meadow, a muskrat marsh, a duck lake, a deer forest, or an antelope mesa, are productive entities that under certain circumstances may be worth far more than anything man can put in their place and that once destroyed may never be reestablished.

The term "wetlands" as used in this paper refers to lowlands covered with shallow and sometimes temporary or intermittent waters. Wetland types are defined and described in *Wetlands of the United States*, U.S. Department of the Interior, Fish and Wildlife Service, Circular 39, issued first in 1956 and reissued in 1971.

Wetlands are generally referred to as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds with emergent vegetation are included. Many wetlands can be drained or filled to create land suitable for agricultural, industrial, residential and other uses. Inland wetlands can be changed to deep water lakes by constructing an earthen fill. As man tampers with natural wetlands the food and cover plants required by waterfowl and other wetland wildlife may not survive. Just as the early settler changed the land he found on this continent, man continues to destroy nature's wetlands, feeling that such "waste land" must be put to productive uses. However, environmental awareness on the part of many segments of the general public within the past decade has helped to reverse this trend to exploit our resources, including wetlands.

Approximately 22 million acres of wetlands in the United States have moderate to high value for waterfowl, according to Fish and Wildlife Circular 39. Of these 22 million acres, nine are Type 3, 4, or 5 wetlands. Type 3 wetland is defined as inland shallow fresh marshes that are usually waterlogged during the growing season. Type 3 in combination with Type 4, inland deep fresh marshes, constitute the principal production areas for waterfowl. Type 5, inland open fresh water, is made up of shallow ponds and reservoirs. Water is usually less than 10 feet deep and is fringed by a border of emergent vegetation. Type 5 wetland is often surrounded by or adjacent to Type 3 and Type 4 wetlands.

It is the policy of the Soil Conservation Service that technical assistance will not be furnished for draining Type 3, 4, or 5 wetlands. Also, under the Agricultural Stabilization and Conservation Service (ASCS) program, cost sharing is not available for draining Type 3, 4, or 5 wetlands. In fact, the 1974 Rural Environmental Conservation Program administered by ASCS prohibits cost-sharing for drainage on any land.

Water Bank Program Authorization

To provide for conserving surface waters, to preserve and improve habitat for migratory waterfowl and other wildlife resources, to reduce runoff and soil and wind erosion, to contribute to flood control, and for other purposes, the 91st Congress passed the Water Bank Act, PL 91-559, December 19, 1970, establishing the Water Bank Program.

The Water Bank Act directed the Secretary of Agriculture to effectuate the Water Bank Program by entering into long-term agreements with land owners and operators in important migratory waterfowl nesting and breeding areas. Agreements provide for the conservation of water on specified farm, ranch, or other wetlands identified in a conservation plan that has been developed in cooperation with the Soil and Water Conservation District in which the lands are located. The act directs the Secretary of Agriculture to consult with the Secretary of the Interior and to take appropriate measures to insure that the program is in harmony with wetlands programs administered by the Secretary of the Interior. The Secretary of Agriculture is also to consult with and utilize the technical and related services of appropriate local, state, federal, and private conservation agencies to insure coordination and a solid technical foundation for the Water Bank Program. The act limits payments to owners and operators in any calendar year under such agreements to $10 million.

The act also provides that the Secretary of Agriculture may appoint an advisory board to advise and consult on matters relating to the act. The board is to consist of persons chosen from members of wildlife organizations, land-grant colleges, farm organizations, state game and fish departments, soil and water conservation district associations, water management organizations, and representatives of the general public.

The $10 million annual limitation of the Water Bank Act limits the program to important migratory waterfowl nesting and breeding areas. Although restoring wetlands is a purpose of the act, all funds to date have been used to preserve wetlands that are endangered by drainage, burning, or filling and to set aside adjacent lands needed for a viable waterfowl nesting and breeding area.

The Secretary of Agriculture has designated 62 counties in the states of Arkansas, California, Louisiana, Maine, Michigan, Minnesota, Mississippi, Montana, Nebraska, North Dakota, Oregon, South Dakota, Vermont, Washington, and Wisconsin as eligible to participate in the Water Bank Program. Fifty of the 62 counties designated are in the states of Minnesota, Montana, North Dakota, South Dakota, and Wisconsin.

Water Bank Program Responsibilities

The Agricultural Stabilization and Conservation Service (ASCS), an agency of the U.S. Department of Agriculture, has general administrative responsibilities for the Water Bank Program. The ASCS State Committee, with representatives from the Soil Conservation Service (SCS) and other state and federal wildlife and conservation agencies, make up the State Development Group, which formulates policies within national guidelines for operating the Water Bank Program within the state. The Fish and Wildlife Service and appropriate state wildlife agencies are a part of this development group.

The ASCS County Committee administers the Water Bank Program within eligible counties. The county committee with representatives from the Soil Conservation Service and other appropriate local, state, and federal wildlife and conservation agencies and organizations make up the County Development Group.

We in the Department of Agriculture have been extremely pleased with the cooperation of all wildlife agencies and organizations in the Water Bank Program. The Fish and Wildlife Service and the state wildlife agencies deserve special mention since they have been very cooperative and have contributed hundreds of man-hours of time, especially at the local level, with on-site reviews of proposed wetland areas.

The ASCS County Committee has general administration of the Water Bank Program at the county level. It accepts requests from farmers, ranchers, and other wetland users to participate in the program. It develops agreements on eligible lands based on a conservation plan developed with SCS assistance through the local soil and water conservation district. It makes annual payments to eligible WBP participants for a period of 10 years.

The Soil Conservation Service (SCS) provides technical assistance in developing a conservation plan covering the participant's entire operating unit. SCS provides related technical assistance involving:

—Identifying Type 3, 4, and 5 wetlands and adjacent lands to be developed or preserved for wildlife on the plan map and identifying the area in the field by the corner markers.
—Applying needed conservation practices to protect and improve wetlands and designated adjacent lands.
—Providing followthrough assistance to insure appropriate protection of wetlands and adjacent lands and needed maintenance of conservation practices applied.

Water Bank Program Participation

Requests for assistance in the Water Bank Program have been accepted in the 1972 and 1974 program years. No new requests were approved in the 1973 program year, as the 1973 Water Bank Program and the 1973 Rural Environmental Assistance Program were terminated by Executive Order, December 22, 1972.

As of June 30, 1974, 1,756 WBP agreements had been approved with 130,192 acres designated as Type 3, 4, or 5 wetlands and adjacent lands to be protected and improved as waterfowl habitat. The average agreement to date contains 26 acres of Type 3, 4, or 5 wetlands and 48 acres of designated adjacent lands protected for nesting and breeding areas. Type 1 and 2 wetlands are often included in the adjacent land area. The average annual payment is $8.78 per acre designated under agreement or approximately $650 per program participant.

The Conservation Plan

The conservation plan, developed by the WBP participant with SCS assistance in cooperation with the local soil and water conservation district, provides for:

—All land use and conservation treatment decisions, including the scheduling of practices, on the wetlands and designated adjacent areas covered by the WBP agreement.

—Either decisions or recommended conservation alternatives on the remainder of the operating unit.

—The installation and maintenance of planned conservation practices. All conservation practices required to protect or improve the designated area in the WBP agreement must be installed and maintained to avoid termination of the agreement for noncompliance. Such terminations result in a refund of all payments.

The conservation plan provides the basis for scheduling onsite technical assistance needed for the installation and maintenance of planned conservation practices in accordance with acceptable technical standards and specifications.

Limited grazing of the designated acreage as a management practice to improve the waterfowl habitat can be approved. The State Development Group must unanimously approve limited grazing before it can be used within the state. Limited grazing must be carefully controlled and practiced in accordance with the specifications stated in the conservation plan.

Where limited grazing is practiced to improve the waterfowl habitat, SCS, with assistance from appropriate wildlife agencies, will specify the kind of livestock to be used, the stocking rate in accordance with growth of the vegetation, the waterfowl species to be favored, the period to be grazed, and the manipulation of the water level as applicable. Wildlife agencies are invited by SCS to make an annual followthrough visit to each participant practicing grazing to help determine the degree of grazing to be permitted in the future. Unseasonable weather conditions are considered in altering the normal grazing pattern.

Conclusion

The primary thrust of the Water Bank Program to date has been in the North Central states of Minnesota, North Dakota, South Dakota, and Wisconsin. Over 100,000 of the total of 130,000 acres designated in WBP agreements are in these four states.

In reviewing progress of WBP in the field, we have found that the landowners, the federal and state wildlife agencies, and the agencies in the Department of Agriculture are enthusiastic about the program. Even though WBP has operated on a rather small scale, it is making a significant contribution in preserving and improving wetlands.

Discussion

MR. FRANK GOLET [University of Rhode Island]: I wonder if you can tell me, has the adjacent land around the wetlands always been included in this act and what are the real problems in trying to include these lands?

MR. PHILLIPS: Well, as I mentioned, we have about a two to one ratio of adjacent lands to wetlands and yes, it has been a problem in obtaining enough adjacent land. In some cases, several applicants who have participated in the Water Bank Program have not been accepted because they were not willing to set aside enough adjacent lands for nesting and breeding areas to make the wetlands a viable wildlife habitat. We do think that the two to one ratio is good. We have a few agreements that involve less than a one to one ratio. Under certain conditions, where there is plenty of permanent vegetation within the wetland area, it may not always be necessary to have as much adjacent area as you have wetlands but in most cases, especially in the areas that are intensively farmed such as we often find in the pothole country, we feel that two to three times the amount of adjacent lands in relation to wetlands is most desirable.

MR. GOLET: Do you have any figures on the width from the edge of the wetland? The reason I am asking this is that the State of Rhode Island, in relation to the Fresh Water Island Act, included a buffer strip around the wetland and this is the only state that I know that does this.

What I am debating the people in the state about concerns the width of the strip. Right now it is 50 feet, which is silly, but at least it is something. At a recent public hearing I got them to push it as far as 150 feet but I think that this is something that needs to be looked into. Of course, in the urban area it would be very different than in the prairie pothole region in terms of human harrassment of wildlife and that type of thing.

MR. PHILLIPS: Yes. The Act itself does not require a buffer strip all the way around the wetland area. The adjacent land does not have to go all the way around the wetland area. This is desirable but in many cases, one side of the wetland area may be exposed to intensive agriculture, for example, while the adjacent area may be around the wetland area on another side, so a buffer strip as such is not a requirement.

MR. ERIC BOLEN [Texas]: What is the potential for expanding the scope of this program to include important wintering areas threatened by drainage, etc.?

MR. PHILLIPS: I am not sure that I got your meaning.

MR. BOWDEN: As I understand it, this program is limited to breeding areas. My question is, what is the potential for expanding the water bank programs to include wintering areas?

MR. PHILLIPS: The Act itself says that it is for breeding and nesting areas. It would require legislation to change the Act to do what you would like, to take care of the so-called wintering areas.

MR. LARRY JAHN [Wildlife Management Institute]: Part of the procedure for maintaining the quality and the integrity of aquatic areas is to make sure that the soil around that aquatic area stays in place. I appreciate the farm plans in which you described what is carried out. However, my question is this—what controls do you in SCS really have in effect under the agreement with the landowner to make sure he does not abuse his land and have accelerated soil erosion take place?

MR. PHILLIPS: I am glad you asked the question because I failed to bring this out in my paper. All of the conservation practices that are needed to protect both the wetland and the designated adjacent lands must be installed before the farmer is eligible for payment. In other words, if water, for example, is coming off of land outside of the designated agreement area, carrying silt, for example, then the area must be terraced or waterways constructed or diversion put in or changed from a cropland use to a permanent vegetation of some sort in order for him to qualify for payment. The erosion must be taken care of before he is eligible for payment.

MR. JAHN: I appreciate the installation requirement but what about the maintenance requirement?

MR. PHILLIPS: These practices must be properly maintained for the period of agreement, which is ten years.

MR. JAHN: Do you enforce that?

MR. PHILLIPS: Yes indeed.

MR. JAHN: Have you actually had a penalty clause where a refund has been made by the landowner to you?

MR. PHILLIPS: I don't think there is anybody from ASCS here but they can tell you that. They have responsibility for the contracts themselves. We have, I know, in a couple of instances, required farmers to come in and put in a reseeding on areas where they did not get a good catch of grass, for example, and it was still eroding. This has to be done prior to the time that the local County Committee would issue that payment for that year. So we tried to avoid any violations by twisting the farmer's arm to get him to do the things he must do in order to collect his payment.

FROM THE FLOOR: I would like to ask Dr. Phillips if the Department of Agriculture has any plans to evaluate the effect of the program?

MR. PHILLIPS: We in the Soil Conservation Service are not permitted to do any research except that which is directly related to soil surveys, which we have the national leadership for. Hopefully, through the Department of the Interior and through the State Wildlife Agencies, someone will see fit to make studies to determine the benefits of this program. To date, however, I know of no such studies. They are very badly needed.

For those of you from the state university campuses, I would suggest that HATCH monies which come from the Department of Agriculture to the State Agricultural Experiment Stations would be a source of funds with which to employ students to do this work along the lines we were just discussing.

MR. JOHN McCARTNEY (Waterloo, Ontario): You mentioned that North Dakota is one of the prominent participants in the Water Bank Program. That is the state where there is the Garrison Diversion Unit, is it not?

MR. PHILLIPS: Yes.

MR. McMURRAY: How does the Water Bank activity relate to that project? What is the relationship? How do you feel about that diversion unit?

MR. PHILLIPS: Well, I am not at all familiar with the Garrison Diversion. I have heard about it and that is it. Therefore, I do not feel competent to discuss it.

The Water Bank Program, as you probably are aware, is on individual farm and ranch units primarily and any relationship would be indirect rather than direct.

Managing Wood Ducks By Population Units

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Introduction

The wood duck (*Aix sponsa*) occurs throughout much of the forested United States and southern Canada but is most abundant along streams and in wooded swamps of the eastern United States. This unique duck is dependent upon a forest environment for food and shelter. Its increasing importance to hunters is shown by an estimated harvest which has grown from less than one-half million in the early sixties to a peak of more than one million in 1970 (Chamberlain *et al.* 1972). Wood ducks presently rank fourth in the overall harvest of ducks in the United States and are second in importance in the Atlantic and Mississippi Flyways (Schroeder, Sorensen, and Carney 1974).

A number of studies have dealt with the ecology and management of wood ducks on a local basis (for example, see Grice and Rogers 1965), and much effort has been devoted to banding the birds and to developing reliable methods of assessing their abundance—either by censusing them directly (Hester 1966)—or indirectly by estimates derived from banding and harvest records (Kaczynski and Geis 1961, Geis 1966). However, a comprehensive study was needed to assess the status and population characteristics of wood ducks throughout the major portion of their range. Therefore, this research was initiated in 1970 to increase knowledge of wood duck population dynamics and to improve our capability for managing this important resource. The study was based upon the analysis of banding and harvest survey records provided by the U. S. Fish and Wildlife Service. Results of the work were presented in an earlier unpublished report (Bowers and Martin 1974). In this paper we describe our findings concerning locations, sizes, harvest characteristics, and survival of wood duck populations in eastern North America, and we discuss possibilities for improved management.

Methods

Defining Populations

Populations were identified by plotting the recovery locations (by one-degree blocks of latitude and longitude) of wood ducks banded May-August 1950-68, and later reported shot or found dead during the hunting season. Birds banded during these months were assumed to be adults and young on production areas. States and provinces from which the geographic distribution of recoveries showed similar patterns were combined into population units.

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Weighting Band Recoveries

The number of wood ducks banded in each state and province has varied widely in relation to actual abundance. Consequently, it was impossible to compare the relative importance of band recoveries from population units until differences in population sizes and banding effort had been taken into account. Weighting factors were obtained by dividing the number of birds banded in each state or province into an estimated population value for that area. This procedure thus provided an estimated number of wood ducks represented by each banded sample. Thereafter, weighted direct recoveries (recoveries reported shot in the first hunting season after banding) from birds banded during the summer were used to measure shooting pressure and to determine the distribution and derivation of harvest.

Since wood ducks are widely distributed at low densities in forested habitat, it is not feasible to measure their abundance by conventional censuses; therefore, we obtained population estimates by indirect methods. Three approaches were used to estimate population sizes for states and provinces within each population unit. The first, forest values, assumed a correlation existed between the distribution and abundance of suitable forest habitat and wood duck numbers. Six forest types were assigned an importance value ranging from 0.5 to 10, based upon wood duck habitat requirements indicated in the literature, together with silvical characteristics of each forest type. A population index for each state and selected Canadian provinces was obtained by summing the products of forest-type acreages and importance values. The second method used estimates of wood duck abundance included in "FHMUP" (Flyway Habitat Management Unit Project), a model developed jointly by State Conservation Departments and the Fish and Wildlife Service. The FHMUP model used information from a wide variety of sources to estimate monthly population values for wood ducks and other waterfowl species within individual states in 1965-66 (Sutherland 1971). The third technique consisted of solving a set of simultaneous linear equations by means of computer, using a matrix of all states and provinces of banding and harvest. In the calculations, we used data on estimated harvest rates (proportion of banded birds shot and retrieved during the first hunting season after banding), together with estimates of average size of the harvest. A description of this general method of population estimation is provided by Chapman and Junge (1956), and Overton and Davis (1969). To our knowledge, the first suggested application of this method to migratory game birds was made by Geis (1966).

Survival Rates and Significance Tests

Estimated average annual survival rates of adults (birds in their second or later year of life) were calculated by the method developed by Seber (1970) and adapted for computer application by Anderson, Kimball, and Fiehrer (1974). Since the Seber method assumes that survival is age-independent, it is not directly applicable to immature birds (young birds capable of flight) which have marked change in survival rate with the change from immature to adult status. To overcome this limitation, immature survival rates were obtained from the relative recovery rate method (Geis 1972), and combined with the Seber method to compute variances.

The *t*-test was used to test for significant differences in survival rates among age, sex, or geographic groups. Contingency tables (Chi-square) were used to test for significant differences in direct recovery rates, or in proportions of birds shot at different times. In all cases, 0.05 was the probability level accepted for statistical significance.

Findings

Population Units and Estimated Abundance

We identified six major summer populations (Figure 1), based upon the geographic distribution of 13,200 recoveries reported from 132,300 wood ducks banded in 32 states and 2 provinces. States within the Atlantic Flyway, together with Ontario and Quebec, form three population units—Northeastern, New York-Eastern Canada, and Southeastern. States within the Mississippi Flyway also form three population units—North Central, Lake States, and Southern.

Table 1 shows summer population values in states and provinces as estimated by means of the three techniques described above. The figures under simultaneous equations represent actual estimated numbers of birds of each age. The total summer population averaged 3.3 million, with a pre-hunting season age ratio of 1.2 immatures per adult. The remaining two sets of data included in Table 1 represent indices of abundance, rather than actual numbers of birds.

Initial attempts to estimate population sizes by simultaneous equations were unsuccessful. Although still not completely satisfactory, the equations yielded more realistic results when harvest values were reassigned to different states and provinces in accordance with the distribution of weighted direct recoveries from forest values and FHMUP.

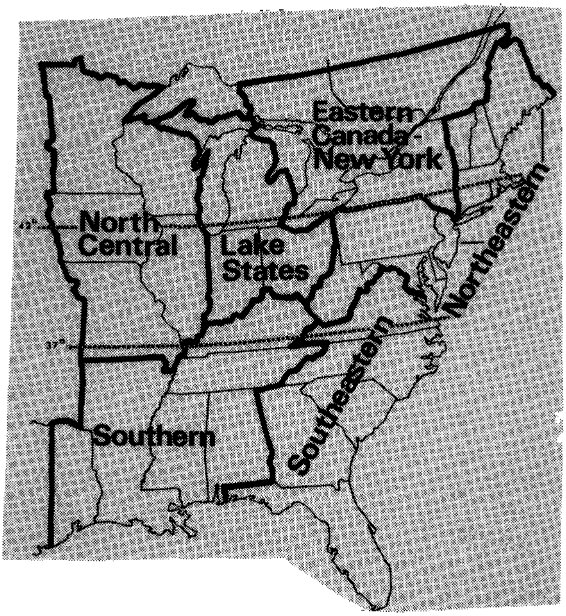

Figure 1. Wood Duck Population Units

Because simultaneous equations did not always yield realistic abundance estimates, and since the figures are not independent of either forest values or FHMUP, the sum of values from all three methods ("Row Sum" in Table 1) was used as the index to comparative summer abundance of wood ducks in each unit. The distribution of the summer population was as follows: Northeastern, 14 percent; New York-Eastern Canada, 14 percent; Southeastern, 19 percent; North Central, 25 percent; Lake States, 10 percent; and Southern, 18 percent. Fifty-two percent of the overall population was in the Mississippi Flyway (including Texas), 38 percent in the Atlantic, and 10 percent was in eastern Canada.

Importance of Different Harvest Areas

Table 2 shows the comparative importance of different states and Flyways in the harvest, based upon harvest surveys made from 1962-68 and weighted recoveries from birds banded 1950-68. Although the distribution pattern is generally similar, weighted recoveries suggest that the fraction of the total harvest is higher in the Atlantic Flyway and lower in Canada than do harvest surveys. It should be realized that the estimates determined from weighted recoveries are not completely independent from those obtained from harvest surveys. The extent of interdependence is unclear because of the complexity of procedures used to make population estimates.

Harvest Distribution from Population Units

Marked differences existed in harvest distribution of wood ducks from different population units. For example, Mississippi Flyway States, together with Texas, accounted for nearly all of the harvest from the North Central Unit, but more than 90 percent of the harvest of birds from the Northeastern Unit occurred in the Atlantic Flyway and eastern Canada (Table 3). Table 4 lists the five states and provinces most important in harvesting wood ducks from each population unit. Southern states were important in the harvest of birds from all six population units. There was a north-to-south pattern in harvest distribution between adults and immatures (Table 5). Approximately 61 percent of the harvest of immature wood ducks from each of the four northern units occurred in states within that unit, 9 percent from states within another northern unit, and 30 percent in southern units. Among adults, however, only 44 percent of the harvest occurred within the northern unit where the birds were banded. Although interchange among northern units was small (7 percent), a high percentage (49 percent) of adult harvest occurred within states in southern units. In marked contrast to wood ducks banded in northern units, southern wood ducks of each age were harvested almost entirely within southern states.

Harvest Derivation from Population Units

The derivation of harvest among states and provinces in the Atlantic and Mississippi Flyways is shown in Table 6. Approximately 92 percent of the immatures bagged in each of the two flyways came from population units within each flyway. The derivation of the adult harvest showed a similar pattern; there was only a 10 percent interchange between flyways in the derivation of harvest. Most of the limited overlap occurred at the southern ends of the flyways, especially in Alabama.

Table 1. Wood duck population indices estimated by three techniques.

	FHMUP Bureau Model		Simultaneous Equation Estimate		Forest Values[1]	Row Sum[2]	
	Adults	Immatures	Adults	Immatures	Wood Ducks	Adults	Immatures
Alabama	28,000	62,000	55,569	156,991	33,862	117,431	252,853
Arkansas	34,000	69,000	40,653	7,752	48,517	123,170	125,269
Illinois	60,000	99,000	21,534	64,212	14,062	95,596	177,274
Indiana	40,000	66,000	40,058	47,554	13,279	93,337	126,833
Iowa	30,000	49,000	26,994	20,415	11,696	68,690	81,111
Kentucky	12,000	16,000	13,561	0	21,195	46,756	37,195
Louisiana	31,000	44,000	34,225	45,534	69,674	134,899	159,208
Michigan	40,000	66,000	58,477	84,825	76,333	174,810	227,158
Minnesota	89,000	149,000	124,394	190,768	99,394	312,788	439,162
Mississippi	44,000	57,000	137,590	56,459	47,894	229,484	161,353
Missouri	29,000	50,000	71,614	56,409	27,623	128,237	134,032
Ohio	40,000	66,000	27,884	27,284	16,425	84,309	109,709
Tennessee	13,000	22,000	0	3,819	14,669	27,669	40,488
Wisconsin	70,000	115,000	138,449	145,592	88,166	296,615	348,758
MISSISSIPPI FLYWAY	560,000	930,000	791,002	907,614	582,789	1,933,791	2,420,403
Connecticut	8,000	13,000	2,356	1,502	4,779	15,136	19,281
Delaware	5,000	8,000	6,921	814	998	12,919	9,812
Florida	60,000	100,000	92,701	51,907	55,496	208,197	207,403
Georgia	30,000	65,000	181,679	115,745	59,856	271,535	240,601

Table 1. Wood duck population indices estimated by three techniques (continued):

	FHMUP Bureau Model		Simultaneous Equation Estimate		Forest Values[1]	Row Sum[2]	
	Adults	Immatures	Adults	Immatures	Wood Ducks	Adults	Immatures
Maine	17,000	28,000	35,099	53,842	43,862	95,961	125,704
Maryland	11,000	9,000	4,002	2,425	5,804	20,806	17,229
Massachusetts	25,000	40,000	20,641	29,721	7,018	52,659	76,739
New Hampshire	25,000	45,000	16,514	29,001	11,330	52,844	85,331
New Jersey	18,000	29,000	20,876	20,502	3,899	42,775	53,401
New York	40,000	70,000	57,612	73,467	39,025	136,637	182,492
North Carolina	40,000	55,000	80,818	91,825	37,270	158,088	184,095
Pennsylvania	23,000	37,000	57,594	69,276	28,482	109,076	134,758
Rhode Island	2,000	3,000	1,818	5,723	1,073	4,891	9,796
South Carolina	40,000	70,000	13,341	62,418	34,948	88,289	167,366
Vermont	15,000	30,000	16,751	32,718	13,903	45,654	76,621
Virginia	10,000	10,000	5,014	34,272	14,183	29,197	58,455
West Virginia	5,000	8,000	22,067	48,821	17,134	44,201	73,955
ATLANTIC FLYWAY	374,000	620,000	635,804	723,979	379,060	1,388,864	1,723,039
Ontario	135,124	196,000	71,482	117,261	100,000	306,606	413,261
Quebec	25,169	19,264	20,316	17,244	26,000	71,485	62,508
CANADA	160,293	215,264	91,798	134,505	126,000	378,091	475,769
EASTERN NORTH AMERICA	1,094,293	1,765,264	1,518,604	1,766,098	1,087,849	3,700,746	4,619,211

[1]The same value was used for immatures and adults.

[2]Total sum of the three estimates.

Table 2. Estimated harvest distribution of wood ducks in eastern North America.[1]

Harvest Area	Immatures Harvest Survey	Immatures Weighted Recoveries	Adults Harvest Survey	Adults Weighted Recoveries
Connecticut	0.4	0.4	0.4	0.2
Delaware	T[2]	0.2	0.1	0.3
Florida	3.5	5.7	4.1	8.5
Georgia	2.4	5.2	3.1	10.0
Maine	0.7	2.5	0.9	1.2
Maryland	0.2	0.2	0.2	0.2
Massachusetts	0.8	0.9	0.8	1.2
New Hampshire	0.6	1.4	0.6	0.8
New Jersey	1.0	1.2	1.1	1.2
New York	4.7	3.2	3.3	3.2
North Carolina	3.2	4.1	3.9	4.4
Pennsylvania	3.4	3.5	2.6	1.9
Rhode Island	T	0.1	T	T
South Carolina	3.8	5.7	5.2	6.2
Vermont	0.6	1.2	0.4	0.8
Virginia	0.9	1.1	1.0	0.6
West Virginia	0.2	0.4	0.2	0.4
ATLANTIC FLYWAY TOTAL	26.4	37.0	27.9	41.1
Alabama	1.8	3.6	2.4	4.9
Arkansas	2.8	3.4	4.7	4.2
Illinois	4.0	3.2	3.7	2.5
Indiana	1.1	1.0	0.9	1.0
Iowa	3.7	2.7	2.5	2.0
Kentucky	0.6	0.2	0.1	0.5
Louisiana	10.0	9.0	12.4	10.8
Michigan	3.2	3.9	3.2	2.2
Minnesota	11.3	5.8	8.6	2.6
Mississippi	2.4	4.0	3.6	7.1
Missouri	1.4	1.7	1.3	1.7
Ohio	3.6	2.0	3.2	1.6
Tennessee	1.0	0.9	1.7	1.4

Table 2. Estimated harvest distribution of wood ducks in eastern North America.[1] (continued):

	Age			
	Immatures		Adults	
Harvest Area	Harvest Survey	Weighted Recoveries	Harvest Survey	Weighted Recoveries
Wisconsin	7.2	7.8	8.1	4.9
MISSISSIPPI FLYWAY TOTAL	54.1	49.2	56.4	47.4
Texas	2.0	3.5	2.7	3.8
CENTRAL FLYWAY TOTAL	2.0	3.5	2.7	3.8
Ontario	15.5	8.5	11.0	5.9
Quebec	2.1	1.9	1.9	1.6
CANADA TOTAL	17.6	10.4	12.9	7.5
Total	100.1	100.1	99.9	99.8

[1]Based on an average weighting factor for direct recoveries from bandings in 1950-68.

[2]Percentages less than 0.1% are indicated by T.

Table 3. Population-unit harvest distribution of adult and immature wood ducks banded May-September 1950-68[1]

Harvest Area	North-eastern		New York-E. Canada		South-eastern		Lake States		Southern		North Central	
	A	I	A	I	A	I	A	I	A	I	A	I
Connecticut	1.1	2.0	0.0	T[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delaware	2.1	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0
Florida	7.7	4.3	8.6	5.2	30.1	27.7	7.0	4.4	3.2	5.4	1.6	0.7
Georgia	10.3	6.3	11.3	5.0	28.1	22.0	6.7	3.6	6.5	4.2	1.5	0.4
Maine	8.0	13.7	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maryland	0.6	0.8	0.3	T	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Massachusetts	6.5	4.6	0.7	T	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0
New Hampshire	5.4	7.5	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New Jersey	6.4	4.7	0.9	1.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New York	2.0	1.9	15.4	14.2	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0
North Carolina	8.1	7.3	5.6	5.4	13.8	15.4	1.4	1.2	0.0	0.9	0.2	0.2
Pennsylvania	7.7	13.9	3.4	3.0	0.0	0.0	0.3	0.0	0.0	0.0	T	T
Rhode Island	T	0.5	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Carolina	14.0	8.7	6.7	6.0	17.7	26.7	3.2	2.4	0.0	1.3	0.6	0.2
Vermont	4.9	6.4	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virginia	1.6	1.5	1.5	2.6	0.0	2.4	0.0	0.2	0.0	0.0	0.0	0.0
West Virginia	2.7	2.3	0.0	T	0.0	0.0	0.5	T	0.0	0.0	0.0	0.0
ATLANTIC FLYWAY[3]	89.3	89.0	54.4	43.1	89.9	94.2	19.9	11.8	10.1	11.8	3.9	1.5
Alabama	2.8	3.7	2.5	1.8	3.7	1.5	5.9	5.2	14.9	13.5	3.1	1.4
Arkansas	0.8	T	0.9	0.6	0.0	0.3	2.7	3.4	9.2	11.4	8.6	5.1
Illinois	0.0	T	0.0	0.0	0.0	0.0	2.3	4.1	0.0	0.4	8.5	9.0
Indiana	0.0	0.0	4.0	0.0	0.0	0.0	5.8	8.6	0.0	0.3	0.7	0.1
Iowa	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.1	0.0	7.5	8.7
Kentucky	0.2	T	0.0	0.0	0.0	0.0	0.7	0.3	2.2	1.4	0.2	T
Louisiana	1.2	1.2	1.5	2.2	2.1	1.9	13.7	8.7	27.2	31.2	17.7	11.6
Michigan	0.6	T	0.7	0.5	0.0	0.0	18.1	32.1	0.1	0.0	0.5	0.2

Table 3. Population-unit harvest distribution of adult and immature wood ducks banded May-September 1950-68[1](continued):

Harvest Area	North-eastern		New York-E. Canada		South-eastern		Lake States		Southern		North Central	
	A	I	A	I	A	I	A	I	A	I	A	I
Minnesota	0.0	0.0	0.0	0.5	0.0	0.0	0.3	0.0	0.0	0.0	9.8	19.7
Mississippi	0.2	0.8	4.5	1.1	2.1	2.1	8.4	6.2	21.1	16.0	7.9	3.0
Missouri	0.0	T	0.6	0.1	0.0	0.0	0.6	0.6	0.2	T	5.5	5.6
Ohio	0.2	1.2	0.7	0.6	0.0	0.0	13.4	13.4	0.0	0.0	0.3	0.3
Tennessee	0.5	1.3	0.1	0.3	2.0	0.0	2.0	0.4	3.5	1.5	1.2	1.1
Wisconsin	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.6	1.2	0.3	16.6	25.5
MISSISSIPPI FLYWAY	6.6	8.2	12.9	8.6	9.9	5.7	76.7	85.5	79.7	76.1	87.9	91.3
Texas	0.0	T	0.9	0.0	0.0	0.0	1.6	1.6	10.2	12.1	8.1	7.2
CENTRAL FLYWAY	0.0	T	0.9	0.0	0.0	0.0	1.6	1.6	10.2	12.1	8.1	7.2
Ontario	1.3	0.2	26.3	40.7	0.1	0.0	1.7	0.9	0.0	0.0	0.0	T
Quebec	2.5	2.3	5.2	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CANADA	3.8	2.5	31.5	48.0	0.1	0.0	1.7	0.9	0.0	0.0	0.0	T
Total %	99.7	99.7	99.8	99.7	99.9	99.9	99.9	99.8	100.0	100.0	99.9	100.0

[1]Based on the average of three sources of weighted direct recoveries.
[2]Percentages less than 0.1% are indicated by T.
[3]Flyway values were calculated separately using larger volumes of data and do not necessarily correspond to column sums.

Table 4. The five most important areas harvesting wood ducks produced in each population unit (demonstrates where most of a unit's wood ducks are shot).

Age Class			
Adults		Immatures	
Northeastern Unit		Northeastern Unit	
South Carolina	14.0%	Pennsylvania	13.9%
Georgia	10.3%	Maine	13.7%
North Carolina	8.1%	South Carolina	8.7%
Maine	8.0%	New Hampshire	7.5%
Florida	7.7%	North Carolina	7.3%
Total %	48.1	Total %	51.1
New York-E. Canada Unit		New York-E. Canada Unit	
Ontario	17.5%	Ontario	40.7%
New York	15.4%	New York	14.2%
Georgia	11.3%	Quebec	7.3%
Florida	8.6%	South Carolina	6.0%
South Carolina	6.7%	North Carolina	5.4%
Total %	59.5	Total %	73.6
Southeastern Unit		Southeastern Unit	
Florida	30.1%	Florida	27.7%
Georgia	28.1%	South Carolina	26.7%
South Carolina	17.7%	Georgia	22.0%
North Carolina	13.8%	North Carolina	15.4%
Alabama	3.7%	Virginia	2.4%
Total %	93.4	Total %	94.2
North Central Unit		North Central Unit	
Louisiana	17.7%	Wisconsin	25.5%
Wisconsin	16.6%	Minnesota	19.7%
Minnesota	9.8%	Louisiana	11.6%
Arkansas	8.6%	Illinois	9.0%
Illinois	8.5%	Iowa	8.7%
Total %	61.2	Total %	74.5
Lake States Unit		Lake States Unit	
Michigan	18.1%	Michigan	32.1%
Louisiana	13.7%	Ohio	13.4%
Ohio	13.4%	Louisiana	8.7%
Mississippi	8.4%	Indiana	8.6%
Florida	7.0%	Mississippi	6.2%
Total %	60.6	Total %	69.0

Table 4. The five most important areas harvesting wood ducks produced in each population unit (demonstrates where most of a unit's wood ducks are shot) (continued):

Age Class			
Adults		Immatures	
Southern Unit		Southern Unit	
Louisiana	31.2%	Louisiana	27.2%
Mississippi	16.0%	Mississippi	21.1%
Alabama	13.5%	Alabama	14.9%
Texas	12.1%	Texas	10.2%
Arkansas	11.4%	Arkansas	9.2%
Total %	84.2	Total %	82.6

Table 5. Harvest distribution of adult and immature wood ducks banded May-September 1950-68 (based on an average weighting factor for direct recoveries).[1]

Harvested In	Northeastern		New York-E. Canada		Southeastern		Lake States		Southern		North Central	
	A	I	A	I	A	I	A	I	A	I	A	I
Northeastern	45.6	58.9	5.1	7.0	0.1	T	0.8	T	0.4	0.0	T	T
New York-E. Canada	5.9	4.4	46.9	62.2	0.2	0.0	2.4	0.9	0.0	0.0	0.0	T
Southeastern	41.8	28.1	33.9	21.6	89.6	94.2	18.5	11.8	9.7	11.8	4.0	1.5
Lake States	0.9	1.3	2.7	1.4	0.0	0.0	37.4	54.1	0.1	0.2	1.4	0.8
Southern	5.7	7.2	10.7	6.2	10.1	5.8	34.9	25.9	88.3	87.0	46.7	29.3
North Central	T	T	0.7	1.6	0.0	0.0	6.0	7.3	1.5	1.0	47.8	68.4
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Atlantic Flyway	89.4	89.1	54.5	43.2	89.9	94.2	19.9	12.0	10.1	11.8	3.9	1.5
Mississippi Flyway	6.7	8.3	12.9	8.7	9.9	5.8	77.0	85.6	79.7	76.1	87.9	91.2
Central Flyway[2]	0.0	T	1.0	0.0	0.0	0.0	1.4	1.7	10.2	12.1	8.2	7.2
Canada[3]	3.9	2.5	31.6	48.1	0.2	0.0	1.7	0.7	0.0	0.0	0.0	T
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1]Expressed as percentages for A (adults) and I (immatures). T equal to less than 0.1%.
[2]Texas was the only state tabulated.
[3]Composed of eastern Ontario and southern Quebec.

Table 6. Derivation of harvest for adult and immature wood ducks.[1]

Harvest Area	Population-Unit Origin (%)[2]											
	Northeastern		New York-E. Canada		Southeastern		Lake States		Southern		North Central	
	A	I	A	I	A	I	A	I	A	I	A	I
Connecticut	100.0	97.3	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delaware	94.6	83.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0
Florida	14.4	14.0	20.0	18.8	47.2	43.8	8.4	9.2	5.2	10.5	4.9	3.6
Georgia	17.0	22.2	24.3	19.9	38.7	38.6	7.1	8.3	8.9	8.7	4.0	2.4
Maine	97.8	100.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maryland	50.5	90.7	24.8	9.3	0.0	0.0	0.0	0.0	24.3	0.0	0.0	0.0
Massachusetts	87.0	98.2	13.0	1.1	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0
New Hampshire	100.0	98.8	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New Jersey	81.9	72.5	16.4	27.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New York	9.8	11.1	87.9	88.9	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0
North Carolina	29.0	32.1	24.5	26.7	41.9	33.9	3.3	3.6	0.0	2.2	1.3	1.5
Pennsylvania	60.4	80.7	36.4	18.5	0.0	0.0	2.0	0.0	0.0	0.0	1.1	0.8
Rhode Island	100.0	91.5	0.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Carolina	36.1	27.8	20.7	21.5	35.5	42.1	5.5	5.0	0.0	2.5	2.8	1.0
Vermont	100.0	99.4	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virginia	46.6	25.5	53.4	50.5	0.0	21.3	0.0	2.7	0.0	0.0	0.0	0.0
West Virginia	88.7	94.5	0.0	2.8	0.0	0.0	11.3	2.7	0.0	0.0	0.0	0.0
ATLANTIC FLYWAY	34.0	44.0	26.0	24.0	29.0	23.0	4.0	4.0	4.0	3.0	3.0	1.0

Table 6. Derivation of harvest for adult and immature wood ducks.[1] (continued):

Harvest Area	Population-Unit Origin (%)[2]											
	Northeastern		New York-E. Canada		Southeastern		Lake States		Southern		North Central	
	A	I	A	I	A	I	A	I	A	I	A	I
Alabama	9.1	18.3	10.7	10.5	10.1	3.7	12.4	17.2	41.0	39.2	16.8	11.0
Arkansas	3.2	0.4	4.5	3.5	0.0	0.9	6.6	11.8	30.4	38.5	55.3	44.7
Illinois	0.0	0.1	0.0	0.0	0.0	0.0	10.1	16.1	0.0	1.6	89.9	82.3
Indiana	0.0	0.0	26.6	0.0	0.0	0.0	55.5	95.4	0.0	3.8	17.9	0.7
Iowa	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.9	0.0	99.1	93.8
Kentucky	7.4	12.2	0.0	0.0	0.0	0.0	15.1	21.5	65.6	55.0	11.9	11.2
Louisiana	1.8	2.5	2.8	5.0	2.8	1.9	13.1	11.6	34.9	40.3	44.6	38.6
Michigan	4.6	0.1	6.5	3.1	0.0	0.0	82.3	95.4	0.7	0.0	5.9	1.4
Minnesota	0.0	0.0	0.0	2.0	0.0	0.0	1.4	0.0	0.0	0.0	98.6	98.0
Mississippi	0.6	3.6	13.3	5.8	4.1	4.7	12.3	18.4	39.9	45.8	29.9	21.9
Missouri	0.0	0.2	8.4	0.9	0.0	0.0	3.3	3.8	2.0	0.4	86.2	94.7
Ohio	2.4	12.9	8.5	6.0	0.0	0.0	84.6	77.2	0.0	0.0	4.4	4.0
Tennessee	5.5	28.8	1.8	6.9	20.3	0.0	15.1	5.6	34.3	20.7	22.8	38.1
Wisconsin	0.0	0.0	0.0	0.0	0.0	0.0	5.9	4.0	3.5	0.5	90.6	95.6
MISSISSIPPI FLYWAY	2.0	3.0	5.0	4.0	3.0	1.0	17.0	20.0	23.0	18.0	50.0	54.0
Texas	0.0	0.3	4.8	0.0	0.0	0.0	4.0	5.2	35.6	37.5	55.5	57.2
CENTRAL FLYWAY	0.0	0.3	4.8	0.0	0.0	0.0	4.0	5.2	35.6	37.5	55.5	57.2
Ontario	3.7	0.4	92.8	98.1	0.3	0.0	3.2	1.2	0.0	0.0	0.0	0.2
Quebec	29.4	24.4	70.6	75.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CANADA	9.0	5.0	88.0	94.0	T	0.0	3.2	1.0	0.0	0.0	0.0	T

[1]Expressed as a percent and based on weighted direct recoveries from bandings in May-September 1950-68.
[2]Percentages less than 0.1% are indicated by T for adults (A) and immatures (I).

Table 7 shows the derivation of harvest in combined states within each population unit. Northern units derived most of their immature (92 percent) and adult (88 percent) harvest from birds produced in each unit, but southern units derived only 40 percent of their harvest from locally-produced birds.

Time of Harvest

The dates of waterfowl hunting seasons are selected in accordance with migrational behavior and generally occur during a time of peak abundance. Among wood ducks, the largest harvest in northern population units occurs in October and early November. In southern population units, the harvest peaks in December. We showed earlier that relatively more immatures than adults banded in northern units were harvested therein (Table 5). Differences also occurred between adult males and adult females in the time and location of harvest. In general, females dominated the October-November harvest in northern areas, while northern males were dominant in the December-January harvest of southern states (Table 8).

Age and Sex Differences in Direct Recovery Rates

We assumed that direct recovery rates from banded samples provided valid indices of rates of harvest and thus could be used to measure age, sex, and population differences in both shooting pressure and vulnerability to shooting the first hunting season after banding. Immature recovery rates were significantly higher than adult rates in 20 of 23 state comparisons. Males of each age were more likely to be shot than were females.

Population Differences in Direct Recovery Rates

Direct recovery rates of wood ducks varied among population units with rates being lower for birds banded in southern units (Table 9). For example, among immature males, the highest rate (0.0914) was in the New York-Eastern Canada Unit and the lowest (0.0493) was from the Southeastern Unit.

We also compared recovery rates among three broad geographic regions: Zone 1—Ontario and states above 42° N. Latitude; Zone 2—states between 37° and 42° N. Latitude, and Zone 3—states below 37° N. Latitude. Direct recovery rates of each age and sex were lower in Zone 3 (southern states) than in Zone 1 (northern states). Except for adults males, recovery rates in Zone 3 were significantly lower than those from Zone 2.

Age and Sex Differences in Survival Rates

Estimated average annual survival rates for wood ducks banded from May to September, 1960-68 were higher among adult males than adult females in 8 of the 10 states having adequate data. Rates averaged 53.6 percent for males and 46.8 percent for females, and the differences were statistically significant. Among immatures banded in the same states, female survival averaged 45.0 percent, but male survival was 40.0 percent. However, this difference was not significant.

Table 10 summarizes age- and sex-specific survival rates of wood ducks banded in each population unit. Figures shown under "Average Survival" repre-

Table 7. Population-unit derivation of harvest for adult and immature wood ducks banded May-September 1950-68.[1]

Harvested In	Population Unit Origin (%)[2]												Total Percent
	Northeastern		New York-E. Canada		Southeastern		Lake States		Southern		North Central		
	A	I	A	I	A	I	A	I	A	I	A	I	
Northeastern	85.3	91.3	12.5	8.4	0.2	T	1.0	T	0.6	0.0	0.4	0.2	100.0
New York-E. Canada	8.9	6.2	88.6	92.9	0.1	0.0	2.4	0.8	0.0	0.0	0.0	0.1	100.0
Southeastern	22.1	23.8	21.7	22.3	41.9	39.3	6.3	6.6	4.5	5.9	3.5	2.1	100.0
Lake States	2.9	3.4	11.0	3.2	0.0	0.0	78.0	91.0	0.3	0.5	7.8	1.9	100.0
Southern	2.7	5.4	6.1	4.8	4.2	2.3	10.5	12.4	36.1	39.4	40.4	35.7	100.0
North Central	0.0	T	0.9	1.4	0.0	0.0	4.4	3.8	1.5	0.4	93.2	94.3	100.0

[1]Expressed as a percent and based on weighted direct recoveries from bandings in May-September 1950-68.
[2]Percentages less than 0.1% are indicated by T for adults (A) and immatures (I).

Table 8. Monthly distribution of harvest for adult wood ducks banded May-September 1950-68.[1]

Banded In	Sex	Sept.	Oct.	Nov.	Dec.	Jan.	Total Percent	Total Recoveries
North Central	Male	0.1	43.2	18.2	33.4	5.1	100.0	958
	Female	0.6	45.0	24.1	28.0	2.3	100.0	481
Lake States	Male	0.7	36.7	20.4	36.0	6.2	100.0	275
	Female	0.6	45.3	19.4	30.0	4.7	100.0	170
New York-E. Canada	Male	7.7	51.1	14.4	21.1	5.7	100.0	209
	Female	4.3	60.6	16.0	12.8	6.3	100.0	94
Northeastern	Male	2.3	47.2	21.8	23.1	5.6	100.0	390
	Female	3.5	47.0	21.8	22.7	5.1	100.1	256
Northern Regions[2]	Male	2.4	44.9	18.5	28.8	5.5	100.1	1,832
	Female	2.1	49.0	21.0	23.7	4.2	100.0	1,001

[1]Based on weighted recoveries.
[2]Weighted average of the four regions.

Table 9. Direct recovery rates for different age and sex classes of wood ducks banded in six population units (1950-68).

Banded In	Direct Recovery Rates Adult Males	Adult Females	Immature Males	Immature Females
North Central Unit	0.0531	0.0474	0.0726	0.0665
Lake States Unit	0.0519	0.0460	0.0785	0.0599
Southern Unit	0.0357	0.0258	0.0465	0.0250
MISSISSIPPI FLYWAY	0.0478	0.0409	0.0667	0.0561
Northeastern Unit	0.0666	0.0568	0.0827	0.0718
N.Y.-E. Canada Unit	0.0659	0.0620	0.0914	0.0767
Southeastern Unit	0.0436	0.0297	0.0493	0.0258
ATLANTIC FLYWAY	0.0636	0.0567	0.0824	0.0675
ALL UNITS (WEIGHTED)	0.0544	0.0475	0.0733	0.0609

Table 10. Estimated average annual survival rates of wood ducks.[1]

Population Unit	Age and Sex	Average Survival (%)[2] Recent	Selected[3] Recent	Composite Survival (%)[4] Recent	Selected Recent
North Central	Adult Male	53.7(5)	53.4(5)	54.0(5)	54.0(5)
	Adult Female	45.6(5)	44.7(3)	47.1(5)	47.1(5)
	Immature Male	40.3(5)	41.1(5)	42.3(5)	42.3(5)
	Immature Female	47.0(5)	43.7(3)	46.0(5)	46.0(5)
Lake States	Adult Male	52.8(3)	52.5(3)	53.2(3)	53.2(3)
	Adult Female	48.1(1)	50.7(1)	51.4(3)	51.4(3)
	Immature Male	42.3(3)	42.6(3)	41.5(3)	41.5(3)
	Immature Female	47.5(2)	47.1(1)	44.1(3)	44.1(3)
Southern	Adult Male	51.4(2)	58.5(1)	60.7(7)	60.7(7)
	Adult Female	51.6(1)	– (–)	57.5(7)	57.5(7)
	Immature Male	50.4(1)	50.4(1)	56.0(7)	56.0(7)
	Immature Female	59.8(1)	60.1(1)	63.8(7)	63.8(7)
MISSISSIPPI FLYWAY	Adult Male	53.2(10)	53.4(9)	56.2(15)	56.2(15)
	Adult Female	46.0(7)	45.5(4)	51.5(15)	51.5(15)
	Immature Male	41.1(9)	41.7(7)	46.5(15)	46.5(15)
	Immature Female	47.3(8)	44.6(7)	51.3(15)	51.3(15)

New York- E. Canada	Adult Male	48.6(2)	54.2(2)	52.8(3)	52.8(3)
	Adult Female	52.0(1)	– (–)	48.4(3)	48.4(3)
	Immature Male	35.7(2)	36.5(1)	36.1(3)	36.1(3)
	Immature Female	33.0(1)	– (–)	35.0(3)	35.0(3)
Northeastern	Adult Male	49.9(2)	50.0(2)	52.1(11)	52.1(11)
	Adult Female	33.8(1)	– (–)	49.1(11)	49.1(11)
	Immature Male	29.5(1)	42.2(1)	39.2(11)	39.2(11)
	Immature Female	26.4(1)	– (–)	34.9(11)	34.9(11)
Southeastern	Adult Male	54.0(1)	– (–)	54.8(5)	54.8(5)
	Adult Female	56.5(1)	– (–)	74.7(5)	– (–)
	Immature Male	75.6(1)	75.6(1)	75.0(5)	– (–)
	Immature Female	58.8(1)	– (–)	56.1(5)	– (–)
ATLANTIC FLYWAY	Adult Male	49.5(5)	53.3(4)	53.4(19)	53.4(19)
	Adult Female	50.4(3)	– (–)	59.8(19)	48.7(14)
	Immature Male	41.1(4)	52.8(3)	52.2(19)	37.8(14)
	Immature Female	41.9(3)	– (–)	43.4(19)	34.9(14)

[1]1960-67 seasons for Atlantic Flyway Units and 1962-68 seasons for Mississippi Flyway Units.
[2]A weighted average obtained by averaging rates from component states of each unit (numbers of states are parenthesized).
[3]Selected rates were restricted to states or units with three or more years of survival rates (data with a coefficient of variation exceeding 40% were also excluded).
[4]Rates obtained by using all banding and recovery data from a population unit.

sent an average for all states within the unit, weighted for differences among states in the estimated abundance of birds. Estimates shown under the "Composite Survival" column are based on total numbers banded and recovered for each unit and probably are more reliable than weighted state estimates. The "Selected Recent" survival rates represent the best estimates obtained from available data.

Weighted rates for combined populations throughout eastern North America suggest that annual survival (with one standard error) has averaged 55.0 ± 2.9 percent for adult males and 50.2 ± 4.0 percent among adult females. For immatures, recent rates have averaged 42.9 ± 6.8 percent for males and 44.5 ± 10.4 percent for females.

Population Differences in Survival Rates

Estimates of average adult survival ranged from a low of 47.1 percent for females in the North Central Unit to a high of 60.7 percent for males in the Southern Unit. Immature survival rates showed a similar wide range among populations. Unfortunately, banding and recovery records were not adequate to assess the extent to which there were real differences in wood duck survival rates among the various populations. However, with the exception of immature females, survival rates of birds banded in states above 42° N. Latitude were significantly lower than rates among birds banded south of this line.

Conclusions

Population Units

One of the most interesting and potentially useful findings from this study was the identification of different summer populations. Three distinct population units were defined in the Atlantic and Mississippi Flyways. Wood ducks from these six units differ in both harvest characteristics and abundance, thus indicating that opportunities for differential regulations are available.

Indirect Population Estimates

Average indirect population estimates for 1962-68 seemed to provide realistic figures on numbers of wood ducks within population units and flyways. However, the population estimates for individual states and provinces are not reliable. Unfortunately, there was no independent way in which validity of the figures could be assessed. Accuracy depended upon precise information on size and rates of harvest, along with the assumption that all major populations of wood ducks were adequately represented by bandings and recoveries. It is impossible to judge how well those conditions were fulfilled. Various factors could have affected reliability of the indirect population estimates. Therefore, it seems likely that these figures better represent indices of comparative abundance than actual numbers of wood ducks present in different regions of eastern North America.

Distribution and Derivation of Harvest

Most of the harvest of wood ducks from each northern population unit occurs in states within that unit or on the southern wintering ground. Little interchange occurs among northern populations. For example, a desire to decrease the harvest of wood ducks produced in the North Central Unit would require no curtailment of the harvest within states in the Lake States Unit because only a small percentage of the harvest from the North Central Unit occurs within the Lake States. Both units contribute importantly to the harvest in southern states; consequently, any major changes in harvest levels in southern units could have an impact upon numbers of wood ducks returning to northern breeding grounds.

Age and Sex Differences in Time and Location of Harvest

There were striking age and sex differences among northern wood ducks in the time and location of harvest. Adult females and immatures of each sex were predominant in the harvest in northern states. In contrast, a higher proportion of the adult male harvest occurred on the wintering ground later in the year. A similar age and sex pattern in harvest has been reported for black ducks (Geis, Smith, and Rogers 1971) and mallards (Anderson and Henny 1972). Research in progress at the Migratory Bird and Habitat Research Laboratory suggests that these age and sex differences in the harvest probably are a characteristic of North American ducks. There are important management implications for wood ducks. Changes in harvest levels within northern states are more likely to affect immatures and adult females, rather than adult males. Changes in harvest levels late in the year in southern states would have a greater impact upon adult males from northern populations.

Age, Sex, and Population Differences in Recovery and Survival Rates

Throughout the eastern United States, adult male wood ducks were 1.15 times more likely to be shot than adult females, and immature males were 1.20 times more vulnerable to shooting than immature females. The relative vulnerability of immatures to adults averaged 1.31. Similar relationships in vulnerability to shooting have been reported for many waterfowl species, including black ducks (Geis, Smith, and Rogers 1971), green-winged teals (Moisan, Smith, and Martinson 1967), and mallards (Geis 1972).

Direct recovery rates of northern wood ducks were higher than rates from southern states, suggesting that northern birds sustain higher rates of harvest. Birds from northern populations encounter a procession of opening dates of the hunting season during their southward migration, resulting in an extended open season. Recovery rates of wood ducks from southern populations could be expected to be lower because of the buffering effect of northern birds during the hunting season, and because southern birds are exposed to a shorter hunting period.

Throughout their range, adult wood ducks had higher survival rates than immatures. Although average annual survival of adult males appeared to be higher than that of adult females, average survival was essentially the same for both sexes of immatures. Wood ducks banded in areas above 42° N. Latitude had significantly lower survival rates and higher recovery rates than did birds banded south of this line. However, any apparent correlation between high recovery rates and low survival rates does not necessarily indicate cause and effect from shooting. The lower survival rates of northern wood ducks could have been caused by higher losses from natural mortality factors. The relationship between shooting mortality and total mortality in migratory birds is poorly understood, and much additional research is needed to assess the impact of shooting upon wood ducks.

Management Recommendations

There appears to be a good biological basis for management of wood ducks within existing boundaries of the Atlantic and Mississippi Flyways. There is limited interchange of birds between the two flyways and most of the harvest in northern population units comes from locally-produced birds. In contrast, the harvest within southern units is greatly augmented by northern birds. Recognition of population-unit differences in harvest characteristics and survival offers considerable potential for improved management, and in the future, it may be possible to regulate the harvest from each population more effectively.

Although data were limited, the difference between recovery and survival rates of northern and southern wood ducks suggests that there may be an opportunity for increased hunting recreation and harvest in southern states. However, any increased kill in southern states should take place before northern birds arrive on the wintering ground. Wood ducks from northern populations are exposed to heavy shooting pressure, and the comparatively low survival rates of females in some populations suggest that increased harvest of these birds may not be wise.

Optimal management of wood ducks would require periodic estimates of abundance within each population unit. In the absence of direct censuses, the most promising solution lies in the development of satisfactory mathematical methods (such as we attempted with simultaneous equations). However, reliable mathematical estimates of abundance will require more precise information on sizes and rates of harvest from all populations than is presently available. The banding and harvest survey improvement that is needed may not be economically feasible at this time.

We recommend that banding be continued and expanded as the major method for monitoring harvest, estimating survival rates, and better defining population units. A larger banding effort is especially needed in the Southern and Southeastern Units to verify that wood duck survival rates are higher in southern states. Bandings are also needed in the Canadian Maritime Provinces, western Ontario, and elsewhere if such areas contain large numbers of wood ducks.

In order to minimize the marking of transient birds, pre-hunting season bandings should be restricted to May 1-August 31 in northern and May 1-September 30 in southern units. The importance of adequate and consistent banding cannot be over-emphasized. A large banding effort in one year, followed by little effort in the next, eliminates data from both years for the purpose of calculating survival. Also, for maximum usefulness, adequate samples of each age and sex must be marked annually.

We estimated that it would be necessary to band a total of nearly 46,000 wood ducks each year in order to obtain useful annual survival estimates of each age and sex (Bowers and Martin 1974). However, fewer bandings will be required if average annual estimates of survival and harvest rates are used to monitor the status of different populations.

Finally, there is a serious need to assess the extent to which direct recovery rates represent the actual harvest rates of wood ducks from different population units. There may be major regional differences in the extent to which hunters report bands from wood ducks. Periodic use of reward bands would provide valuable insight into this question and would be needed to monitor probable changes in reporting of bands resulting from an expanded banding program.

Acknowledgements

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Discussion

DISCUSSION LEADER HENNEY: Thank you, Frank. You have covered a lot of information here. I am sure there are going to be some questions. I might start off the question and answer discussion by asking you whether there has been any move in recent times to do a reward band study on wood ducks. I think there is a key factor, especially where you can look at the harvest or at the direct recovery rates, but if you do not have a feel for what percentage of hunters are sending in bands, it is very difficult to obtain an estimate of the harvest rates.

MR. BOWERS: To my knowledge, none has been done for the wood duck. I know that reward bands have been used in past studies but as far as the wood duck goes, I do not believe so. However, you are correct— a lot of data was based on direct recovery rates mainly because we were skeptical of reporting rates that are now being obtained.

FROM THE FLOOR: I wonder if one keeps banding local populations of wood ducks, will the recovery rate go down? After all, people do become so familiar with the fact that it is just a departmental operation three miles up the river that they do not send their bands in.

MR. BOWERS: Well, this might be possible. I think there are studies that show that reporting rates are great around the area of banding because people are more likely to report those birds—they are familiar with the programs going on.

FROM THE FLOOR: I would suggest that the reason that recovery rates rely on banding stations is simply because the birds are there. This is the place where they have come down for refuge purposes, etc. However, it is the mystery of the distant recovery that impels a man to report a duck band, whereas the present hunter who knows the presence of the banding program, will simply not do anything but dump the thing. Therefore, what I am implying is that we keep on banding wood ducks year after year and that people simply become aware of the fact that the wood ducks were banded only a few miles away, so they are simply going to stop their reporting.

MR. BOWERS: That may be true. I have no further comments.

MR. MARTIN: [United States Fish and Wildlife Service] I would like to make a comment. If we had a reliable operational survey to measure the abundance of wood ducks then I think we could maybe get out of the banding business insofar as they are concerned, particularly if we had reliable harvest information. However, lacking a reliable census procedure and because of the difficulties in making reasonable and reliable population estimates, I see no way that we can defer monitoring changes in population status of wood ducks by way of banding to measure survival rates and harvest rates. That is why, of course, we feel bands are needed—to correct the direct recovery rates to actual harvest rates.

CHAIRMAN HICKEY: There has been some talk about getting a 1970 equivalent of the CCC, where we will employ youth to do work somewhere in the natural environment. With some training, perhaps, these youngsters might be drafted into banding programs, where they could band representative samples of the population, like wood ducks.

Management of Atlantic Brant: Implications of Existing Data

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From 1933 to 1952 the harvesting of Atlantic Brant was prohibited in the Atlantic Flyway. The seasons were closed in response to a population decline that was thought to have been triggered by the disappearance of eel grass (*Zostera marina*), an important winter food of Brant along the Atlantic Coast prior to 1933 (Cottam 1935, Cottam *et al.* 1944). The season was reopened during the fall of 1951.

The first four seasons (1951-1952 to 1955-1956) varied from 10 to 30 days in length with a daily bag of from three to six birds. Following these four seasons, the seasons were increased to 60 to 70 days in length, and bag limits were set at six birds per day (Addy 1972). Under these harvest conditions the Brant population varied about an average of 180,000 birds (S.D. = 45,000) and sustained a mean annual harvest of 21,000 (S.D. = 8,800). The January inventory of 1971 recorded 151,000 Brant along the Atlantic Coast. One year later this number had dropped to 73,300, the population having sustained an estimated harvest of 70,000 during the 1971-1972 season. This kill was almost double the highest harvest previously recorded (37,300 during the 1963-1964 season) and had been taken from a largely adult population (.06 juveniles per adult). This exceptionally high harvest, followed by poor reproductive success in 1972 caused the population to decline to a 25-year low of 40,700 by January 1973.[1] Because of this precipitous decline the Brant season was closed during 1972 and has remained closed through 1973 and 1974.

Prior to the reopening of the season there will undoubtedly be an evaluation of harvest regulations and management strategy. Intermittent liberal and closed seasons are one approach to Brant management; however, a sustained annual harvest which varies with availability would seem to be more desirable. Since the harvest can significantly affect the population, accurate control of the harvest would be a primary prerequisite for maintaining the Brant population at huntable levels. Indeed, harvest manipulation is the only active management option available in the case of the Atlantic Brant.

The objective of this study was to use existing data in developing regulations designed for effective management of Atlantic Brant.

Materials

The data utilized in this study are the recovery records of Brant banded from 1965 through 1972 (U.S. Fish and Wildlife Service), aerial waterfowl inventories (U.S. Fish and Wildlife Service and New Jersey Division of Fish, Game, and

[1]All population, harvest and reproductive data from the U.S. Fish and Wildlife Service.

Shellfisheries 1948-1952), Brant harvest estimates (U.S. Fish and Wildlife Service 1955-1972), and age ratio information (New Jersey Division of Fish, Game and Shellfisheries 1961-1973).

Results and Discussion

The Atlantic Brant is a relatively long-lived bird (Phillips 1932, Cottam *et al.* 1944). The mean life expectancy for adults banded in 1965 and 1966 was four years, and the mean life expectancy for birds of the year banded in 1966 was two years. Such longevity permits the population to survive years of nearly total reproductive failure (Phillips 1932, Barry 1962). Brant do not breed until they are at least two years old, and average clutch size is approximately four (Barry 1962). The mean of the juvenile:adult age ratios observed from 1961 to 1972 was .65 (S.D. = .54) juveniles per bird in adult plumage. A minimum estimate for the juvenile:adult female ratio, calculated by doubling the individual juvenile to adult ratios yields a mean of 1.18 (S.D. = 1.09) juveniles per adult female. The estimate is a minimum because the number of nonbreeding second year birds could not be determined. These data indicate that years in which all adult females are able to reach their full reproductive potential are rather infrequent. A number of other authors have reported this extreme variability in the reproductive success of the Atlantic Brant (Barry 1962, Cottam *et al.* 1944, Phillips 1932).

The annual mortality rate for adult birds, based on direct recoveries, is 20 percent, compared to 45 percent for young of the year. These results are almost identical to those reported by Hansen and Nelson (1957) for Black Brant (*Branta bernicula orientalis*) along the Pacific Coast.

Using these mortality figures in the structural model for a stable population described by Henny et al. (1970), an average of .91 juveniles per breeding female is necessary to maintain a stable population. The observed minimum ratio of 1.18 previously stated barely exceeds the level needed.

If the harvest and inventory figures are indicative in some relative context of what is going on with the population, the adult mortality rate for 1971-1972 increased to about 40 to 50 percent. The causes of the record harvest, although somewhat unclear, may be related to a severe decrease in availability of sea lettuce, (*Ulva lactuca*), an important winter food (Penkala 1975). Increased activity by Brant in search of other foods may have increased their susceptibility to hunting pressure, but available information is far from conclusive.

In any event such a loss would have been difficult to recoup even with relatively successful breeding, but the Brant reproductive efforts during the summer of 1972 yielded only .0008 juveniles per adult.

It seems apparent that the mean reproductive success of the bird dictates that adult mortality should not rise appreciably above 20 percent. If the harvest could be controlled to achieve this end, continuous open seasons would be possible.

Harvests have traditionally been controlled by modifications in season length and bag limit. Less frequently, timing of the season has been used to affect harvest or direct harvest toward a particular sex or age class of the population.

In Black Brant, for instance, Denson and Murrell (1962) reported that 60 percent of the Brant killed in Humbolt Bay were shot during the final 2 ½ weeks of the open season. In addition they reported that the ratio of adult to immature birds in the hunter's bag rose as the season progressed. These results lead them to the conclusion that season timing could affect the harvest level and age structure of the population.

Since season length, bag limit and season timing were constant for Atlantic Brant from 1956 through 1972, one would expect the variability in harvest to result from factors such as population level, proportion of juveniles in the population, a relative index of hunting pressure (namely, calendar year), and/or some interaction of these factors. Multiple linear regression was used to test the reliability of these and other variables in predicting harvest. Eleven years of data (1960-1971) were available. The highest simple correlation was $r = 0.458$; between harvest and the independent variable representing the proportion of juveniles in the population. The highest multiple correlation coefficient observed was $r = 0.663$. In all cases, both multiple and simple regressions, the "F" values were not significant at the 95 percent level and none of the slopes were significantly different from zero.

The complete failure of these variables to predict harvest indicates that either (1) the measurement of one or more of these variables is rather inaccurate; or (2) one or more other factors not normally considered to affect harvest is in fact linked to the harvest rate. Examining 22 years of Atlantic Brant population data, Lynch (1972) cites some cogent arguments to support the possibility of inaccurate estimates of the variables. He points out that the seeming appearance and disappearance of adult birds is somewhat less than believable.

Yet, despite these problems, effective harvest control should be possible. If we assume that the Brant is not unique among the anatid species and that its harvest is to some extent affected by season length, bag limit and season timing, control of the harvest will be achieved by manipulating one or all of these factors.

New Jersey annually winters an average of 77 percent (S.D. = 10.1 percent) of the flyway population of Atlantic Brant. Recovery records from 1965 through 1972 showed that a yearly average of 64 percent (S.D. = 12.3 percent) of Brant band recoveries occur in New Jersey. Therefore, an initial consideration in a management scheme should be the geographic and temporal distribution of Brant harvest and wintering populations in New Jersey. Data on the distribution of wintering birds is provided by monthly waterfowl inventories (New Jersey Division of Fish, Game, and Shellfisheries 1953-1972), and data on harvest is available through band recovery records (U.S. Fish and Wildlife Service 1965-1972).

Recovery records from various ten minute blocks were combined so that the area of recovery coincided with the boundaries of specific flight segments used by New Jersey Division of Fish, Game, and Shellfisheries for its monthly fall and winter waterfowl inventories.

The percentages of the yearly maximum populations and percentage of the recovery records by biweekly period for the state are plotted in Figure 1. Brant population density in New Jersey reaches a maximum by mid-November, then remains relatively stable throughout the remainder of the season. The number of recoveries peaks during the last two weeks in October and the first two weeks in November, when slightly more than 50 percent of the harvest takes place.

Combination of the ten-minute blocks and flight segments yielded five specific sections of coastline, which are listed in Table 1 along with the mean percentage of the population supported in that segment and the percentage of the band

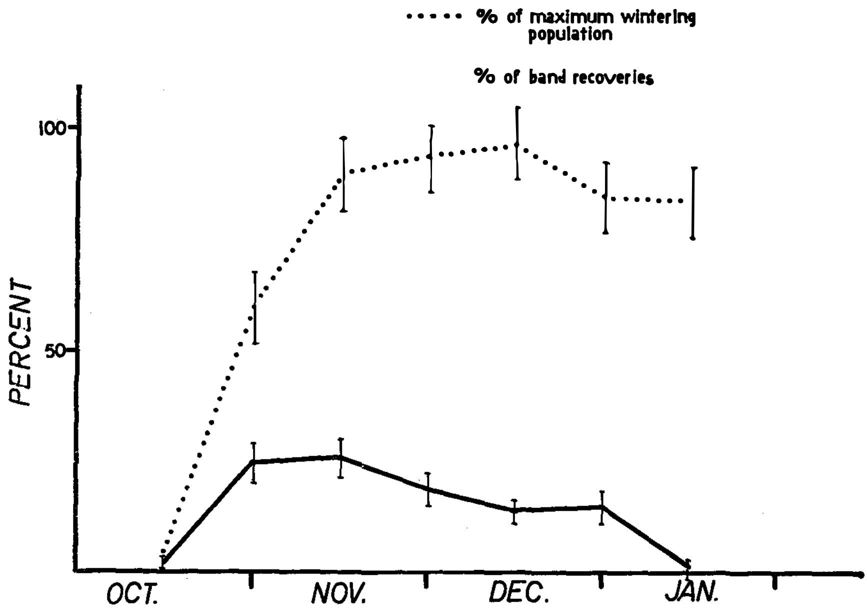

Figure 1. Mean percentage of population and band recoveries in N. J.

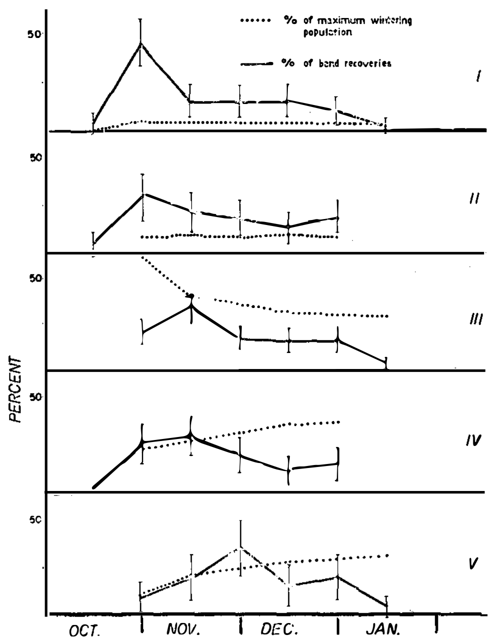

Figure 2. Percent Supported and recovered by segment

Table 1. The distribution of wintering Atlantic Brant and band recoveries in New Jersey.

	Flight Segment	Average Percentage of New Jersey Population Supported		Percent of All New Jersey Recovery Records	
		Mean	2 x S.D.	Percent	2 x S.D.
I.	Barnegat Bay Metedeconk River to Rt.72 Bridge, Manahawkin.	4.0	(2.4)	17.5	(7.6)
II.	Little Egg Harbor and Great Bay Rt. 72 Bridge to Oyster Creek	8.5	(3.4)	15.3	(7.2)
III.	Absecon and Reeds Bays and Brigantine National Wildlife Refuge	32.0	(13.8)	34.9	(9.6)
IV.	Lakes Bay to Seaisle City	34.1	(6.4)	19.8	(8.0)
V.	Seaisle City to Cape May Point	22.8	(6.8)	12.4	(6.4)

S.E. Standard error
S.D. Standard deviation

recoveries there. Those sites to the north of Absecon and Reeds Bays and Brigantine National Wildlife Refuge account for a higher percentage of the recovery records compared to the population wintering in that area, whereas segments to the south account for a small percentage compared to the wintering population.

Plots of the mean percentages of the total population and percentages of recovery records at each segment for biweekly intervals indicates that a relatively low and stable percentage of the population winter in the segments north of Segment III, whereas to the south the percentage increases throughout the season (Figure 2). Segment III, in contrast, begins with a rather high percentage but drops throughout the season. These changes probably represent a redistribution of the birds rather than new arrivals since the total population remains relatively stable after early November (Figure 1). The higher level of hunting pressures (Figure 2) indicated by the high percentage of band recoveries early in the season combined with the changes in distribution of the population throughout the season account for the disproportinate relationship between percent supported and percent recovered at the various segments. The relatively low percentage supported and high percentage of recovery records during late October at Segment I and II indicate that most of the harvest at these areas is taken as the birds migrate through.

The later peaks of percent recovered at the segments south of Segment III are probably related to the population density which does not reach its maximum until later in the season. Those segments supporting a high population density early in the season when hunting pressure is greatest will account for the highest proportion of the harvest. A majority of the hunting pressure is expended during the first two to four weeks of the season.

Therefore, a delay of from two to four weeks in the opening date of the season should greatly reduce the harvest. A shortcutting of the season by removing weeks in December or January would have little effect. One reason for the high hunting pressure early in the season is probably a lack of competition from other hunting seasons. In New Jersey an opening date during the second week in November would place the Brant season in competition with the upland game season.

The segments north of Segment IV would show the most significant decline in numbers harvested by a later opening date. The segments to the south would be little affected since a majority of their harvest occurs later in the season. A shift in distribution of hunters could nullify the effect of a delayed opening date, but since the total pressure is decreased late in the season, a redistribution of hunting pressure, if it does occur, should have a minimal effect.

Conclusions

Increasing the accuracy of estimates of harvest numbers, population levels and reproduction for Atlantic Brant appears to be necessary. The need for harvest control in Brant management is indicated, and since the Atlantic Brant winter in such a restricted area, the implementation and evaluation of new management strategy should be relatively easy. A delayed opening date should be utilized when harvest restrictions are dictated by adverse breeding conditions and a low population level. If this plan is implemented in New Jersey, an intensive field evaluation of its effect should be conducted.

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Discussion

DISCUSSION LEADER HENNEY: I have a few questions here in order to get the discussion started. The age ratio for that which you were discussing, I assume it is an age ratio based on field observation as opposed to the age ratio in the harvest, is that correct?

MR. PENKALA: No, it isn't. Not until the last three years have we gone to that method. Therefore, the age ratios would be more towards juveniles because they are more susceptible to gunning pressure. Since I don't know the number of second-year birds in the population which would tend to drop that ratio, I feel they kind of compensate for each other and that probably, in fact, my juvenile to adult ratios are more likely to be high than to be low. The actual reproductive rate is probably considerably lower than what was presented because they are from bag collections.

FROM THE FLOOR: I guess in Wisconsin I am exposed to Dr. Bryson, our meteorologist, who said to me not long ago, that the summer of 1971 did not come to Pappen Island—they had no summer. This is why the age ratio changed in relation to the high Arctic Geese at that time and it seems to me this illustrates one of the problems of managing a geese population—we do not get a handle on the age ratio on this population until some point after the birds have arrived and, if we cannot do that, then it seems to me we are in trouble. I wonder if the speaker would like to comment on how hunting seasons will be adjusted to what takes place in the High Arctic?

MR. PENKALA: For the past four years, Doug Heyland of the Canadian Fish and Wildlife Service, has been working with satellite photos and he has been very accurate, in a qualitative sense, in that he can tell us whether or not we are going to have a relatively good or bad breeding year. As we continue to coordinate our age ratio counts, which we are now doing in the field, with his satellite photographic work on the amount of ice and snow and its effect on breeding grounds, I think we can begin to find the estimate of reproduction on breeding areas. We usually get these sometime in late June or early July, which is usually early enough so we can set season bag limits at the Flyway Council meeting.

MR. JOHN GRANDY [Defenders of Wildlife]: I would like to make a comment. I suppose that the population level now is something on the order of 85,000 or something in that range. A rough calculation that I did, based on your kill statistics and winter populations back in the early seventies, indicates that this may be less than half of the carrying capacity of the Arctic range. I certainly hope that when the seasons are selected this year we will take into account the welfare of the resource and maybe keep the season closed for another year or two or three, until we have insured that the carrying capacity has been equaled and not get into the situation we are in with the Black Duck right now.

DR. PENKALA: I think that the carrying capacity of the Arctic breeding areas can vary greatly from year to year. Just some rough estimates would indicate that the average, if we look at the average population and in some years we get very good breeding, that there is at least space for 40,000 to 50,000 females and I think we could have a limited season at this time probably somewhat greatly restricted from what it used to be and still not damage the population. What I am trying to do is to get to the point where we are managing the birds by some other method than open and closed seasons—where we have a feeling for what is going on with the population and can manipulate the harvest to achieve a desired kill level. This is what I am getting at and continuation of the closed season is essentially staying in the same rut we have been for a number of years.

MR. GRANDY: Right, I understand that. What I am suggesting, however, is that with the imprecise measurement that we have in terms of population, that the best testament of allowable harvest for the next few years is URA.

MR. SVENDSEN [University of Ohio]: One of the things that I am interested in is your approach to the long-range wintering grounds, especially with regard to eel grass and sea lettuce, because I don't care what the nesting habitat is in the Arctic, if you don't give brant adequate wintering habitat, they are not going to come through the winter and the population is not going to reach anywhere near the nesting capacity. This has been neglected in the past. What are its prospects for the future.

DR. PENKALA: Well, I have just finished a two-year project on Brant food habits on wintering grounds and my results indicate that Brant foods on wintering habitat are not in short supply and that Brant are not tied into either sea lettuce or grass. They will eat large quantities if available and if not available they will switch to alternate foods and birds on alternate foods for as long as two months showed no significant change in their total body weight.

Therefore, it would be my opinion that barring, let us say, a very hard ice storm in which the birds are caught for some reason, I don't think we will have any problems on the wintering ground.

MR. HUGH BOYD [Canadian Wildlife Service]: I think that Doug Heyland would wish me to point out that the satellite photograph studies you referred to are in an area where there are not any appreciable number of Brant, or certainly not Brant that goes to the American Atlantic Coast. One of the puzzling features about Brant in the Canadian Arctic is that we don't know to any sufficient extent where the breeding range of your wintering population may be. Because of this fact, I don't think we can really estimate what the carrying capacity in the summer may be. Therefore, the argument that the population should be allowed to climb to something closer to that capacity is a somewhat speculative one, I think.

FROM THE FLOOR: If the Brant is so versatile in switching from one food to another, I wonder if our speaker can explain the population crash we experienced in the thirties when the eel grass went out?

MR. PENKALA: It would be my opinion that there were two events that occurred at the same point in time and we jumped from a corellation to a cause and effect interpretation.

The number of Brant which we had during 1972 in the Atlantic Flyway was approximately 40,000, and considering the censusing techniques and problems in censusing birds, this may have involved just as many birds in our population. The decline was not caused by disappearance of eel grass at this time—it was caused by a number of population-oriented consequences which happened to occur at the same time. I think there is a strong possibility that this may have been the same case back in the early thirties.

FROM THE FLOOR: However, I think you have to be very careful because, again, you are going back to a corellation which may not be the causation, especially when you say they can be shifted adequately on to another type of food for several months and the body weight not be affected. The body weight is not necessarily an indicator for reproductive success or ability to reproduce and there are adequate examples in wildlife populations of species after species being forced on to alternate food supplies and not having any reproductive success whatsoever while maintaining reasonably good physical condition outwardly, but inwardly it is much different. Therefore, I don't think you can say that they maintain weight on alternate food supplies and that it does not affect them.

FROM THE FLOOR: I might ask one more question that would be pertinent to the age structure of populations right now. I believe it was mentioned earlier that birds do not breed until they are at least two years old. In the current population of 75,000 to 85,000, I wonder what percentage of that population might be yearlings, which would not be expected to breed at all this coming year.

MR. PENKALA: It was running about eight to ten percent yearling birds. The remainder of the population was about half birds aged three to four years and older, and the other half was birds that are two years old. Because of the good reproductive success we had last year, we had a ratio of about 60 percent juveniles to 40 percent adults.

FROM THE FLOOR: If the body weight is not an index of reproductive success in a goose population, I wonder if the discussants here will explain to me how the goose population of the United States from one coast to the other have all gone up so much since World War II? I interpret this change in these species to the fact that the wildlife management profession has provided winter food. These birds have gone north with body weights that have been considerably in excess of what they had in the past.

I also have another comment on body weight with regard to Blue Geese. If the season in Southampton happened to be late, the birds would fall below normal body weight. There was an interesting effect here, in that when the Blue Geese attempted to fly to Minnesota and North Dakota, they could not make it all the way non-stop.

MR. PENKALA: We are getting out of the area of my expertise and getting into physiology and nutrition, which I probably know just about enough about to get myself into a lot of trouble. Therefore I would like to stay with the Atlantic Brant rather than comment on the status of all species of geese.

CHAIRMAN HICKEY: Thank you very much, Joe.

I can remember the vast change in Brant Geese in 30 years and my impression remains that this was not a matter of population dispersion.

Harvest Trends of Canada Geese in Utah[1]

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Great Basin Canada geese (*Branta canadensis moffiti*) in Utah were first banded in substantial numbers in the late 1930's by personnel of the Bear River National Wildlife Refuge (NWR). There was a lapse during World War II followed by more bandings in the late 1940's. After a second lapse during the Korean conflict, banding efforts were resumed at the Refuge in 1952. During that same year, the Utah Division of Wildlife Resources initiated a goose banding program on the state-operated Waterfowl Management Areas (WMA's). Goose banding in Utah since 1952 has been conducted each year with the Division assuming the major role. The overall age ratio of geese banded has approximated three young per adult. Greatest numbers have been banded in the extensive marshes along the northern and eastern edges of the Great Salt Lake. Here, shallow waters facilitate driving and capture of the flightless geese with air-thrust boats. Additional geese are banded each summer on the State's numerous irrigation reservoirs and along the Green River in the northeastern part of the State. Both State and Federal personnel have developed highly efficient banding operations and together band approximately a thousand geese each year. Through the 1972 hunting season, high recovery rates on some 25,000 bandings had yielded approximately 9,000 recoveries of Utah-banded Canada geese.

The result of this banding effort was a set of banding data having several qualities desirable from the analysis viewpoint. The contiguous data spanned two decades and existed in sufficient quantity to permit analyses on an annual basis using recently developed methods. The geographic base of the data was representative of the distribution of geese in Utah. Most important, the data were from prehunting season bandings of predominantly locally produced geese. This enabled findings to be viewed with reference to a specific breeding population rather than a conglomeration of migrating or wintering birds. In addition to the data from Utah bandings, some 1400 recoveries of Canada geese banded in other areas of the West and recovered in Utah were available for comparisons.

All these data were used in a study of Canada geese associated with Utah. The first objective of the study was to determine the characteristics of the harvest of these geese. Findings regarding this objective are presented in this paper.

[1]Information presented will be used in the senior author's thesis as partial fulfillment of requirements for the MS degree from Utah State University.

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Methods

The banding data, on magnetic tapes, were provided by the U. S. Fish and Wildlife Service's (USFWS) Bird Banding Laboratory, Laurel, Maryland. Because hunter harvest was the focal point of the objective, only recoveries of geese reported as being shot were used in the analyses. Recovery distributions were plotted by degree block of latitude and longitude with the aid of a computer program developed by the senior author. Inferences regarding the recovery distributions were simply drawn from inspection and percentage breakdowns by area. No attempt was made to develop statistical procedures to be used in testing for differences in the plotted distributions. All recoveries reported from Utah during 1952-1971 were pooled to determine harvest chronologies. Pooling was accomplished by assigning each recovery, regardless of year, a Julian-type date based on actual opening days of hunting seasons being always considered as day one. During the above time period, goose hunting seasons in Utah averaged 82 days in length (range 57-95), and weighting factors were used to adjust for differences in season length when the data were pooled. Survival and recovery rates were estimated using the method of Brownie and Robson (in press).

Results

The Harvest in Utah

Utah was divided by coordinates into three reference areas, Northern, Southern and Eastern, for purposes of analysis. The analyses centered primarily on banding and recovery data for these areas. These divisions by coordinate lines not only fit the physiographic areas described by Nelson (1966), but also facilitated computer processing of the data.

Northern Utah, lying north of latitude 40° and west of longitude 111°, encompasses the Great Salt Lake marshes and, therefore, most of the State's breeding habitat and hunting areas. Most of the State's waterfowl hunters also reside in Northern Utah. The heavily populated Wasatch Front and outlying regions accounted for approximately 91 percent of Utah's annual duck stamp sales from 1961-70 (Schroeder *et al.* 1974). With this concentration of waterfowl habitat and hunters, it is not surprising to find the bulk of the State's annual goose harvest taking place there. USFWS harvest survey data available for the period 1962-1970 indicate that 78 percent of Utah's annual goose harvest occurs in the Northern area.

With the exception of one year, goose seasons in Utah have opened on a Saturday, and since 1952 the average opening date has been October 12. Sunday hunting is permitted in Utah. The Northern area usually experiences a heavy turnout of hunters on the opening weekend. Consequently, the peak harvest of geese in this area takes place immediately on the opening weekend. The phenomenon is particularly pronounced for Utah-banded geese with 22 percent of a season's harvest of them being taken that first weekend and 34 percent by the end of the first week of the average 82-day season (Figure 1). For geese banded outside of Utah the peak harvest also occurs on the opening weekend; however, it is less pronounced. And the total harvest of these out-of-state birds is distributed more evenly through the season with a median harvest day of 39 in contrast to the median harvest day of 21 for the Utah-banded geese. Interest in goose hunting in Northern Utah apparently slackens considerably after the initial high. This happens despite the fact that numbers of geese available to the hunter do not peak until early November with an influx of birds that are presumably migrants (Figure 2). As a consequence, locally produced geese bear the brunt of the harvest in Northern Utah.

The Southern area lies south of latitude 40° and west of longitude 111° and contains a smaller proportion of both waterfowl habitat and hunters. Habitat here is concentrated at man-made impoundments and a few river bottom areas. Approximately 6 percent of the State's annual duck stamp sales occurs in Southern Utah, as opposed to USFWS estimates of 18 percent of the annual harvest being made here.

Over the years, season openings, lengths and other hunting regulations in the Southern area have been the same as those for the Northern. The harvest chronology in the Southern area is similar for geese banded both in Utah and other states (Figure 3) with their respective median days of harvest being 57 and 55 during the average 82-day hunting season. The goose harvest does not start with a great opening weekend and sharply diminish as in Northern Utah. Instead, there is a steady harvest through the beginning and middle of the average season, with an increase at the end. Data available for those years with seasons

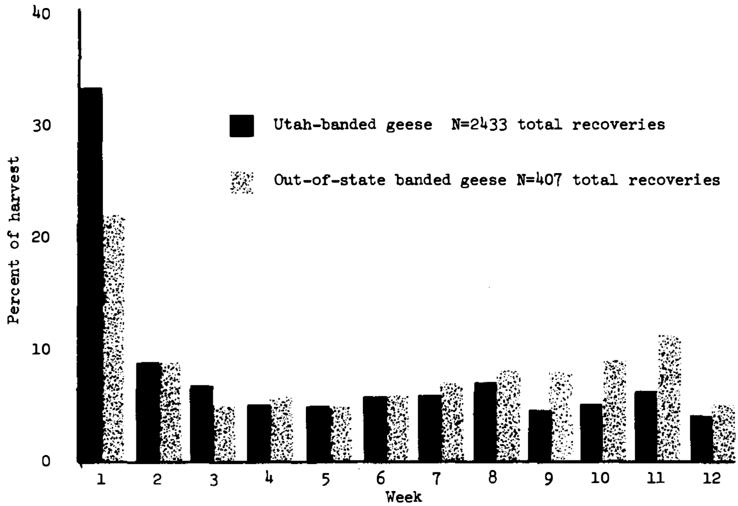

Figure 1. Percent harvest by week during the 82 day "average" season in Northern Utah. Week 12 contains 5 days.

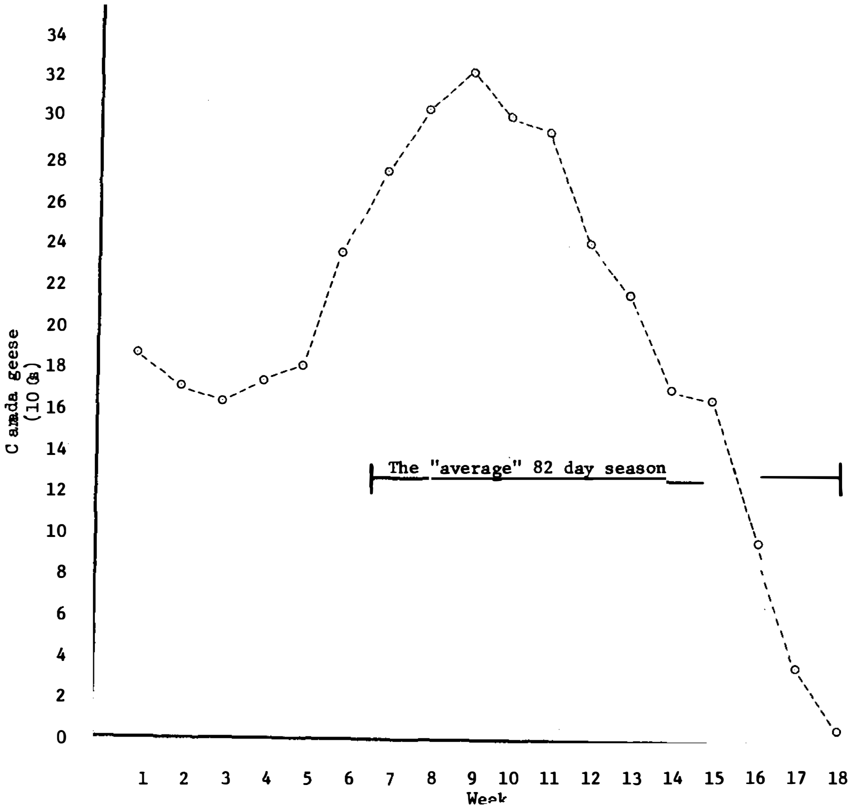

Figure 2. Mean weekly Canada goose count at Bear River NWR, 1953-72. Counts starting September 1 and ending December 31.

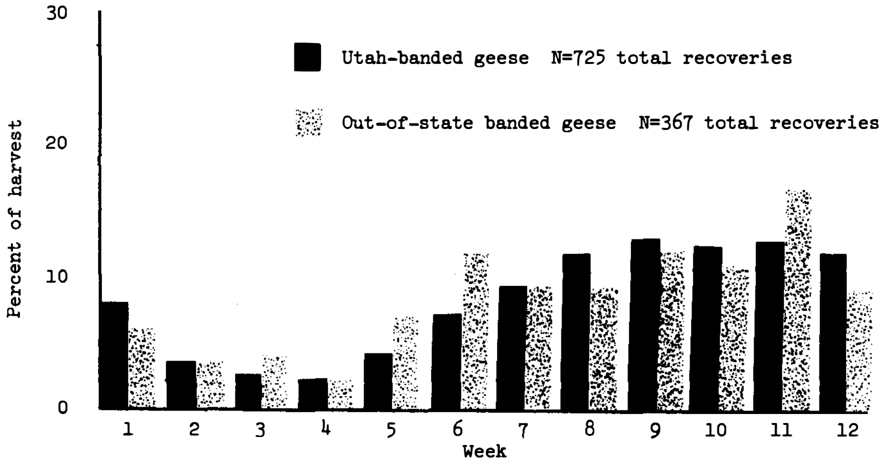

Figure 3. Percent harvest by week during the 82 day "average" season in Southern Utah. Week 12 contains 5 days.

longer than the average indicate the harvest continues to rise for as long as the season remains open in Southern Utah.

No comparable data exist as to the time peak numbers of geese are available to Southern Utah hunters. However, the late season rise in the harvest suggests that more geese are available toward the end of the season as migrants are passing through. One might then expect that, with the bulk of the harvest occuring late in the season, geese produced locally are not as important to the harvest as they are in Northern Utah. And indeed, this seems to be true. The ratio of out-of-state banded birds to Utah-banded birds (all years of banding) in the Southern area harvest is .35:1.00 compared to .15:1.00 for Northern Utah.[2] For both the Northern and Southern areas, the source of the out-of-state birds is similar. They come from other Intermountain production areas. The harvest contribution of geese from outside the range of the Great Basin geese is nil.

The remainder of Utah, lying east of the 111th meridian, is defined as the Eastern area. Habitat here is largely confined to the Green-Colorado River system, and the bulk of the harvest takes place on or adjacent to these Rivers. Approximately 4 percent of the State's annual harvest is made here by 3 percent of the State's duck stamp purchasers. Being confined to very limited habitat, the geese along the rivers are particularly vulnerable to hunters. Over the years, shortened seasons and reduced bag limits have been promulgated to afford some additional protection for the birds. Because these regulations have in most years differed from those governing the rest of the State, no attempt was made to determine the chronology of the harvest for Eastern Utah. Most of the harvest takes place in the Brown's Park vicinity. Very few geese are taken south of the 40th parallel.

The source of geese harvested in Eastern Utah differs markedly from that for the remainder of the State. Goose production is increasing in the area, primarily due to the management endeavors at Ouray NWR and Brown's Park and Desert Lake WMA's. However, production is not yet sufficient to provide for any substantial harvest; thus, the Eastern Utah harvest appears to be sustained by out-of-state produced birds. The ratio of out-of-state banded birds to Utah-banded birds here is 9.00:1.00. Most of the out-of-state banded birds have come from Wyoming where they were banded as molting adults on the Green River and at Ocean Lake and Wheatland Reservoir. Exactly what production areas they originally came from is unknown. Table 1 summarizes the characteristics of the harvest of Canada geese in the three harvest Areas of Utah.

The Harvest Outside Utah

In recent years, out-of-state harvests have become an increasingly important factor influencing the Utah-produced geese. Prior to 1950, 89 percent of the band recoveries from Utah geese were taken in Utah. This led Van Den Aker and Wilson (1949) to suggest that Utah geese were largely non-migratory. During the early 1950s almost 80 percent of the total harvest of Utah-banded geese

[2]The reader should bear in mind that these ratios are of banded birds only and do not reflect actual percentages in the total harvests of the areas. Differential banding efforts in other states presently preclude any conclusion regarding the actual percentages.

Table 1. Comparison of harvest characteristics in the three Canada goose harvest areas of Utah.

Characteristic	Northern Utah	Southern Utah	Eastern Utah
Percent of mean annual duck stamp sales 1961–70	91	6	
Percent of mean annual harvest 1962–70	78	18	4
Median harvest day for Utah-banded geese 1952–71	21	57	—
Median harvest day for nonUtah-banded geese 1952–71	39	55	—
Ratio of Utah-banded to nonUtah-banded geese in the harvest all years	.15:1.00	.35:1.00	9.00:1.00

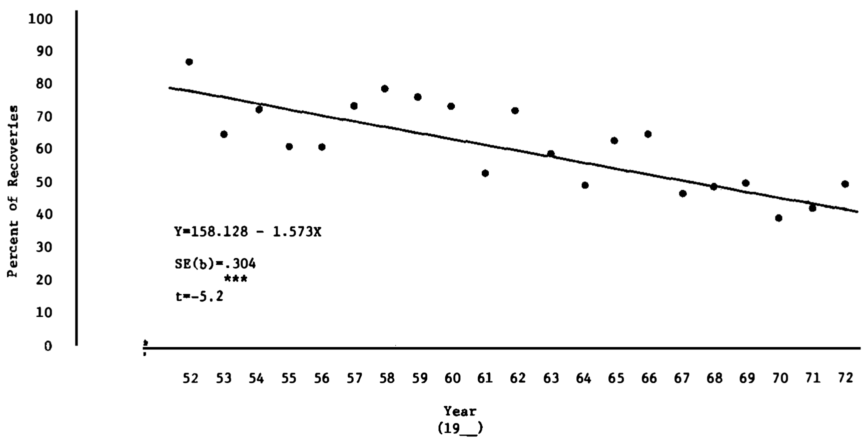

Figure 4. Canada geese banded in Utah and recovered in Utah expressed as an annual percentage of total recoveries from all areas. N=6904 total recoveries.

was still taking place in Utah. There has been a statistically significant ($t = -5.2$, 19 d. f.) decline from this figure, and in recent years Utah's portion of the harvest of geese produced in Utah has dropped to less than 50 percent (Figure 4). There is little evidence to suggest that the decline is an artifact of differential band reporting rates by area.

A review of annual recovery patterns helps show how the decline in Utah's portion of the harvest has occurred. The typical direct recovery pattern for Utah-banded geese shows the most likely recovery area to be Utah. This is true for both adult and local geese banded in the Northern and Southern areas. Out-of-state direct recoveries not made in Utah are to the southwest in Nevada and California. There is almost no post fledgling northward migration of geese banded in Utah; and consequently, very few birds are taken north of Utah during their year of banding. A typical indirect recovery pattern shows geese being recovered from southern Canada (southern Alberta and Saskatchewan) to California. Most of the geese going to Canada are non-breeders in their second year of life. Ostensibly, they do so in a molt migration and linger long enough to be shot at the beginning of hunting seasons. A few geese in their third and later years of life are also taken in southern Canada. Presumably, these are unsuccessful or non-breeders. Over the past two decades Canada's share has been a relatively constant 3 percent of the total harvest of Utah-banded geese. The combined 7 percent take by Montana, Idaho, and Wyoming has varied little also. Other minor harvest areas such as northern California, Nevada and northern Arizona have accounted for another combined 9 percent of the long term harvest.

The biggest increase in the harvest outside Utah has occurred in the Imperial Valley area of southern California. The development of the Salton Sea NWR and surrounding agricultural lands has served to attract increasing numbers of wintering geese (Tiller, pers. comm.). Not all these geese come from Utah, but a substantial portion certainly must. The recoveries suggest this, and winter sightings of geese colormarked in previous Utah studies (Martin 1964, Arneson 1970) were most frequently made in the Salton Sea area. The increased take of Utah birds in southern California has been proportional to the decline in Utah that has been most apparent in the Southern area. Jensen (1973) has presented data that indicate a decrease of wintering geese in Southern Utah has accompanied the decline in Utah's share of the harvest of Utah geese.

Conclusion

Changes in the harvest distribution of Utah-banded Canada geese have not been paralleled by changes in related parameters (Table 2). Despite the declining proportion of Utah birds in Utah's harvest, both State and Federal estimates indicate total annual harvests have not decreased. It may be that the total annual harvest in Utah is being sustained by an increased take of geese from elsewhere in the Intermountain West. It is unlikely that the harvest is being sustained by an increasing population, for Flyway-wide winter inventories do not reflect any increase in the Great Basin Canada geese (Jensen 1973).

Estimates of annual survival rates do not appear to be significantly changing from the 20-year means of 64 and 54 percent for adults and locals, respectively. Annual gosling production indices on waterfowl management areas in the State

Table 2. Annual estimates of Canada goose harvest in Utah and related parameters, with means and correlations with time.

Year	USFWS[1] Harvest Estimate	State[2] Harvest Estimate	Winter Inventory (Total)	Gosling[2] Production Index	Survival (Adults) %	Recovery Rate (Adults) %	Survival (Locals) %	Recovery Rate (Locals) %
1952	—	18,426	—	—	57±11	22±5	31±4	25±2
1953	—	9,635	—	—	39±6	23±2	28±5	28±2
1954	—	11,957	—	—	83±16	21±3	48±8	24±2
1955	—	10,453	—	1,820	47±8	13±2	40±6	20±2
1956	—	9,941	—	2,295	65±11	19±3	49±7	21±2
1957	—	3,161	—	2,260	81±16	13±2	90±16	17±1
1958	—	8,587	—	2,004	47±10	11±2	47±8	17±1
1959	—	8,306	—	2,017	53±9	16±2	40±6	21±2
1960	—	8,101	—	2,510	87±13	13±2	57±8	16±1
1961	5,700	8,696	—	3,058	73±11	9±1	67±9	13±1
1962	6,700	9,152	—	3,065	64±7	8±1	66±5	13±1
1963	10,200	15,957	—	3,371	64±6	14±1	52±5	16±1
1964	8,600	13,084	51,400	1,939	74±8	15±1	60±7	20±1
1965	8,300	9,621	43,300	2,400	62±7	7±1	69±7	10±1
1966	14,800	17,994	49,300	3,128	57±7	14±2	36±4	20±1
1967	6,700	12,474	41,100	2,014	69±9	11±1	64±8	13±1
1968	9,100	17,384	33,200	2,813	57±9	13±1	39±6	17±2
1969	17,400	11,485	40,500	1,949	80±15	14±2	52±9	17±1
1970	12,500	10,797	29,800	2,200	55±10	10±1	64±11	12±1
1971	7,800	14,992	41,600	1,392	67±17	11±1	80±21	15±1
1972	11,820	19,006	41,400	2,427	—	9±2	—	13±1
1973	14,120	—	39,300	—	—	—	—	—

Table 2. Annual estimates of Canada goose harvest in Utah and related parameters, with means and correlations with time (continued):

Year	USFWS[1] Harvest Estimate	State[2] Harvest Estimate	Winter Inventory (Total)	Gosling[2] Production Index	Survival (Adults) %	Recovery Rate (Adults) %	Survival (Locals) %	Recovery Rate (Locals) %
Mean	10,288	11,867	41,090	2,370	64	14	54	18
r[3]	0.542	0.395	−0.534	−0.041	0.174	−0.666***	0.412	−0.708***

[1]Taken from USFWS Waterfowl Status Reports. Estimates may include 0 to 5 percent snow geese.
[2]Compiled from Utah Pacific Flyway Waterfowl Reports. Harvest estimates for 1952-55 may include 0 to 5 percent snow geese.
[3]Correlation coefficient between variable and years.

have not varied appreciably from the long-term mean. However, both survival and production should be viewed conservatively. The survival rates are low in comparison to life table estimates for many other populations of Canada geese (Grieb 1970). Mean life spans after banding for Utah geese banded as adults and goslings are only 2.2 and 1.9 years, respectively. If the survival rates were to go much lower, it does not seem reasonable to assume that the already high production rates (Martin 1964) would increase to compensate.

Pacific Flyway states have generally been cooperative in the management of the Great Basin geese, and there are presently no major problems with the regulation of harvests. Survival rates and production still appear adequate for population maintenance while providing much recreational opportunity. How long the status quo can be maintained is questionable, though. Interest in waterfowl hunting is at an all-time high in the Pacific Flyway if one considers duck stamp sales as an indication. This growing recreational demand coupled with changing harvest distributions may result in some future management problems. We suspect geese from production areas other than Utah are also being affected by the changes.

The development of refuges with surrounding agricultural areas in the central portions of the Mississippi and Atlantic Flyways has led to "shortstopping" and its associated problems (Crider 1967, Reeves *et al.* 1968). It appears that the opposite situation may be developing in the southern portion of the Pacific Flyway. This "overdrawing" of geese from more traditional wintering areas, along with the increasing consumptive demand, has the potential to produce situations leading to zoning and quotas. We recommend that the trends outlined above be monitored closely.

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Discussion

DISCUSSION LEADER HENNEY: Thank you, John. I might add one question to get the discussion started.

Several authors in the 1930's indicated that these birds were not that migratory in Utah. Were there, in fact, any recoveries in California, Nevada or Arizona at that time?

MR. TAUTIN: Yes, Chuck, there were. I believe I mentioned that prior to about 1950, 89 percent of the recoveries were made right in Utah. However, a number of remaining recoveries were made in Southern California and Northern Arizona. They were made predominantly along the Colorado River, which was then the traditional wintering area. In recent years recoveries along the Colorado River have declined. The bulk of the recoveries are now being made to the west, in the Salton Sea area, where, as I mentioned, there has been a lot of agricultural development in conjunction with the establishment of refuges.

MR. JOHN RATTI: [Utah State University] I was wondering if you would comment on your histogram, which indicates approximately thirty to thirty-five percent of the total group harvest in Utah occurring in the first week. I see potential management applications here in that most of your data was generated during a period when regulations on the goose season were completely different than today. What I am specificially referring to is the delayed season now on goose harvest, in which the goose season opens two weeks after the waterfowl season. I was wondering if you would comment on how you think the percentage of the first week's harvest may change in the future due to this delayed season?

MR. TAUTIN: That histogram was based on a composite of 20 years recovery data for Northern Utah and, as I mentioned, all recoveries were adjusted to a common starting day, day number one. However, when I broke it down by individual years to examine the question that John has raised here about the delayed opening in recent years, it became apparent that even with the delayed opening, the pattern was still the same. The heavy kills were occurring on the opening weekend and, insofar as management implications go, it is my opinion that the delayed opening has not done a whole lot to curtail harvests.

Another major implication of this histogram is that with an average 82 day hunting season in Utah—and over the years that has ranged from about 57 to 95 days—in our attempt to curtail harvest by cutting a season off with regard to 15 to 20 days—for example, say from 83 days to 70 days—we do very little to cut down on total harvest.

MR. FANT MARTIN: John, we studied geese in Utah years ago. A relatively high proportion of recoveries were occurring there, as well as in other states, due to solicitation activities from conservation officials and even sports writers. Does this still continue to that extent now? And what impact would that have on your estimation of harvest distribution if curtailed in Utah?

MR. TAUTIN: That is a good question and one that was considered early in the analysis. It is also a question that should be addressed by anybody who has ever worked with banding recoveries and, most frequently, it is not addressed. I feel that band soliciting hasn't been an important factor and does not account for the changes in distribution I have outlined.

I feel this way for two reasons. The first one is circumstantial. If you will recall, I indicated that the annual percentage of recoveries taking place in Canada, Wyoming, Idaho, and other minor harvest areas has remained fairly constant. If we were to expect that the changing pattern in the relationship between Southern California and Utah were due to a differential band reporting rate, we would also expect this change in the other peripheral areas and we did not.

The second reason is that the survival rates, as I mentioned, were generated by the Robsen-Brownie method. This is a fairly recently developed method, based on a prototype called the Seber Method. The modification of this method incorporates several tests or hypotheses that we can feed in to test the data. I should add that these programs have been largely developed by the people at the Migratory Bird and Habitat Research Laboratory.

To get back to my point, one of the hypotheses tested is whether or not first-year recovery rates for adult birds varied from recovery rates on birds banded in previous years. We must bear in mind that the output of this program covered a 20 year span and there were about two years in there where we had some significant differences. We suspect that this may have involved some heavy band solicitation in one particular area. However, in view of the fact that we are considering a 20-year span here in discussing these changes, I don't feel that the one or two years where there may have been soliciting, makes a big difference. I think we should view this with the twenty-year period in mind.

DISCUSSION LEADER HENNEY: One more point here. I was looking at the table of first year recovery rates and it looked like about 20 to 25 percent the first couple of years of banding, at least in the early fifties. With the last 10 or 12 years, the recovery rate has been considerably lower, approximately 14 percent, I think, which has been the average for the last seven or eight years. What this does suggest is that the harvest and the population are remaining about stable and that there is a drop in band reporting rates. What you are saying, however, is that it is a uniform drop, at least if I interpret you correctly. Is that right?

MR. TAUTIN: Yes, Chuck. There has been a highly significant decrease in band reporting rates and I am suggesting that it has not been differential by area—that it has been, with the exception of these couple of years of increased solicitation, relatively constant—a constant decline over the range where these geese are recovered.

Closing Remarks

JOSEPH J. HICKEY: Ladies and gentlemen, it has been an interesting morning. In looking back on this session, the thought comes to mind that twenty-five years ago we would not have had this session. What has changed, I believe, in relation to this Fortieth Conference, is the width of our horizon. It has certainly broadened. We are now talking about urban wildlife, which could not have gotten into the Conference twenty-five years ago, and we have a new interest in non-game birds and non-game wildlife.

Our research tools seem to remain largely the same, although in our management in the migratory bird area, we are tending to look at the smaller and smaller population units while still using the banding techniques. We are calculating survival rates, although on a far more sophisticated basis than we did in the past. I have tried to think of when the first survival rates for migratory birds were even reported to this Conference and it certainly could not have been before 1950. At least two of the papers this morning had to depend on the use of computers. This certainly has been one of the great changes in research and made possible such papers as those of Robbins and Erskine and Frank Bowers. These papers simply could not have been written without computer help.

Unfortunately, however, we only had this morning in which to talk about the problems of migratory birds. I have the feeling that there are some terribly important problems that face migratory birds in the two or three decades immediately ahead and this will involve the discussion of winter habitats in the areas just south of the United States. The disappearance of the Bachman's Warbler in the last five years probably means the extinction of that species and this disappearance and extinction, to my thinking, is due to the great destruction of the winter habitat of the species on the Isle of Pines. The rate of this destruction in Latin America is well known to attendees of this Conference and it is not even stabilizing, but still accelerating. I believe, therefore, that we face considerable reductions in the numbers of our non-game migratory birds as they winter in Latin America. It is fortunate for us that the Breeding Bird Survey that Robbins and Erskine talked about is now a reality and we can keep an index on this problem and see what happens.

May I then, in closing, express for our audience its thanks for the stimulating morning that our speakers have given us.

Strengths and Weaknesses of Environmental Assessments

Chairman:
GORDON A. ENK
Director, Environmental and Economic Studies, Institute on Man and Science, Renselaerville, New York

Discussion Leader:
CHARLES J. CICCHETTI
Professor, Social Systems Research Institute, University of Wisconsin, Madison

The Environmental Assessment Statement as a Natural Resource Planning Tool

Thomas Dolan, IV and Robert M. Maestro
Betz Environmental Engineers, Inc.
Plymouth Meeting, Pennsylvania

The concept of natural resource planning can be traced to the year 1913 when C. C. Adams published his *Guide To Animal Ecology*. In this treatise he referred to ecology as a process which involves the integration of both the human and natural ecosystems. Since that time, and particularly within the past two decades, the principles espoused by Adams have been augmented, synthesized, tested and applied to individual sites and entire regions with varying degrees of success.

The National Environmental Policy Act of 1969 (NEPA) ushered in the Environmental Decade and, with it, an increasing sense of urgency for the management and conservation of both our nonrenewable and renewable natural resources. Management became recognized as a highly integrated process. No longer could one component of the environment be considered in isolation of all other components, e.g., the management of water resources could not be divorced from considerations of land use. Sophisticated technologies were required. Fortunately, the concepts, teachings and experience of a number of universities in the United States and Canada have been available to fill the needs created by changing attitudes and new Federal and State legislation which mandate a high degree of multidisciplinary integration in decisions affecting our natural resources (Belknap and Furtado 1967).

Historically, natural resource and land planning to meet human needs has been influenced almost exclusively by the concept of highest and best use at least apparent cost. The impacts on natural resources and environmental quality have received short shrift. Concern for lack of consideration of the natural environment in planning efforts began to gather momentum in the mid-1950's. Ten years later it hit full stride, as reflected by public and private actions and the outpourings from academic and governmental institutions. Comprehensive planning was by then being exercised at the local level, although still with only limited attention being given to natural resources as important determinants. With the expanding influence of natural resource and environmental quality determinism, comprehensive planning took on new meaning and concomitantly precipitated new conflicts. President Ford focused on these conflicts in his recent call for balance among our environmental, economic and social goals.

Analysis of recent usage of environmental determinants as a planning aid indicates that there is still no truly comprehensive, integrated method for analyzing natural and human resources in terms of satisfying human needs. Difficult areas include: (1) flexibility necessary to provide for changing values and needs, (2) data processing and simulation of consequences of policy decisions, (3) integration throughout the planning process of required disciplines, (4) comprehensive assessment of human needs, desires and values, (5) dynamics of natural and man-made interrelationships, and (6) the forecast of tomorrow's demands (Belknap and Furtado 1967). Although the state of the art of natural resource planning has continued to advance, these areas, together with jurisdictional, budgetary and political problems and conflicts, have caused a dreary number of land use plans to languish, unimplemented, on shelves of oblivion.

In 1970, in the first report on the state of the Nation's environment delivered by a U.S. President, concern was expressed over the prevalent attitude of our land as a limitless resource. Comprehensive approaches, which included ecological, economic and social concerns, were emphasized, and the President called for a National Land Use Policy.

As the country enters the second half of the Environmental Decade, it is still faced with the lack of sufficient Congressional support to pass a National Land Use Policy Bill. Few states have passed comprehensive Land Policy Bills, although 36 states have passed legislation or are studying proposals related to state land use regulations (U.S. CEQ 1974). Specific state land use control legislation, e.g., flood plain restrictions, continues to meet stiff opposition in many states, however.

Urbanization and Support Facilities

If we analyze the urbanization process in detail, the key role of support facilities becomes apparent. Facilities encourage, support and direct urbanization. In these capacities, they have the potential to strongly impact a municipality's natural resources.

In the 1950's and 1960's, new highway locations and favorable house financing were responsible for expanded suburban growth which developed into a housing boom. The availability of sewage facilities was not of great importance, as septic tanks were relied upon heavily. This created many public health problems due to the prevalence of systems which were either improperly designed or incorporated on lots which were too small. Some newly created suburban areas were supplied with sewage facilities, but these typically did not provide effluents of sufficiently high quality.

By the late 1960's and early 1970's, public sewage systems, discharging high quality effluents, had become a necessity. Suburban sprawl, promoted by new highways, had to have sewage facilities to support their existence and allow for additional expansion. Sewage facilities soon became a limiting factor for increased urbanization, and, with the new highway construction program approaching completion, wastewater facilities evolved as the major infrastructure stimulant for urban sprawl.

Initially, the principal obstacle to the creation of badly needed facilities was the lack of capital. Pollution problems became so severe in many areas that moratoria on development were established. Fortunately, these problems were recognized by legislators, and in 1972 new amendments to the Water Pollution Control Act of 1965 (PL 92-500) were adopted by Congress. These amendments provided for Federal Funds ranging from 75 to 100 percent for the planning, design and construction of wastewater facilities. The amendments also insured that no funds would be granted unless such facilities met the planning criteria of the U.S. Environmental Protection Agency (EPA). Wastewater facility planning has, thus, become one of the most significant inputs to future land use patterns for a community.

These amendments dictate that a study be conducted to determine the most economically and environmentally sound alternative for serving an area with wastewater facilities before Federal funds are granted for design and construction. The study is referred to as a Wastewater Facilities Planning Study, or a "201" Study, in reference to Section 201 of PL 92-500. This statute also requires "208" Studies (Section 208, Water Quality Management Study) which cover a much larger geographical area, and address both point and non-point source discharges. The product of the "208" Study is, in part, similar to that of the "201", i.e., determination of the most economically and environmentally sound alternatives for providing wastewater facilities.

Role of the Environmental Assessment Statement

A significant component of both the "201" and "208" Studies is the analysis of existing and proposed land use plans in relation to the proposed facilities, with particular attention being paid to their potential effects on future development. This analysis is embodied in the Environmental Assessment Statement (EAS), which is an integral part of "201" and "208" Studies.

The purpose of the EAS is to insure that proposed wastewater facilities are planned so as to minimize adverse environmental impacts. These include both the primary impacts from the construction and installation of facilities and the secondary impacts associated with development encouraged by the facilities. As is shown in Figure 1, this process is initiated with an inventory of environmental factors, including components of the natural ecosystems and socio-economic factors. The data base is used to evaluate land use plans, which serve as bases for the location and size of the facilities, and to develop and analyze alternative wastewater systems. The analysis includes alternative locations of interceptors and treatment plants and alternatives for effluent discharge and sludge disposal. Once an alternative system has been selected, a more detailed environmental evaluation is performed. This analysis includes unavoidable adverse effects, mitigative measures, short-term versus long-term use of man's environment and any irreversible and irretrievable commitment of resources.

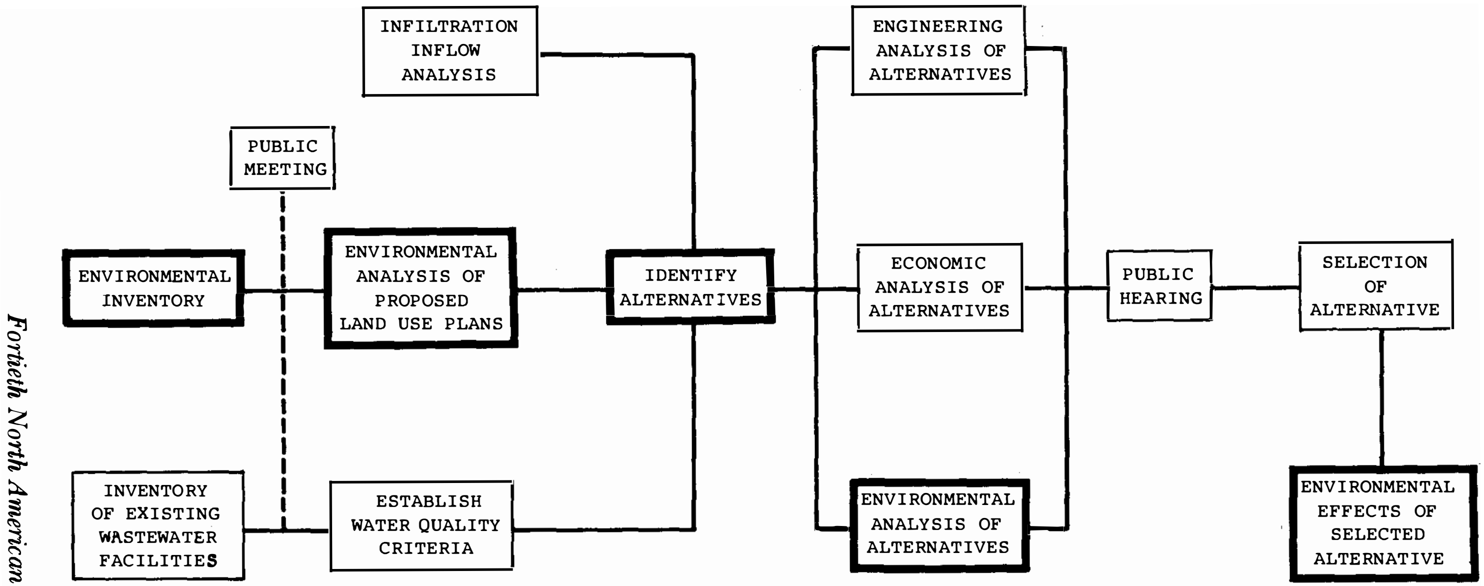

Figure 1. Flow diagram illustrating the relationship of the Environmental Assessment Statement to the overall Wastewater Facilities Planning (201) Process. Those components which are totally or partly the responsibility of the Environmental Assessment Statement are indicated with a heavy outlined box.

Thus, a mechanism now exists which can provide a significant contribution to natural resource planning efforts at the municipal level. Unfortunately, this process has not been working as well as intended.

Strengths and Weaknesses

The evolution of the EAS as a natural resource planning tool has been a slow process for essentially the same reasons that its development as an effective regulatory mechanism has been gradual. Its major strengths lie in the EPA Guidelines. If followed as presented, the EAS serves as an effective natural resource conservation and planning mechanism. Most importantly, the EAS process is fundable, up to 100 percent, at the Federal level. Further, the EAS process provides a structure for balancing considerations pertaining to environmental, economic and social impacts. Its lack of effectiveness has stemmed from conceptual, procedural, technical, institutional and political problems, and from the fact that, principally from ignorance, the general public has failed to participate to the extent intended by the Act.

Ironically, one of the major weaknesses is that the NEPA requirements for the EAS were well ahead of their time. This resulted in implementation problems which are only now being resolved five years later. EAS's are required for any new or augmented waste treatment or conveyance facility regardless of the fact that the design of the facility has been completed. Such statements, prepared after-the-fact, meet NEPA requirements, but because of the substantial added cost of redesigning the facility, the project is justified as designed, with only token consideration of alternatives. Federal recognition has been given to this problem with a change in EPA's administrative requirements. As of June 1975, Federal funds will no longer be granted for design and construction until an EAS has been approved.

The success of the EAS as a land planning tool is dependent upon the abilities of the consultant to produce a statement which objectively and accurately addresses the major primary and secondary impacts of a project, including the identification of land use controls. Implicit is the need for multidisciplines and the capacity of the consulting firm to integrate the different value systems represented. For example, the planning of sewage facilities has traditionally been the sole responsibility of engineering firms. The EAS requires new perspectives, and the marriage of scientific and engineering principles has not been without conflicts (Dolan 1974). A lack of Federal agency criteria for consultant qualification continues to encourage the preparation of EAS's which are neither effective as land planning devices nor adequate in terms of satisfying NEPA requirements. The consideration of secondary impacts is loosely defined in the EAS Guidelines of EPA, and only recently has that agency started reviewing statement requirements, including issues to be considered and level of detail, with consultants.

The EAS process is both complex and tedious, and lack of procedure for conflict resolution is responsible for much of the delay as the statement moves from the consultant through the many State and Federal reviewing agencies to the CEQ.

Sensitive land use planning requires early and continuing input from regional interests and the general public, as well as the local municipality. The EAS process has been less than effective in this regard, owing to the failure of consultants to recognize the importance of these interests in the identification of the important issues to be resolved. This weakness inhibits the early identification of impacts, which in turn leads to poorly organized data collection, including the gathering of too much and the wrong kinds of data. The emphasis in many EAS's has been on resource inventory, much of it irrelevant and undocumented, with only minimal attention being given to the analysis of the impacts of a project and its alternatives and the forecasting of future conditions. In Massachusetts, efforts have been made to draw upon representation from the general public to assist in the preparation of EAS's. (Massachusetts 1973).

The diversity of impacts, both primary and secondary, of waste management projects, has compounded the technological difficulties associated with the preparation of EAS's. The scarcity of useful and reliable data for resource inventories and impact analyses is a continuing problem, as is the variation in quality of available data and information. Thresholds beyond which severe environmental damage may occur are either unknown or poorly defined by indicators for which there are no, or at best limited, standards (Greenberg and Hordon 1974).

The weighting of environmental, economic and social impacts for the purpose of evaluating potential tradeoffs of a project and its alternatives is a complex task which has lacked necessary objectivity. Reliable forecasting has suffered from a lack of tools, including adequate mathematical models for the prediction of direct or indirect environmental impacts.

New pollutants and potential synergisms pose a specific problem in making impact projections related to wastewater facilities, including land disposal. Existing standards of common pollutants are not scientific absolutes, e.g., phosphates and their relationships to algal growth (Greenberg and Hordon 1974).

Institutional deficiencies which have contributed to ineffectiveness of the EAS process include a ponderous review procedure, for which there is inadequate staffing at both the Federal and State levels. For example, EPA, Region III, has yet to commence the reviewing of statements submitted with 1973 and 1974 grant applications. Because EPA attitudes, as reflected in its EAS Guideline revisions, have changed since the preparation of EAS's for 1972 and 1973 facilities applications, further project delays will result from the return by EPA of statements to municipalities for reasons of inadequacy. The effectiveness of the overall EAS/Environmental Impact Statement (EIS) review process is currently being investigated through a CEQ sponsored study, with emphasis being placed upon the question of accommodation by reviewing agencies in order to avoid conflict with the lead agency for a project.

In spite of the high level of Federal financial participation in "201" wastewater projects, inadequate funding of EAS's by municipal clients has had marked effects on the level of detail of EAS's. In part, at least, this has been due to the failure of municipal officials to recognize the importance of the EAS, including its role as a natural resource planning tool.

Case Study

The quality of Environmental Assessment Statements must be upgraded before they can become effective as a natural resource planning tool. The following case history illustrates an approach to achieving this goal.

Betz Environmental Engineers, Inc. recently completed a Wastewater Facility Planning Study for Hamilton Township, Mercer County, New Jersey (1974). In the EAS section of the study, particular attention was devoted to the secondary impacts of development which would be encouraged by the proposed facilities. Recognizing that the municipality's land use plans would be the major determinant for location and sizing of the facilities, EAS environmental inventory parameters and investigative levels of detail were selected to evaluate not only alternative wastewater systems, but also existing and proposed land use plans.

Table 1 facilitates identification of significant environmental conflicts with Hamilton Township's land use plans. Within this Table, suitabilities of the major types of land use are evaluated with respect to the natural resource components of major concern. The "conditionally suitable" category indicates that a compatible relationship is possible, but only if proper mitigative measures are incorporated.

The environmental conflicts are illustrated in Figure 2. A major conflict relates to sufficient recharge of ground water supplies. The Magothy-Raritan aquifer recharge area outcrops in the northern portion of the Township. The zoning map proposes relatively high densities in this area which presently has a high percentage of impervious cover.

The Magothy-Raritan aquifer is considered to be the most important single source of ground water in the eleven-county region (Barksdale et al. 1958). It is also an important source of water supply for the Township. As can be seen in Figure 3, Hamilton Township is underlain by one of the two high level intake portions of the Magothy-Raritan aquifer recharge area. In addition to its importance for recharge of ground water supplies, infiltration in this high level intake area is also critical for prevention of salt water intrusion into ground water supplies for the New Jersey shore area, as shown in Figure 3. The EAS includes recommended adjustments that can be made in the allocation of proposed land uses to maximize recharge in this area, while maintaining the planning objectives of the community. Recommendations were also made for methods which would provide for increased recharge within a proposed large, high density development, the relocation of which is not feasible.

Another area of major conflict is associated with environmentally sensitive ecosystems. Two such areas exist within the Township: Trenton Marsh and Great Bear Swamp. Both are zoned for industrial and residential uses.

Trenton Marsh represents a unique type of ecosystem as a freshwater tidal marsh. This marsh is regarded as the largest freshwater tidal marsh on the east coast. Great Bear Swamp represents a vegetation community that is limited with respect to the Township and the surrounding area. The EAS justifies retention of these areas based upon their ecological and social values.

Other areas of conflict include proposed development within 100-year flood plains and existing woodlands. Once the severity of these conflicts was explained, Township officials initiated steps to update their land use plans to minimize direct impacts that would develop by irreversibly linking the wastewater facilities with present land plans.

The completed Wastewater Facilities Planning Study accommodates these areas of environmental conflict. No interceptors are planned that will encourage further encroachment upon either Bear Swamp or the Trenton Marsh. Interceptors within the outcrop area of the Magothy-Raritan are planned so that their

Table 1. Natural suitability matrix.

	Residential						
Geology	High	Med	Low	Commercial	Industrial	Open Space	Agriculture
Aquifer recharge area	★[1]	★	●[2]	★	★	●	●
Soils							
Suitable for septic tanks	○[3]	○	●	○	○	NA	NA
High susceptability to erosion	★	★	★	★	★	●	★
0–8% slopes	●	●	●	●	●	●	●
8–15% slopes	★	★	●	○	○	●	○
>15% slopes	○	○	○	○	○	●	○
Prime agricultural soils	○	○	○	○	○	★	●
Hydrology							
100 year flood plain	○	○	○	○	★	●	●
High seasonal water table	★	○	○	★	★	●	○
Vegetation							
Woodlands	○	○	★	○	○	●	○
Unique or limited communities	○	○	○	○	○	●	○
Wildlife							
Habitats of rare or endangered species	○	○	○	○	○	●	○
Unique or limited habitats	○	○	○	○	○	●	○

[1]★ h conditionally suitable [2]● h suitable [3]○ h unsuitable NA h not applicable

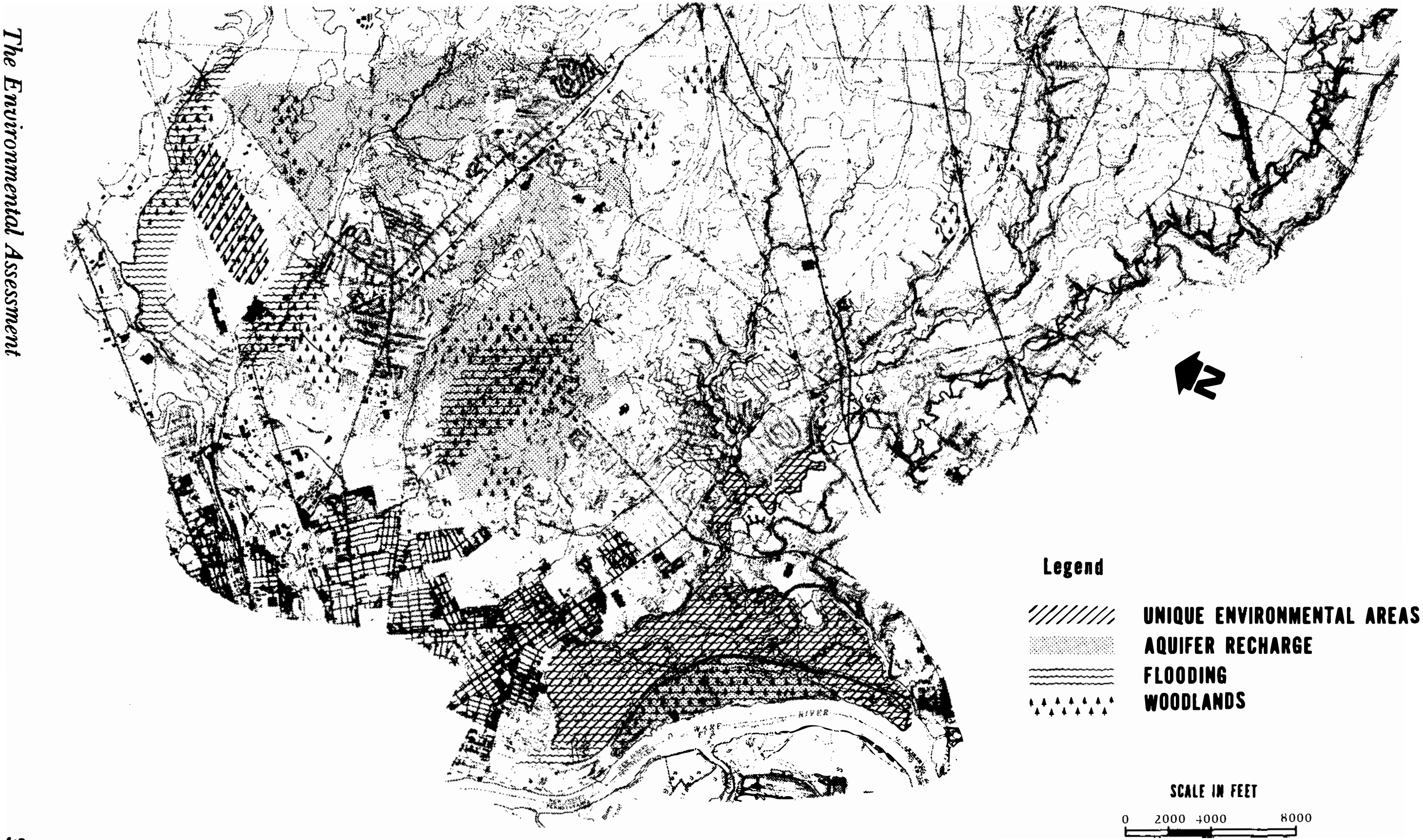

Figure 2. Areas of environmental conflict with proposed land use plans.

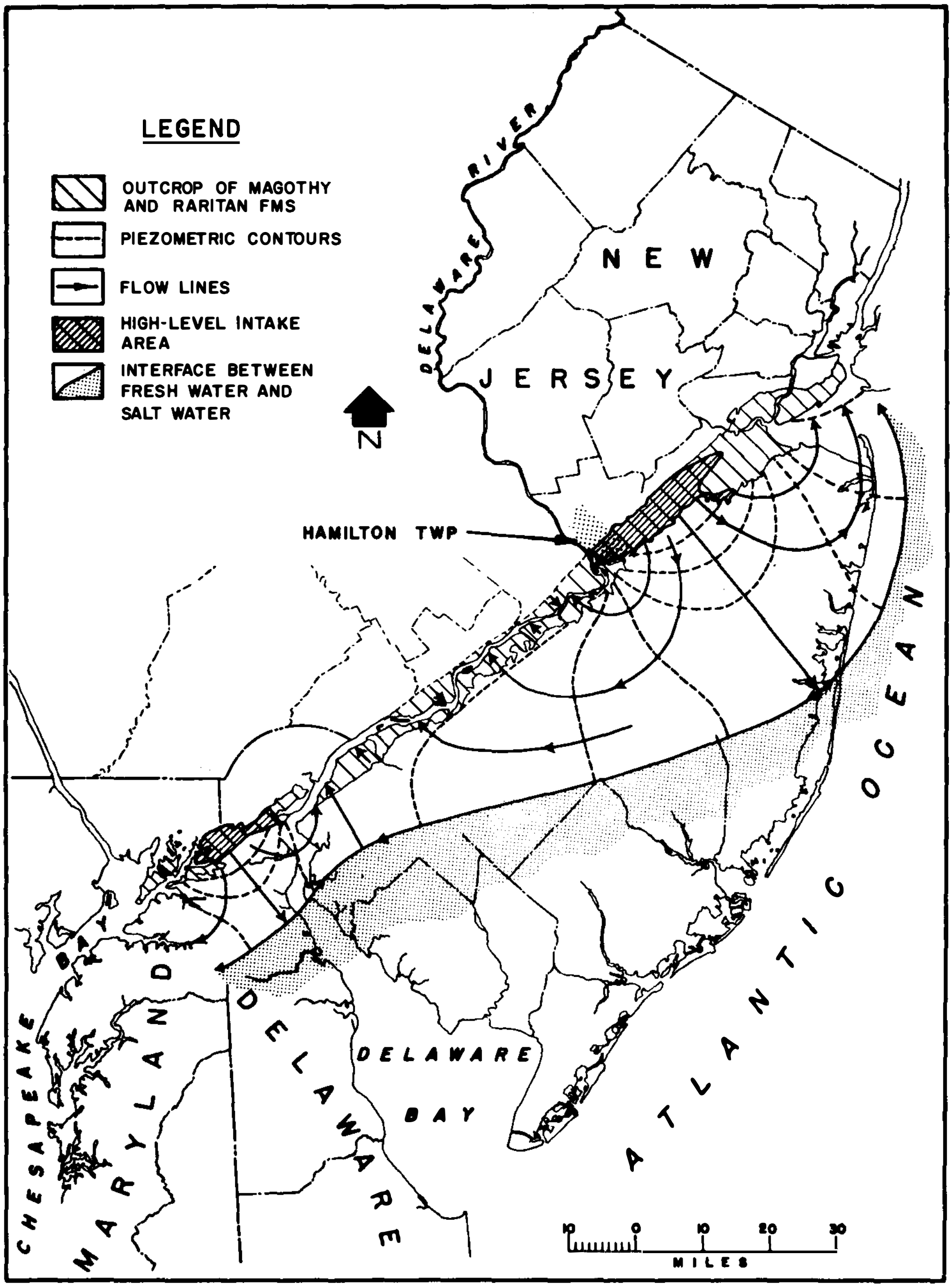

Figure 3. Theoretical flow patterns in the Magothy-Raritan formations. From Barksdale, et al., 1958.

size does not have to be fixed until updating of the land use plan has been completed. In addition, all efforts have been made to keep interceptors out of the flood plains as well as woodlands.

Impressions

Although the Hamilton Township Case Study does not reflect the full range of possibilities of the EAS, nonetheless it does point up the strong potential of the process as a land use and natural resource planning tool. Comprehension of ecosystem dynamics and input predictability are constantly improving, and the reliability of forecasts of primary and secondary impacts will proceed concurrently. At the same time, with the refinement of systems analysis techniques, the ability to integrate the different values inherent in an inter-disciplinary approach will be enhanced.

A major thrust of the President's Council on Environmental Quality is toward the improvement of the quality of EAS's. As higher quality is realized, confidence in the process will rise and will be recognized and accepted by decision makers as an important mechanism for land use planning. Achievement of this euphoric level of understanding and agreement can only be achieved with the support, and stronger inclusion in the EAS process, of informed constituencies.

Meanwhile, agency attitudes are undergoing important metamorphoses in their approaches to the concept. EPA, for example, recently used the Environmental Impact Statement process to impress badly needed land use controls on a conglomeration of local municipalities in Southeastern Pennsylvania: Participation in a regional sewage treatment plant being contingent upon the adoption of local land use control statutes. Thus, the country is moving inexorably in a direction in which, at the very least, developers of all kinds will have to give careful consideration to proposed land uses. The endpoint, at which vested interests and the general public can realize the full intent of the EAS as a land planning mechanism, appears to be within the forseeable future.

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Discussion

CHAIRMAN ENK: Thank you very much, Tom. I think his presentations has opened a Pandora's Box. It is the first time that I have heard NEPA referred to as the Consultant's Employment Opportunity Act. It has been regarded this way in legal circles, but in reading over Sections 101 or 102-C, I never have seen the role the consultant has played, but it is obviously there.

Who has the first question?

FROM THE FLOOR: Do you, in your work, ever analyze the environmental impact on the zoning within different counties in terms of what the consequences of zoning would be in terms of wetlands, for example?

MR. MAESTRO: Yes. We find it important to evaluate both the regulations and ordinances in effect and, in relation to this particular study, we were actually able to have the municipality recognize the importance of incorporating environmentally oriented ordinances. As soon as we identified these areas of conflict and brought them to the attention of the client, and even though they did not know what an acquifer recharge area was, they realized the importance of environmental planning. The next day, the Township Adminstrator sent a letter to the head of the Planning Board directing him to initiate an update of their master plan.

MR. MAGEE [Massachusetts]: I am wondering what kinds of studies were done to the wetlands to display to the public their value in critical areas—productivity studies, diversity experience or this type of thing, or, really, what were the criteria?

MR. MAESTRO: We inventoried all of the natural processes and included in the inventory the wetlands, habitat, etc. Likewise, we were in touch with the local conservation groups, as well as local agencies, which knew of the relative importance of different areas within the township.

We also made site surveys and contacted local institutions and identified studies currently under way on productivity. Further, when we had our initial public meeting, we presented all the information to the people, explained what the project was about and requested input from them.

One of the most difficult things I have found in viewing these environmental assessment statements is coordination with the Engineer, to have the Engineer realize that this is a new process that must be incorporated and that no longer, as in the past, could he proceed without them. In other words, we did not want to limit ourselves to narrow ranges of alternatives. We looked, for example, at something like 14 alternatives and screened them down to about five, which were most environmentally sound. Then we would coordinate those five with the Engineer's economic analysis to see which ones were most cost effective. Frequently it worked out that the most cost effective are also the most environmentally sound. Sometimes we win and sometimes we don't.

Toward New Concepts in Environmental Management

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The principal mechanism for environmental management in the United States and many other areas of the world is to establish a set of environmental quality criteria or standards which limit the amount or rate at which anthropogenic effluents can be released into natural systems. Monitoring networks varying in spatial design from local to global and in temporal design from continuous to discrete intervals sample air, water, and living systems to detect and report infractions of the established standards. The hypothesis to be discussed in this paper is that the method of using standards and monitoring is not adequate for either the preservation or conservation of natural resources.

How Pollution Standards and Surveillance Systems Fail

The United States has implemented an extensive bureaucracy for the setting of standards and regulation of environmental quality which is reviewed annually by the Council on Environmental Quality (for example, see *Environmental Quality*, 1974). However, current trends in many environmental parameters in both air and water (see *Environmental Science and Technology* 1969, 1970; *Washington Post*, February 16, 1975, pkl) and analysis of variations in the quality of the human work environment (Wagoner 1975) indicate few, if any, improvements in environmental quality other than a reduction of pathogenic microorganisms in drinking water. Although detailed interpretation of trends in specific chemical parameters in air and water are difficult because of inadequacies in the available data, increased growth seems to have balanced any effective reductions in pollutant loads being discharged into the natural system (*Environmental Quality*, 1974). It has been estimated by the World Health Organization that 75 to 85 percent of all cancers are related to environmental contamination (Wagoner 1975).

The concepts and methods used to set environmental standards have been a subject of active discussion (for example, see *Environmental Quality*, 1973; Fox 1966; Byrd 1970; Dinman 1972; Brownlie 1972; National Academy of Sciences 1975). Environmental standards are generally established by extrapolation of acute toxicity test results with an arbitrary safety factor. The most common toxicity tests, run on pesticides, heavy metals, and other chemicals which are released into the environment, are 24 to 48 hour determinations of the lethal dose required to reduce a population of a laboratory animal species by 50 percent (termed the LD_{50}). More sophisticated, but less commonly used, tests involve the study of long term sub-lethal effects on laboratory species, *in situ* toxicity studied in controlled ecosystems, and studies on the toxicity of a specific chemical to different species from a selected area. Data on the chronic effects of chlorinated hydrocarbon pesticides such as DDT have demonstrated detrimental biological effects at such low concentrations that these compounds have been restricted from broadcast applications to the environment. Undoubtedly, if more intensive testing was performed on more specific chemicals and waste effluents commonly released to the environment, water quality standards would be much more restrictive. More intensive testing of chemicals is both time consuming and expensive and is generally in conflict with industrial interests.

Environmental surveillance methods presently suffer from a variety of problems including inadequate sampling, improper analysis procedures, and inadequate instrumentation for accurate detection of environmental pollutants at low concentrations. These problems can be illustrated using stormwater runoff as an example. Stormwater runoff is generally characterized by rapid fluctuations in both water discharge and chemical composition in stream environments (Turner *et al.* in press). Table 1 illustrates the wide range in chemical composition observed in both natural and urban runoff in a North Florida watershed. The variability in composition of these streams could only be documented with continuous sampling and elaborate analytical precautions. Table 2 illustrates the potential environmental significance of short-term and large volume stormwater discharges on the chemical environment of receiving waters in a lake. A few hours of stormwater runoff can transport an amount of a chemical equivalent to

Table 1. Comparison of mean concentrations (mg/l) for stream water constituents in the three watersheds under stormflow and baseflow (low flow) conditions.

Constituent	Forested	Suburban	Urban
		Stormflow	
SS*	34±25	176±324	299±378
TDS*	58±25	115±118	161±181
Silicon	3.57±0.48	2.56±0.49	1.72±0.74
NO_3–N	0.06±0.03	0.30±0.15	0.12±0.10
NO_2–N	0.002±0.002	0.04±0.05	0.014±0.02
NH_3–N	0.06±0.02	0.08±0.05	0.16±0.23
PO_4–P	0.10±0.06	0.05±0.04	0.12±0.13
		Baseflow	
SS*	12±4	7±3	10±17
TDS*	43±8	53±9	86±30
Silicon	4.17±0.54	2.96±0.13	2.15±0.74
NO_3–N	0.05±0.03	0.18±0.05	0.10±0.06
NO_2–N	0.009±0.022	0.021±0.045	0.007±0.011
NH_3–N	0.04±0.01	0.05±0.02	0.06±0.12
PO_4–P	0.13±0.06	0.04±0.02	0.06±0.03

*SS = suspended solids; TDS = total dissolved solids.

several years of low flow runoff. This brief illustration documents the hypothesis that the typical environmental monitoring system based on sampling at a regular interval may miss major chemical events which could control environmental quality.

Table 2. Days required to transport equivalent amounts of material at baseflow as are transported by an average storm.

Constituent	Urban Watershed	Suburban Watershed	Forested Watershed
Water	19.3	3.3	6.2
Suspended solids	3859 (10.6 yrs)	167	21
Dissolved solids	68.1	10.7	5.9
Silicon	7.8	2.43	5.6
NO_3—N	14.3	4.9	10.3
NO_2—N	10.8	2.2	4.7
NH_3—N	58.4	5.0	8.1
Ortho PO_4—P	21.8	3.6	5.8
Dissolved P	11.7	3.3	3.7

A more complex problem in establishing water quality standards is the effect of different chemical forms of a specific element on organisms. For example, mercury is much more toxic to certain algae in organic form as compared to inorganic mercury (Harriss *et al.* 1971). In contrast, inorganic copper is more toxic to algae than organically bound copper. At present most studies on the differential toxicity of various chemical species of an element must be conducted in the laboratory by chemical addition to test organisms, since instrumental methods for detecting most of the different chemical species in natural waters are not available at present.

In addition to technical difficulties in setting water quality standards, substantial problems exist in the institutional procedures used to evaluate and establish standards as law. A case study on the establishment of water quality standards for the Wisconsin River has demonstrated that public agencies may fail to generate the necessary information for proper evaluation of alternative water quality management programs (Fox and Wible 1973). Fox and Wible also point out the fundamental problem of how to secure a balanced assessment of social preferences in selecting environmental quality objectives in view of the fact that waste dischargers can generally invest more time and money toward achieving their goals than public interest representatives.

New Directions for Environmental Management

The development of new environmental quality management systems to replace the standards and monitoring procedures presently used should be a primary goal for all environmental interests. The transition will require new techniques for both the control of existing pollution sources and for the prevention of future environmental deterioration. The following paragraphs will briefly discuss some of the available alternatives for each situation.

One of the best developed and relatively new concepts for controlling point sources of waste discharge is the effluent charge system. The effluent charge concept has been recently discussed in detail by Kneese and Schultze (1975). The objective of the effluent charge system is to provide polluters an economic incentive to reduce waste discharges. The polluter can utilize any technological alternative which seems best suited to a particular waste problem. For example, an industry discharging dissolved phosphorus could use a technology for removing phosphorus from waste water or could set up a closed cycle system where the waste discharge could be recycled for use in aquaculture or as cooling water. The problem of establishing effluent charge rates for a wide range of wastes is obviously a difficult task which has discouraged wide acceptance of this method of environmental quality management.

Many existing non-point sources of pollutants, such as stormwater runoff, carrying metals and organics and agricultural pesticides reaching non-target areas cannot be traced back to a specific source by the time they are detected in the environment. However, the general initial sources of most non-point source pollutants such as pesticides and stormwater runoff are known and can be eliminated by the substitution of alternative processes. For example, biological and integrated pest control techniques could be developed to replace most pesticides currently used in agriculture (Van Der Bosch and Messenger 1973). Intensive greenhouse agriculture could be expanded to reduce both pesticide use and water consumption in food production (Taylor and Humpstone 1973). Stormwater management presents an even more difficult problem because of the irregular nature of the discharge in both intensity and frequency of occurrence. However, stormwater can be diverted to holding facilities for later use as irrigation water for agriculture or cooling water for industry, trapped by individual building collection facilities for subsequent non-consumptive use, or injected into subsurface aquifers to recharge groundwater supplies.

The environmental quality management alternatives mentioned above can be implemented with existing technology and land development patterns in many areas.

New concepts for resource management are now being developed which will make a major contribution to land use planning. The most exciting development is the use of energy accounting as a method for the quantitative assessment of environmental carrying capacity (Odum 1971). The key concept in energy analysis is the evaluation of the net energy change resulting from a change in the environment. Energy is the fundamental variable which structures and drives all environmental systems and, in most cases, a planning alternative which results in maximum net energy production will provide maximum benefit to the ecosystem. In the present era of declining net energy available from fossil fuels, the system which can most efficiently utilize available energy resources has a competitive advantage. Thus, the principal effort of environmental quality management should be focused on the analysis of energy fluxes rather than the secondary parameters presently used as standards of environmental quality.

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Discussion

MR. MAGEE [Massachusetts]: The thing that needs to be brought out here is that the use of the biological population is frequently a tool which is not used often enough. The long-term changes in the population will reflect short-term extreme events that are very difficult to monitor. I just feel, therefore, that more attention should be given to these alternative tools. People can look at diversity, productivity, and population structures which are frequently very good indicators of water quality in a given area.

MR. HARRISS: Thank you very much for your comments. I agree, with one major reservation, and this is similar to the reservation that I have with others, for example, with chemical monitoring. That is, by the time we sometimes can identify the change in the community structure, the change becomes an irreversible change and, therefore, it is an after the fact technique.

Of course, we are all trying to develop techniques which are early warning systems or which are predictive so that we can avoid the changes in communities. These communities, of course, will always evolve, but, we hope, at a certain rate which is compatible with what we would like to have aesthetically. This is my real reason for using the biological indicators. Individual organisms, as indicators, I don't think are adequate.

Your suggestion of using communities is fine, but still we would like to have a better predictive tool than just monitoring. Also, with respect to that, I might mention that water quality criteria are developed on acute toxicity tests and generally on a very limited number of species. We see now, for example, that quite often, if you develop a criteria based on, for example, the effect of mercury on fish, this is totally inadequate. If you base the criteria on the criteria on total chemical content, total Mercury, it can be misleading because the effect of the organic Mercury may be much more severe than the inorganic Mercury. Therefore, our criteria are often inaccurate on that basis.

MR. KEITH BAYHA[U. S. Fish and Wildlife Service, Washington, D. C.] In relation to your research, have you developed a relationship to stress the net effect of conversion of land from agricultural or forest uses to urban uses on a nutrient content of run-off over a period of months or years?

MR. HARRISS: In relation to the watershed that we have studied, we do have quantitative data, quantitative balances for a three-year period. I would say the answer to the question is "Yes" for this watershed. However, I would not want to extrapolate for another region. I think each region has its own unique ecological characteristics and our study is useful for planning in the southeastern region, particularly in the region with sandy soil, but to carry beyond that would be extrapolating too far.

MR. BAYHA: From your literature review, do you know of other investigators who have had that type of relationship identified?

MR. HARRISS: Yes, there are other studies. We felt, however, that the unique opportunity here was to have comparative studies over the entire development process.

I don't know if any studies have been lucky enough to have that particular timing as for example, in the case of the highway and in the case of encroachment of urbanization, but certainly I can give you the list of references we have found in connection with our studies.

CHAIRMAN ENK: An important question that came to my mind was—can this type of analysis really be used in the impact statement? Can it be used in the impact statement in relation to somebody trying to make a decision whether or not to go ahead with a particular project?

MR. HARRISS: I think it can. The difference here is in the impact evaluation process. Rather than asking the question, "Will this particular change in land use result in a change in water quality," which will precede set criteria, the impact process asks how the proposed change in land use affects the pathway and not rate of mineral flow through the system.

Then, we can go back and identify for a given change. For example, in the case of how highway construction for a given area affects the infiltration rate in the soil, we could predict what the change would be in the flow rates per unit area of water and, therefore, the transport capability of water in different areas of the region under concern. We could predict this and therefore have a much better basis for identifying the impact—using what I would consider the fundamental approach by asking the question as to how the reflex factor will be maintained. This is a much more fundamental question than saying "Will the process result in exceeding the water quality criteria?".

However, I think the answer here is that it is not easy to use. It is a little more complicated but then somebody mentioned generating employment and it will generate employment for a lot of ecologists. I think it can be done.

Problems and Opportunities With Environmental Impact Statements

Corps' Problems in Preparing EIS

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There has been a gradual shift in public awareness and a growing realization that our natural environment is less than an infinite resource. The National Environmental Policy Act of 1969 (NEPA) is a dramatic example of this awareness. The feature of NEPA with which the public is most familiar is the requirement for the preparation of an assessment of the environmental effects of future projects. This is displayed in the form of an Environmental Impact Statement (EIS) under the requirements of that Act's Section 102(2) (C). The EIS requires the decision maker to consider and evaluate all environmental aspects of a proposed action. He must also make all the factors considered a matter of public record and conduct "give and take" sessions in the arena of public opinion. After competitive views are discussed and decisions modified as appropriate, the entire record is placed in the hands of the Council on Environmental Quality (CEQ) and before the Congress.

Background Information

The effect of NEPA on Federal agencies has been dramatic. Extensive modifications in point of view and procedure are evident. In the Corps of Engineers alone, some 1,750 impact statements, draft and final, have been prepared and filed. The Corps has produced EIS for a greater variety of engineering projects than any other agency and only the Department of Transportation has filed a greater number with CEQ. We have the experience and the ability to speak with authority on impact statements.

The Corps of Engineers recently evaluated the effects of this Act on its current projects and found we have performed reasonably well when it comes to identifying and eliminating adverse effects or otherwise solving the problem. An assessment was made of over eight hundred projects in various stages of completion from planning and design through construction and operation. Based on these data it was found that about one out of every three active projects in Civil Works has been modified because of NEPA. The implementation has included a host of actions ranging from complete elimination of a project to minor project modifications: dams have been resited, elevation of pools adjusted, spoil areas relocated, fish and wildlife losses mitigated, fish passage structures added, highways relocated, levees set back to avoid channelization of natural streams, greenbelt floodways established, etc., just to name a few of the kinds of modifications we have been involved with.

The requirement to produce these statements is good! We have re-oriented our thinking and we now consider more alternatives and non-traditional alternatives as solutions to the Corps mission problems. We work more closely with the public, civic minded groups, elected officials, etc. Our concepts and procedures have been modified and changed. The environmental considerations are now an integral part of planning and decision making in exactly the same way that the social, economic and engineering considerations are a part of that same process.

When NEPA became law in 1970, there were no methodologies for systematically assessing environmental impacts. The wide variety of techniques available today were produced under pressures of necessity, by Federal agencies, the academic community, and private consultants. Most of these techniques were not full-blown methodologies for preparing impact statements at all but rather tools borrowed from other endeavors to handle a rather narrow set of environmental impact issues.

Problems inherent with novel procedures and requirements were bound to occur and there have been many. We have examined reoccurring problems associated with Corps projects and have identified four general areas of difficulty in making environmental assessments. These are: *defining the objective and scope of the study; selecting a team or organization to conduct the study; selection of an appropriate methodology to be utilized to complete the assessment; and finally the actual preparation of the EIS.*

Defining Objective and Scope

Once the need for an environmental assessment is established, the first task is to define the objective and scope based on the purpose for which the information will be utilized. Failure to make these definitions clear results in the production of insufficient information to properly examine the viable alternatives essential to the assessment process and makes the justification for a given course of action almost indefensible. Critical to these definitions is the determination of the level of study detail required. This varies depending upon the stage in the planning process where the data is required and the complexity of the project. For example, if one is preparing environmental information dealing with, say, fifteen alternatives in preparation for a formulation stage public meeting, the data need not be as detailed and precise as when the information is to be used in describing the most viable three alternatives and the selection of the best alternative in preparation for the late stage public meeting and the draft EIS. The establishment of useful environmental information to affect the decision making process requires both time and money which also relates specifically to the level of detail and ultimately to the appropriate definition of objective and scope. Failure to recognize the significance of these influencing factors and the need for a well defined objective and scope of work has caused the preparation of some less than satisfactory reports and put an unnecessary strain on our contractor-corps relationship.

Selection of Team and Management

During Fiscal Year 1974, the Corps of Engineers employed 215 full-time employees to work on the preparation and circulation of environmental assessments and impact statements. Their costs for labor and materials plus the cost of outside contractural services for this period amount to about $22 million. Approximately 40 percent of these costs were Corps in-house and 60 percent by outside contracts. Contractors were used in the preparation of data in about one-half of the EIS written by the Corps of Engineers. To date there have been approximately 725 separate contracts functioning in this capacity since enactment of NEPA.

It is imperative that there be a close working relationship between the Corps environmental resource personnel and the staff of the contractor. In our most successful endeavors the contractor was, in essence, a part of the planning process. The degree to which the contractor was isolated from the planning effort can usually be equated directly with the extent of dissatisfaction with the final report.

The basic problem from a management viewpoint is lack of effective communication. This breakdown in communication frequently starts at the very initiation of contractor and the Corps negotiations. The organizations requesting the environmental assessment frequently are not familiar with the subtleties of the environment but are strong on understanding economic and engineering characteristics of the proposed action. On the other hand the organizations having capabilities to perform the environmental assessment frequently are naive about the economics, engineering and operational structure of the client. As a result, it is not infrequent that people involved in environmental assessments have an inadequate understanding of the proposed action.

Another problem is the selection and the management of an interdisciplinary team. The selection of the project manager is critical to the success of the contractor-Corps team. It is no easy task to manage such a team to insure cross communication, production of information at compatible levels of detail, and to have the disciplinary inputs available on time to meet deadlines. The problems of management of interdisciplinary teams vary depending upon the contractor, for example, university versus consulting companies. Our experience has been a mixed bag of success and failure. Interdisciplinary team efforts at universities have a high success in the area of original contributions to environmental assessment approaches and methodologies, but are difficult to coordinate because of the complex organizational structure of most universities. Organizations such as consulting companies doing environmental assessments do not generally have as complex problems organizationally but frequently do not have the staff capabilities present at universities. We have had some individual problems at universities and with consultant firms as well. For example, individuals (particularly those who are accustomed to working under grant–type research projects) sometimes find it difficult to adjust to an applied problem with tight schedules.

All will agree that coordination is necessary. However, the problem is when, where, and how much? There are no simple answers. The basic guidance in the Corps is that the contractor personnel must be considered as part of the planning team and contribute to the planning process. When not working as an integral part of the team, the contractor and District staff must have frequent exchanges of information. The results have been most satisfactory when data was exchanged informally on a weekly basis and where formal coordination meetings were held monthly to deal with schedules and problems as they arose.

From our experience, certain criteria emerge which we feel have been the most successful in the selection of team managers and to a certain extent team members, whether in-house or for a potential contractor. There is no one expert category that is needed more than another. Experience has shown that a narrow biological background is not preferred over the ability to relate scientific information over a wide base of disciplines. Although formal training is important, competence is essential. A broadly trained experienced professional who can apply himself to a range of problems, and who is not afraid to admit limitations, is superior to an expert. Highly technical input can be obtained from exogenous sources when needed. When developing environmental teams, we look to satisfying multidiscipline requirements so as to present a broad base of expertise and experience.

Some type of critical path scheme or matrix is almost indispensible to the assessment team management when conducting complex studies. In order to establish the best chance for success, the Corps has appointed a coordinating leader assigned to work closely with the contractor project manager. Care, however, must be taken not to interfere with the project manager who must demonstrate performance control over the interdisciplinary team members.

Selection of Appropriate Methodology

Numerous methods have been developed for quantifying environmental impacts of engineering activities and for displaying tradeoffs among planning objectives so that decision makers can wisely select the best alternative. Examples include those techniques developed by the U. S. Geological Survey, Universities of Georgia and Wisconsin, Bureau of Reclamation, Northwestern University, Battelle-Columbus, Battelle-Northwest, Stanford University, U. S. Environmental Protection Agency, USAE Tulsa District, USAE North Pacific Division, USAE Construction Engineering Research Laboratory, USAE Waterways Experiment Station, etc. It is not my intent to summarize or evaluate these techniques but at the end of this paper a reference list is provided which was prepared by Dr. Rex L. Eley, Waterways Experiment Station, Vicksburg, Mississippi. Corps of Engineers specialists have examined all available techniques as they apply to Civil Works activities and report that each method has certain advantages and disadvantages. The basic problem facing those conducting an environmental assessment is to determine which methodology or combination of methodologies are best suited for the situation being evaluated.

There are *subjective methods* and *numerical methods*. Most environmental impact statements in the past and currently in process utilize some form of a subjective method. They are characterized by a great deal of descriptive material in the form of written text, maps, and lists of specific parameters such as environmental conditions, biological species or other factors which provide mostly a framework for an area inventory. When using either method, the assessment is generally accomplished by a comparison of the assigned effects of development alternatives to a baseline of "no action".

The primary advantage of subjective comparisons is simplicity of concept. The reasons for a judgement are stated and subject to public scrutiny and criticism. The importance of each effect is stated and emphasis can easily be placed on the most important effects, but sometimes secondary effects are overlooked or only partially identified. The conclusions are based on trained professional subjective judgements and in the absence of well defined, statistically valid data, there is no better substitute which will get the job done.

The primary disadvantages of the subjective comparisons are the lack of uniformity in subjective analyses, and non-uniform considerations of the various types of environmental effects. Because of training, background and experience, the subjective ranking of several alternatives can differ markedly if made by different persons. The amount of difference is usually a function of the amount, accuracy, quality and availability of the data. The more data the more similar are the judgements. A team effort helps to resolve differences of opinion but where efforts fail to resolve these differences, more than one opinion should be reported. Another disadvantage to the subjective methodology is a lack of continuity in the report. Any and all kinds of data can appear in the report but it is sometimes impossible to determine what data is relevant to the project and influenced the judgements and which information might be superfluous. This situation comes about because fixed procedures and assessment factors are not used for evaluation of the alternatives.

The primary advantages of the numerical methods are uniformity of application and completeness. They are uniform in application because they have a standard evaluation procedure. A systematic method, generally using some form of a matrix, is used to determine numerical values for each effect and overall numerical ranking for each alternative. The methods evaluate impacts by comparison in a format which plots in a matrix the degree and relative significance of a proposed development action or alternative against a range of specified environmental, economic, and social factors. In some matrices a symbol or descriptive terminology system is used to rate impacts. In others a point value rating system is determined and numerical values are assigned to each cell of the matrix where an interaction occurs. In either of these, the magnitude and/or degree of importance may be indicated. Each alternative can be expressed in a two dimentional matrix but a network of multi-alternatives can be analyzed and compared using a system of multiple matrices. Weighting factors or multipliers are sometimes applied to individual parameters in an attempt to compensate for inherent differences in their magnitude or importance in relation to the final net effect. In any event the total numerical values for several alternatives when compared will indicate the supposed best alternative.

The disadvantages of numerical evaluations are: (1) too complex for routine use, (2) difficulty in adopting parameters and weighting factors to local conditions and non-economic resources, (3) subjective inputs can control results, (4) high cost in acquiring data and reducing it to proper form for calculation, (5) low understandability and (6) inability to project the public and community policies and preferences.

Matrix analyses are used fairly extensively throughout the Corps, particularly for large complex projects. But the use is limited mostly to the early stages in planning. In a few instances the matrix analyses have been carried through to a point of assigning comparative numerical values to different alternatives. Such figures have assisted the District Engineers in making their decisions, but these figures have not been the only factor which influenced the final recommendation. There is no substitute for trained professional subjective judgements in the evaluation of construction effects on the environment, nor is there likely to be for some time. But matrices analyses should not be precluded from immediate use on a selective basis and work should continue to refine current evaluation systems.

Preparation of EIS

The current rules and regulations have been translated into a procedure which makes the EIS cost too much in terms of money, time, and other resources. Too much attention has been given to the procedural aspects. Environmental statements prepared today can generally be identified by their great bulk and diversity of information. Several hundred pages is not uncommon for an EIS and a thousand or more pages is somewhat unusual but occasionally occurs. These statements are not necessarily bad, in fact, some are very good. They meet every procedural aspect of the law and reveal a tremendous amount of information. They meet the demands of the courts, but do they meet the needs of the public? Who reads these bulky documents? Perhaps more important is the question, what function do these environmental statements play in the decision process?

The time has come to rethink the EIS process and streamline what has become too often a "paper drill." We have struggled with this problem and developed some ideas we think could provide an appropriate solution to the dilemma.

The environmental considerations must be an integral part of planning and decision making in exactly the same way that the social, economic and engineering considerations are a part of that same process. The environmental data should appear, therefore, along with the other information in the planning and engineering documents. For example, if a project were in the pre-authorization stages in the Corps, the principal planning document would be the Survey Report and this report would contain all the pertinent data of a social, economic, environmental and engineering nature. The EIS would be prepared after all the data for the Survey Report had been compiled and would be based on the data and analyses that was covered in the planning report. The impact statement would become a summary document primarily written to inform the public and addressing the specific five points for consideration prescribed in Section 102(2)(C) of NEPA. The EIS would reflect the factual data contained in the Survey Report including the coordination and the correspondence information received.

We believe that, except for a few special and complex projects, the entire EIS need not exceed ten to twenty pages in length. The bulk of the data and the assessments having been reported in detail in the Survey Report or other decision documents. The decision documents are also made available to the public. By following this procedure the cost would be greatly reduced and the public would receive a readable document.

An analogy is that the use of the environmental data or EIS should be similar to buying a house. You do not buy a house solely for the way it looks and its setting. You look inside to see how many bedrooms it has, whether or not it has a furnace and air conditioning, whether or not the basement leaks. You find out its availability and how much it is going to cost. That is, you look at the engineering, the economic and logistics concepts in *conjunction* with the environmental setting—what it looks like. In a similar way, logistics, economics and engineering details of a project should not be included in the EIS, but should be an essential part of the total planning process. The environment should also be an integral part of that process and not separated out for consideration independently. When separated there can be no assurance that the environmental data will be available at the appropriate time for consideration by the decision maker.

Summary

In summary, we in the Corps are convinced that you can't adequately comply with NEPA unless the environmental issues are made a part of the planning and engineering processes. The EIS as prepared today duplicates a great deal of the information contained in our planning and engineering reports and too often the contents of the different documents are not correlated or compatible with each other. Neither the EIS nor the planning and engineering documents provides the decision maker with all the essential facts in a timely manner, and the combined use of the documents is not completely satisfactory. A properly prepared planning document would serve all the functions of the EIS and more. If an EIS is prepared, it should be a short summary document composed to inform the lay public. We intend to move in the direction of the smaller EIS in accordance with the ideas I have expressed. While the Corps planning process is somewhat different than other agencies, the concepts are certainly adaptable to the needs of these agencies as well.

The implementation of NEPA has been and still is a dynamic changing process. The Corps has been a leader in sincerely trying to make NEPA function to the best interests of the public and in accordance with its founders' high ideals. We intend to maintain our leadership role.

Environmental Impact Assessment Methodologies

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Discussion

CHAIRMAN ENK: Before Grant started to speak, I did make a comment about giving a minute or two to anyone who had a question that dealt with specific interpretation of data. Are there such questions?

MR. ROLAND CLEMENT [National Audobon Society]: I would like to ask Grant Ash, in view of the fact his chart did show consideration of social assessments, what is happening to the social well being element that has been talked about, kicked back and forth so much during the last few years?

CHAIRMAN ENK: Would it be all right if we came back to that question later on? I don't see it as being one of interpretation.

MR. CLEMENT: Very fine. I will bring it up later.

CHAIRMAN ENK: If there are no questions of interpretation, we will proceed.

NEPA has been discussed as just "ecological" or just "environmental" type of legislation. There are those of us who believe, however, that when Congress used the phrase "the human environment" and talked about inter-relationship between natural and human systems, they were certainly involving more than just ecology—they were going into the natural, economic and social aspects.

The Use of Economics in Project Evaluation

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I

The use of economic analysis in project evaluation has a very long, if not entirely distinguished, history. Julius Margolis (1959) has cited a provision of the Vermont constitution that in fact requires that the benefits from the monies to be levied and expended be demonstrated to exceed the costs. And, indeed, throughout American history we find efforts to weigh the worth of public improvements against their costs, perhaps becoming firmly institutionalized by the 1936 flood control legislation which explicitly requires that the "benefits to whomsoever they accrue exceed their costs." To review the basic methods of economic analysis in benefit-cost studies, is of course, outside the scope of this brief paper. Volumes have been written on the subject, a standard work being Eckstein's *Water Resource Development, the Economics of Project Evaluation* (1958). What I think might be more useful is to highlight briefly more important applications of economic analysis in project evaluation; to note its limitations as applied in the past; to comment on its significance and highly important omissions, as it has been practiced; and to raise some fundamental questions which I feel are not being addressed in project evaluation and which are susceptible to economic methods of analysis.

II

The coincidence of the greatly stepped up program of water resource development in the United States during the 1930's and the requirement of the Flood Control Act of 1936, led to a great deal of effort to develop principles and practices that would be responsive to the requirement of the Flood Control Act of 1936 to evaluate projects by comparison of benefits and costs—and where flood control was involved, by consideration of potential loss or savings of life. The Subcommittee on Benefits and Costs of the Interagency River-Basin Committee represented the official group in the government that worked toward developing the appropriate methods of evaluation. The so-called *Green Book* (1958) which presented the basic principles represents a signal achievement. Eckstein's (1958) more academic and theoretically integrated study has put this methodology into basic theoretical perspective and is a standard text in "how to" analysis, with the rigorous theoretical underpinning provided, along with the qualifications and limitations that characterize the application of analysis to practical problems.

As a useful body of principles for evaluating proposed projects, the Subcommittee's and Eckstein's work deserve much credit. There are two limitations, however, affecting the results of such analysis as carried out in practice that need to be mentioned.

Economic analysis of benefits and costs of long-lived investments involve as much art as science. There is need to project the relevant course of events within the area of project influence over a very long period of time, and getting to understand human responses to changes in the social and physical environment does not come easily. Accordingly, since the analysis has been done by the agency proposing the project, and there are a whole host of both gross and subtle forces in operation tilting the predilections of the construction agency toward development, we can as a matter of course anticipate a certain bias in the results of such analysis by agency personnel whose agency's fortunes depend on a vigorous developmental program. We find evidence of this in the many project benefit-cost ratios of 1.1:1 and even 1.01:1—benefit-cost ratios, which on their face would be very suspect given the margin of error of such estimates. Other evidence exists in the general practice of the assiduous search for benefits, but the apparent occupationally induced myopia in perceiving costs. For example, take the widespread calculation of secondary benefits that was relied on to add something to the benefit total when primary benefits fell below the corresponding costs. This was done without apparently recognizing that there were corresponding secondary costs—the secondary costs were completely neglected in the evaluations. The first limitation of benefit-cost analysis in practice, despite the sophisticated methodology, resulted from the institutional milieu in which it was conducted—there was an inbuilt institutional bias that tilted results so as to favor excessive development.

A second limitation of benefit-cost analysis as practiced may also have in some way an institutional basis. The problem to which I refer is the tendency for the effort in benefit-cost evaluation to concentrate on the "intermediate" goods or services produced by resource development projects. That is to say, by the construction of a multi-purpose water storage reservoir we obtain such "intermediate" services as a flood damage reduction thus upgrading the use to which a flood plain may be put, the possible improvement in navigation services useful in transporting other intermediate products or final consumption goods more efficiently, and hydro power—among possibly other intermediate goods. These are all outputs of a multiple-purpose project that represents inputs to some other productive activity before ultimately coming out as final consumption goods or services. The effort expended on benefit estimation methodology seems to have been selectively restricted to the evaluation of the worth of such intermediate goods or inputs to further production. The significance of final consumption services that are both incidentally provided, such as water-based outdoor recreation on new impoundments; or destroyed, such as recreational activity supported by a free-flowing stream or the peculiar habitat provided by the site inundated by the reservoir, where winter habitat is a limiting factor, appear not to have received the kind of attention accorded the intermediate goods purposes of development. This is a phenomenon that is very difficult for me to understand. It is not as though all of the recreational benefits were associated with the reservoir site remaining undeveloped, and representing an opportunity cost, thus tending to be overlooked during the diligent search for benefits of project development. In some areas of the Southwest, for example, where there are few, if any, natural lakes, the artificial lakes caused by impoundment represent a major recreational opportunity.

This is not to suggest that the policy statements on the matter, whether contained in *Supplement #1 of Senate Document No. 97* (1962) or the more recently issued *Water Resource Council's Guidelines (1973)*, ignore water-related outdoor recreation benefits. Rather they appear to harbor skepticism about the use of economic analysis in the area of consumer behavior where services are not priced, despite the willingness to embrace comparable analysis in the area of producer behavior when the intermediate services, e.g., developed navigation channel, are similarly non-priced.

The basic methodology for determining the demand for, and hence value of outdoor recreation was provided in the seminal work of Marion Clawson (1959), and some equally imaginative, but less well-known work of Robert K. Davis (1963), over a decade and a half ago, with substantial additional development by a host of subsequent researchers too numerous to detail here. This work has been undertaken by widely varied sponsorship—the Department of Health, Education and Welfare, the Bureau of Outdoor Recreation, Resources for the Future, Inc., the fish and wildlife management agencies of state governments, and, not infrequently, independently by advanced degree candidates in economics at various universities throughout the country. Lacking suitable media for communication, it has been done to a certain extent in isolation from others working in the field. Understandably this has not permitted the adoption of uniform conventions, as for example when dealing with income classifications, with some variability in results. It was because of some variability in methods and results that the Water Resource Council rejected the use of economics in the estimation of benefits in this area of final consumption services. Instead it proposed the use of arbitrarily selected values for use pending further development of recreation demand methodology (*Federal Register*, Sept. 10, 1973, p. 24804).

It bears mentioning that projecting the occurrence of extreme hydrological events is also subject to some uncertainty—and will vary depending on the hydrologic models employed. Yet the evaluation of the benefits of storage for regulating the hydrologic regime downstream is in significant part dependent on the recurrence interval and run of extreme events, for which alternative models will provide as much variability as found among econometric models estimating the benefits from recreation. It appears no more reasonable to select a narrow range of per day recreation benefits, under the circumstances, than to have selected a narrow range of benefits per acre foot of flood control storage to be applied to flood plains downstream of flood control projects. Accordingly, until the same kind of effort has been invested in the development of benefit estimating methods for final consumption services as have been for the intermediate services *by the resource development agencies* and through sponsored research, one may harbor very serious questions about the adequacy, even reasonableness, of project evaluation carried out under the WRC guidelines.

III

Above I have discussed some of the institutional impediments to meaningful economic analysis in project evaluation, unless the evaluation is carried out by a disinterested party without institutional incentives to tilt in one direction or another. I have also commented on the technical deficiency of evaluation guidelines when only the intermediate goods and services are subjected to analysis, and the final consumption services benefits are drawn from a black box. I would like to turn now to an economic consideration of a very important issue about which I feel there is considerable confusion, and which has the potential, in combination with other deficiencies in the application of benefit-cost analysis, of creating a great deal of permanent mischief. This has to do with employment of a differentially low discount rate for project evaluation, *coupled with the practice of not providing monetary estimates of annual environmental and other hard to measure costs that may continue long after the finite productive life of a project.*

There is a rich literature related to discounting future values that I need not get into here. The first reference to the problem by renowned economist, to my knowledge, was by Pigou, who in his *Economics of Welfare,* said the following, which has implications for the rate of discount in resource development projects.

> "It is the clear duty of Government, which is the trustee for unborn generations as well as for its present citizens to watch over, and if need be, by legislative enactment, to defend, the exhaustible natural resources of the country from rash and reckless spoliation. How far it should itself, either out of taxes, or out of state loans, or by the device of guaranteed interest, press resources into undertaking from which the business community, if left to itself, would hold aloof, is a more difficult problem. Plainly, if we assume adequate competence on the part of governments, there is a valid case for *some* artificial encouragement to investment, particularly to investments the returns from which will only begin to appear after the lapse of many years."

The concern about making provision for unborn generations by reducing the rate of consumption of exhaustible resources prompted Pigou to suggest it appropriate to receive a lesser yield on investment in renewable resources. An example might well be one in which the government undertakes a long term commitment for R and D in solar energy conversion or possibly fusion technology that would provide an inexhaustible source of pollution-free energy and thus stretch out the use of fossil fuels that may have a higher valued use as sources of chemicals, etc., for future generations. A community might properly delay for a substantial period returns to an investment in R and D that will make provision for the future.

I believe it was with this general notion in mind that the National Water Commission recommended a discount rate that is roughly half only of yields to investments in sectors from which funds for water resource development would be forthcoming. I don't know what the rationale behind the rider to the 1974 Omnibus Rivers and Harbors Bill might have been, but I suspect there was as much a concern for pork as for future generations involved in the action to permit use of a low discount rate. The question remains, is a water resource development project likely to be the kind of investment that Pigou had in mind as justifying a lesser yield (i.e., passing the benefit-cost threshold only by using a lower discount rate)? There are a number of facets to this question and we ought to consider them thoughtfully.

To begin with, we might consider a hydroelectric development or a multiple-purpose project with hydroelectricity as one output, an investment in solar energy. That is, the energy to lift the water from the oceans to be precipitated in the watersheds above the dam is provided by the sun. A hydro project is a freeloader, picking up the energy from falling water on its descent back to the sea. It's a way to tap into the renewable energy resources embodied in the hydrologic cycle. So far so good, but there are other facets to the problem.

Hydroelectric development is the most capital intensive energy source, with 90 to 95 percent of total cost of energy at the bus bar accounted for by capital. Located where the sites are, rather than where the markets (load centers) are, the capital costs of transmission facilities, and associated power losses in transmission also are a factor. Increasing the proportion of hydro to other energy sources will tend to increase the demand for certain exhaustible resources—the metallic minerals required for the hydro power cum transmission plant. So, while we've gotten to first base, we're still not home free.

To continue, the reservoir associated with a hydroelectric site might occupy land for which there are alternative uses. If the site represents land suitable for productive agriculture or silviculture, its development as a reservoir site in turn preempts an alternative use of a renewable character. If this is private land for which compensation is paid, the discounted value of the future income stream figures into the cost of the project to be compared with the benefit. But here condemnation at fair market value uses a higher discount rate for the value of the renewable alternative output than for the renewable energy output. A bias is thus introduced into the benefit-cost evaluation through the use of a lower discount rate on the project's output, remembering that both output streams represent renewable resources. There is no justification for using differential discount rates under the circumstances.

Suppose that the reservoir site has an alternative use, but that it occupies public land for which compensation does not need to be paid. An environmental impact statement will be required under NEPA, but no need exists nor any help given by WRC guidelines for estimating the monetary value of the preempted service flow from the site left in its natural state. Here, because there is no requirement whether by NEPA or the Water Resource Council to evaluate the monetary benefits foregone by reason of the preemption, the use of a low discount rate for the water resource development grossly biases the results in favor of development. That is, there is a stream of opportunity returns foregone in perpetuity, the present value of which would be larger at a low discount rate. But such costs are left out of account entirely.

Does it make any difference that the development has a finite life while the service flows from the alternative uses continue in perpetuity? If the project has a finite life but is capable of redevelopment at the end of its life, and appropriate cost accounting procedures are used, the project may be regarded as having a renewable life even if for accounting purposes it is set up as a finite lived facility. But, are water resource projects typically subject to redevelopment? One would have to have more technical information than I currently have to answer that question in connection with any particular site. But there are a class of projects for which redevelopment is not possible. In areas of the country where streams typically carry a substantial sediment load, reservoirs tend to fill with sediment. A given portion of the storage space is allotted to receive the sediment so that the remainder can serve conventional storage functions. For larger projects provision is made to receive enough sediment to permit a 100 year life of productive service—for smaller reservoirs, 50 years. What then is done with a spent reservoir?

This is a question to which there is no ready answer—there being till now too little experience with non-functional storage reservoirs due to siltation. One thing is known, however, that its efficiency is impaired progressively as the storage capacity is progressively reduced, and that eventually it ceases to produce benefits altogether, being no longer functional. But that may be the most happy outcome. It may become dysfunctional as well as non-functional, incurring substantial costs due to its dysfunctionalism. For example, the structure built to impound water may not be equal to the task of safely containing contents of greater density than water. To prevent damaging structural failure may require any one of a variety of defensive strategies each of which represent costs. In short such facilities not only cease to produce benefits at the end of their lives, but in addition tend to incur interment costs.

The lower the discount rate, of course, the higher the present value of such interment costs—but to my knowledge they are never calculated. One reason may be that in the past, the rate of sedimentation *generally* appears to have been moderate enough at least in connection with large storage reservoirs so as not to constrain the useful life of a water control project (Dendy and Champion 1973). However, this need not necessarily remain as generally true in the future.

Given the threat to the continued flow of resource commodities at competitive prices in international trade, it is very likely that we as a nation, will need to look more to our own sources of energy and minerals. Both the probable need to shift the balance of energy and mineral supplies to domestic sources, and the tendency to make use of progressively leaner mineral deposits suggests we may experience substantially greater land surface disturbances and erodable spoils piles than has been the case in the past. Past experience has shown that the sediment load may increase 30 to 40 times over natural conditions with coal mining and processing in a watershed. An event of this sort could, accordingly, reduce the life of a reservoir with a functional storage capacity of 1,000 years under normal conditions, to only 25-33 years under the postulated conditions. Indeed, The Corps of Engineers Fish Trap Reservoir in Kentucky is a ready, dramatic, example of just this phenomenon.

The earlier a reservoir becomes dysfunctional and the lower the discount rate, the higher will the present value of the environmental costs a dysfunctional reservoir imposes. If we reckon the value of the preempted service flows of an undeveloped site in perpetuity compared with the finite life of a water control project, then, of course, the lower the discount rate, the higher the value of the site retained in an undeveloped state. But to apply the low discount rate to the stream of annual benefits from the water control project, while failing to evaluate the preempted benefit flow of the undeveloped site, is basically a meaningless exercise. And if the Water Resource Council does not insist on an estimated value of the preempted services based on as good and conscientious an analysis as are the hydrologic estimates, then we have reason to suspect project evaluations represent meaningless exercises.

How this problem should be handled is open for discussion. One means of recognizing early the future interment costs or permanent annual security maintenance costs for dysfunctional reservoirs is to include such costs in project cost estimates at the time they are proposed. That is either a sinking fund be set up, or a performance bond provided, of such value that the annual throw-off or yield upon the retirement of the reservoir from useful service, will be sufficient to maintain the facility in safe condition or in some manner remove the nuisance features of the structure.

IV

In summary, I have touched upon the ancient art of weighing benefits and cost of public improvements. In this I have indicated the value and need for such evaluations. But, the practice of benefit cost analysis has almost never been completely adequate. The deficiencies of the use of economics in project evaluation appear to be partly due to the institutional environment in which the evaluations are conducted. That is, those who are rewarded with discovering that benefits from a project do indeed exceed the costs, as calculated, are entrusted with the calculations. We can anticipate results that provoke the suspicion of the skeptics. Secondly, there has been the tendency to devote substantial time, effort and resources in the valuation of intermediate services provided by water resource development projects. Absent has been a comparable effort to refine sufficiently a conceptually consistent corresponding methodology for estimating the benefits of final consumption services—e.g., recreation benefits. Since some of these benefits represent final consumption services provided by the environment that would be precluded by development, they represent environmental costs that continue in perpetuity, while the benefits of development typically have a finite life—and perhaps in future potentially decreasing periods of normal functioning in particular instances.

If the use of economics is to contribute to valid project evaluations, it appears the above conditions should be dealt with. Thought should be given to establishing a mechanism whereby the evaluation is conducted by a disinterested party on behalf of the public in response to initiation by the water resource development agencies. The agencies themselves ought to encourage, i.e, sponsor, the kind of effort in development of methodology for estimating the benefits of final consumption goods as they have traditionally for the intermediate goods associated with water resource developments. Finally, if a lower rate of discount is used than the yield on the investment that are preempted by the project sector, then it must be applied even-handedly to all of the environmental costs as well. If, as may be the case, it is too difficult, if not impossible, to provide meaningful monetary estimates for all of the environmental costs, there does not seem to be any warrant for using a lower discount rate for project benefits than is used for discounting throughout the federal establishment in connection with any other program. To use a lower discount rate for project benefits while failing to monetize the environmental costs for similar discounting, is a dubious practice that reflects an abuse of economics in project evaluation.

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NEPA and the Scientist

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My argument depends on the following three points:

I. Knowledge is power.
The power of knowledge is greatest in objectivity, weakest in advocacy.

II. The role of a regulatory agency is objective, but watchdogs are needed to keep them that way.

III. The cost of regulating, correcting environmental damage, and the research necessary for the proper performance of these functions should be borne by those served or making a profit from any use or degradation of these resources of the public.

I. Knowledge is Power

To quote Noah Webster, "Science concerns itself with the observation and classification of facts, with the establishment of verifiable general laws. This accumulated knowledge is systemized and formulated with reference to the discovery of general truths or the operation of general laws." Implicit in this definition is a necessary preoccupation with objectivity. The credibility of a scientist depends on his reputation for objectivity.

The legal and administrative hearing system used to collect information for environmental decision-making is the product of a legal tradition based on advocacy. To win, one needs only to best his opponent. Truth is a relative commodity, many times obscured entirely by procedural issues. It is not surprising most environmental court cases are not fought on substantial issues but on legal intricacies with which lawyers are more comfortable. As environmental law matures, more and more issues will be substantial. In Wisconsin we saw the DDT hearing some years ago and the recently fought case concerning Reserve Mining. In both cases, each side had teams of contradictory experts. The hearing examiner and the judge both had to do considerable homework, and Judge Lord even had to hire his own experts. These two issues are exceptions; usually the expertise of two sides is not as equally matched.

Friar Roger Bacon wrote in the late thirteenth century, "Knowledge is Power." One learns things not to simply satisfy his curiosity but to control things. Proceedings in legal form tend to magnify the manipulatory power of science and reduce the objectivity. One might argue quite convincingly that advocacy and objectivity are opposite sides of the same coin and one simply can't have both. Many scientists scorn advocates, as any young assistant professor who has tried to use his testimony for purposes of promotion within the university knows. There ought to be a role for the objectivist in these important proceedings.

However, the very technique of cross examination is not only antagonistic to the essence of scientific discourse, but is designed to control information and thought in a manner contradictory to the standard polemics of science. Lawyers argue to different purposes than scientists.

This system fosters knowledge salesmen. These salesmen, worshipping the trinity Roger Bacon, Machiavelli and Xaviera Hollander, serve the highest bidder. They come from universities, consulting firms and government agencies. They change from one side to another with each shift of the political mind, moving from public regulator to academician to hired gun with the ease of Don Juan shifting beds. Witness the careers that proceed from AEC funded research to Oak Ridge to private consultant to AEC regulator, or the Dow Professor of Toxicology or the Westinghouse Environmental Impact Group. They are the logical end products of a scientific establishment, half of whose time and effort is spent soliciting money. These sophists are well trained, respectable and a great threat to the credibility of all scientists. There seems to be a Gresham's Law of Forensic Science, that bad science drives off good.

For example, at a recent graduate seminar, a man identifying himself as a professor of Plant Pathology at the University of California at Berkeley spoke on the safety and efficacy of 2,4,5-T and related compounds. He mentioned that the safety procautions of the manufacturer (in this case Dow) satisfied him in every way. Only on agressive questioning did he reveal that he was paid, and well, by Dow to make this and similar presentations around the country. Further investigation revealed that he was accompanied by two public relations people hired by Dow to make arrangements for him and get him on the media. Once on the air he was always identified as a professor from Berkeley, never as a paid consultant from Dow. This man and others like him are destroying the credibility of all scientists.

Why is this so?

NEPA and the state equivalents call for complete disclosure of the predicted impacts of a project. These often include questions of considerable importance and equal uncertainty. For example, a significant ecosystem is affected. Experts are called to testify about the impact of the project. If the effect is long term or subtle, an honest ecologist cannot be sure, to a scientific certainty, how the area will behave. He cannot clearly describe ecosystem quality, much less precisely predict how it will change. Diversity, stability, resilience and other derived ecological concepts are still in the formative stage. It would be more convincing and less honest to simplify the concepts and assert them with confidence. The expert who does so increases the force of his argument at some cost to truth. But the temptation is great. Particularly when the highway engineer predicts with certainty the number of lives saved by this project or the businessman predicts the increase in jobs. Many competent scientists, seeing the limits of their science, know full well the pitfalls and weaknesses in their arguments. They are simply not willing to subject their properly uncertain knowledge to the intellectually misleading process of decision through legal adversity.

To put it simply: Under the present system of environmental decision-making, the most powerful scientific knowledge is not available. There is a large reservoir of knowledge held by scientists who do not care or dare participate in legal proceedings.

II. The Objective Role of the Regulatory Agency

Theoretically, regulatory agencies are unbiased. They are not advocates. They must weight the demands on them from a variety of special interest groups and then act to insure the greatest amount of good for all the people of the state. We are concerned with the sort of agency which permits use of resources owned by the public at large, such as clean air and water, by some narrow subset of the public. In many cases, this special use deprives the public of future resources.

Unfortunately, "the people" are an unorganized bunch with a wide variety of sometimes conflicting interests. When resource allocation time rolls around, no one individual stands to lose much and the applicant usually stands to profit. The agency has to evaluate the will of this silent and diffuse constituency against the goals of the applicant. Statutes help express the general and sometimes historic will of the public, but also leave much to the discretion of the agency. I recognize that many agencies are simultaneously playing double roles. One, the technical staff, which is alternately an advocate for various projects and an assisting body to the permit-granting arm of the agency. The second role is that of judge. In the former case, the role seems constitutionally ambiguous. Scientific knowledge seems more honorable as a servant to the judging process.

The exercise of this discretionary power depends on the knowledge available to the judge or hearing examiner. Their nebulous constituency contributes little. Should anyone step forward to represent "the people" he automatically becomes a special interest group. In many instances, however, only the applicant and agency are involved. Expertise must come from one or the other. The applicant with a profit possible and clear goal is a much better advocate than the agency, with its unclear, evanescent mandate and manpower pulled many directions simultaneously. The agency must deal with many applicants about many things. The applicants deal with one agency at a time and about one project at a time.

The agency is usually overwhelmed by the single-mindedness of purpose and the focused resources of the would-be user. Unable to resist the expertise of the applicant, the agency seeks more knowledge. The applicant has such knowledge as makes his case seem good. The public, however, has not focused its expertise and many scientists avoid this sort of conflict. The agency can only get information from the users of the resource and ultimately becomes a parasite on the industry it should regulate.

The agency obviously needs considerable expert knowledge of its own. The all-encompassing provisions of NEPA and WEPA seem to demand that each agency maintain a whole university of independent experts. Unfortunately, each permit is different and in many cases only one or two issues are critical. On the other hand, the critical area may demand knowledge at the edge of the state of the art. (In this changing world, the edge is a moving target.) The public cost of maintaining these sorts of staffs would be immense. Ironically, the public would pay those expenses to enable its own resources to be exploited.

Agencies are plagued by another malady. Agencies seem to take their own preservation as their primary goal, having higher priority than the best management of the resources they are charged to protect. In natural resource areas this conflict is quite likely to occur. The wisest decision in many, if not all, environmental situations is to forego immediate rewards in favor of long term rewards. Political expedience dictates that the term of office is the time period of concern. The wisdom of the long term choice may not become manifest during this period. It appears that political pressures say, "Do something with immediate results. Even if it's wrong." An agency preoccupied with its own survival is less effective. (If this seems to comment on how leaders should be appointed to such agencies, it is not accidental).

Better, it seems to me, that the agency hire experts on an *ad hoc* basis (perhaps for a few months, depending on the issue). This provides the knowledge needed without a large, permanent staff. It has the additional advantage that these visiting experts would have no vested interest in the agency *per se*, providing a much needed watchdog function.

III. The Costs

The total cost of doing business can be divided into internal costs (those borne by the company) and external costs (those not included in the company's budget). Typical internal costs are salaries, raw materials and so on. An external cost might be the education of employees' children, or the $1,000,000,000/year in federal aid to victims of Black Lung disease. A number of items have been internalized by some industries in the past few decades. Some of these are employee health and retirement benefits.

Recently, many people have become aware that use and degradation of the environment are costs which are usually externalized. Many people have attempted total cost-balance equations including environmental costs. Usually these people have been frustrated by the unquantifiables, such as aesthetics and recreational use.

There seems to be no substantive argument possible that when the Widget Works pollutes the air and this pollution affects the health of people five miles away or kills a Christmas tree farm that these are some of the Widget Works' costs. The argument is that the regulators either can't predict the cost and thus set the standards and issue the permits accordingly (or worse, won't). Nor is it likely that the Widget Works will support or actively pursue the necessary research to either cure or calculate a way to recompense the sufferers. Or is it likely that their objectivity would be unchallenged. Yet this research is part of doing business.

It seems reasonable that all environmental protection research costs, as well as the cost of regulating, should be added to the cost of using public resources.

There is a costly assumption implicit in many cases concerning the environment: Projects are considered innocent until proved guilty. For example, usually no permit is required to emit a pollutant until it is conclusively shown to do harm. The burden of proof lies on the conservationist and he has little money.

At first blush, estimating the cost of environmental degradation seems economically complex. I suggest that wherever possible the cost of correcting the damage stand as the predicted cost, though any procedure that achieved a zero impact more cheaply would certainly be approved. For example, it may well be cheaper to remove pollutants from the air at the source than to clean up the air over a 625 square mile area after the pollutants are scattered. More concretely, if a highway is to be expanded over a wetland and it can be shown that the wetland performs a filtering and purifying function equivalent to a $60,000,000 water treatment plant, then the Highway Department would have to pay that amount to the appropriate authority and include this in their cost/benefit calculations. The same would apply to all resources.

IV. The Fee

I propose that a fee be charged all applicants for use of common resources. This fee would cover all regulatory costs, all necessary research by the public's agent, and all reclamation of environmental damages. This money should not be used to increase permanent staffs. There are several precedents for this sort of user costs (e.g. hunting and fishing licenses). Many of the segregated funds tend this way. (The best example I know is the system used by the Wisconsin Public Service Commission). There are several advantages:

1) The users pay their own way.
2) Profit margins and prices reflect the environmental costs of the product or service.
3) The decision-makers can rely less on advocate-experts or prejudiced research.
4) In-house reduction of the number of people whose goals may be confused by a desire to protect the environment on one hand and his job on the other.
5) More scientists can be acquainted with the decision-making process.
6) The visiting experts act as watchdog on the agency they temporarily serve, increasing the agency's perspective and reducing it's preoccupation with itself.
7) Most Important. Better decisions will be made.

Discussion

CHAIRMAN ENK: I believe we can now have some free flowing discussion. Please address your questions to a particular speaker or a set of speakers if they are members of the Panel.

Now, with regard to the general comments and discussion, I would again like to call on Roland Clement because I denied him presenting his question before.

MR. ROLAND CLEMENT: You have presented a lot of interesting detail but I am distressed with what seems to be varying and fundamental dilemma here and I want to try to indicate it to you.

For example, Mr. Krutilla said that amenity values are not included in the economic analysis and, of course, these amenity values are a by-product of the ecological functioning. Now, economists have had a good 25 years to build this into the formula and they have not yet succeeded.

On the other hand, Grant Ash, speaking for the Corps of Engineers tells us that social benefits are one of the measurements involved in assessing a project. However, I am sure that those of us who listened to the people from the Natural Resources Advisory Council yesterday were aware of the fact that we do not know how to assess social well being. There are some Section 80 studies going on, I am told, to try to decide what to do about the Water Resources Council accounting system and as far as I can tell, there has been no public input and no public input has been invited.

Therefore, here we have a double dilemma—the dilemma of identifying or defining parameters and making sure we have the best possible input to the decision-making process. Now, let me come back to my question. Would Mr. Ash tell us what the Corps of Engineers is doing about social accounting and I would like to hear what Mr. Krutilla has to say about what we really need in this area.

MR. ASH: As you know, Roland, about two years ago we had the mandate to put "social" into it. This came in via the flood control bill in Section 2022. However, I will have to admit that for a year and a half or so there was mostly a superificial kind of evaluation of the "social" impacts. However, principles and standards at least came out for public review. They have even been in the *Federal Register*. Nobody has done a great deal to change what was originally put in there, but most of the agencies have been working hard to interpret those in terms which could be more meaningful to the public. As of last October, all projects would have an addendum in which the "social" amenities would be delineated. Again, however, I will have to admit that they are superficial.

"Social" gets into the secondary objectives and as to how far we have to deal with it is the question. We have just written an eighteen-page ERA, accompanied by two appendices, one describing the planning process—how you implement these things and put them into the planning process making sure "social" is a part of it, and the second providing for what kind of tables and presentations might be made to put these features in.

If we follow the course of action we are talking about now—more "social" development—then more data will have to be furnished starting this coming July. There is additional data being evolved in draft form in the field but it has not as yet gotten beyond that stage.

MR. KRUTILLA: I think it is probably correct to say that the federal construction agencies are dominated by the engineers and that the federal marketing agencies are dominated by economists, and, therefore, it is very difficult to provide the wherewithal for the construction agency to make the necessary investment in resources and the kinds of professional expertise to get the input into good professional, economic analysis in that area. The alternative might be something that would follow the pattern of the National Income Conference, that the National Bureau of Economic Research followed when they developed the concept for national income accounting. Here, of course, the professional membership was involved.

I could see something of this nature funded partly by the agencies, partly from external forces that involved all the interested parties, with participation of economists and planners from the federal agencies, in somewhat a similar manner as the Sub-committee on Benefits and Costs operates, but, on the other hand, with a substantial input of expertise from the academic community. I could see this, for example, as basically a way of transferring knowledge to the general practitioner at the time it was generated. This, I say, would be one possibility. However, it would likewise require a new institutional arrangement.

MR. JEFF BRUNINGA: I would like to ask a question of Mr. Ash. In relation to your preparation of the impact statement, does the Corps of Engineers actually consider the alternative of no action throughout the EIS process and, if so, how many of the 1700 environmental impact statements you prepared have recommended "no action?"

MR. ASH: As a matter fact, the "no action" alternative is in every impact statement and by law it has to be there. In fact, all references are made back to "no action" or "without action," as we call it.

As to how many have been turned back, having to do with "no action," I don't have any figure. However, there have been several cases where this has been done. By an act of Congress we were permitted this last year to look over the old hanger-on kind of projects that we have had and we have come up with a list of proposed projects that should be dropped. This, of course, fills several pages.

MR. ROLLIN SPARROWE [Missouri]: I would like to direct a comment to Mr. Ash. I was specifically interested in your response to the potential use of numerical systems for dealing with planning relative to river basin developments. You analyzed, among other things that such systems were too complex and were somewhat hard to understand for certain people who would be interpreting the results. Further, you mentioned they were too costly. Finally, however, I find it hard to understand how you can reject the developing American numerical planning systems by calling them "subjective," when they take us from the era of the windshield river basin surveys and guesswork to a situation in which we can compare projects and project plans which have the value of the existing wildlife habitat expressed in recognizable repeatable units of value. I would like to have you respond to that if you would.

MR. ASH: I am merely saying we do not have them now. You don't have a system now worth a hoot. Of course, we have looked at a lot of them.

For example, at the present time we are looking at one which the Fish and Wildlife Service has put together, which Gary Hickman talked about yesterday. This, again, if it does something for fish and wildlife, great, we are willing to look at any of these techniques.

It looks like the best thing we have seen, really, in looking at the detail, is this matter of systematic analysis getting into it. We are presently spending a great deal of money looking at the analysis system. We think this is the way it will go in the future, at least for us. We have already looked at several kinds of systems that are available.

As to tne cost, it is just a hard fact that this is the way it comes out: It costs you more money to get data in that form and, as I said in my remarks, maybe we can get the computer system to the point where we will not have to keep redoing the same data over and over again. We are doing it that way now. As we request data, we have a tendency to get repeat data over and over again from these people, a second and third time and on down the line. Hopefully, sometime we will get a data system on a computer where we can call for only a minute amount of data and get it just on that basis and forget about all the extraneous material that comes along with it. However, the fact of the matter is that, as we look at it today, there is no such system that has been perfected as yet. Therefore, every time we look at this, we look at it from scratch again and thus it is more costly than some of these other things we have been doing in the past.

MR. SPARROWE: I was referring only to the wildlife habitat portion of the analysis and evaluations necessary with regard to doing these assessments. I think we could go a long way toward solving this problem if we could put things into recognizable units and, in turn, we would not then be asking the general public to look at the matrix systems. We could get to the point where we could say, for example, that X number of units will be lost and then, in relation to reparations, we could get a least X units back of the same general type of habitat.

MR. ASH: You know, you make it sound very easy. However, it is a very difficult problem.

On the eighteenth of April, the people from the Fish and Wildlife Service, as well as some of our biologists, are going to have a meeting to see if we cannot arrive at something like this. However, the Fish and Wildlife people are having just as much trouble with it as we have. What you have to do here, is work some trade-offs within a system. As I have said we are trying to approach this in a very open way and I think the best thing I have seen develop thus far is one system the Fish and Wildlife Service has developed.

MR. KRUTILLA: I am a little bit troubled about some of the things that have been said here thus far. For example, it was mentioned that the Water Resources Council has attempted to address non-marketable values and then decided to go down some other path. Well, flood control is a non-marketable value; navigation is a non-marketable value. The point is, however, that some of these agencies have made a considerable investment in sources of determining the value and unless there is a commitment on the part of these agencies to either get the competence to do this, or some other support for this kind of activity, we are going to spend the rest of our lives talking about intangibles and, to my way of thinking, there is no reason for it.

MR. PETER AMES: I have a comment and a question for Mr. Ash. My comment is that it seems to me if you read the final impact statements from a multitude of different projects, it is very hard to believe that critics are not reading those statements thoroughly because many of the comments are very detailed and are directed at even the small details of the statements. I think very often the critic reads that part of the statement which interests him the most, but he reads it in considerable detail.

My question is this—that as I listened to the speakers, it seemed to me that the term "environmental assessment" and the term "environmental impact statement" have been used interchangeably by some speakers and differentiated by others. As I understand the Corps' regulations, there is a document required called "an environmental assessment" which precedes the "environmental impact statement" and is distinct from it—which requires an inventory and assessment of alternatives and in which actually a matrix treatment is called for by the regulation. Is that correct?

MR. ASH: Usually when we refer to an environmental assessment, it is a document that refers to a permit program—where someone comes to us and asks us to build something in navigable waters. Here we look at it and determine what impact statement is required. We then ask the individual who is involved to make an assessment according to certain rules which we have provided, but we cannot then turn around and just stamp it as an EIS for the Corps. The Corps then has to take statement, analyze it and prepare its own impact statement. It is probably used in an interrelated manner if there is an assessment of environment as part of the impact statement.

Social Impacts of Resource Decisions

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Opening Remarks

Ralph R. Widner

I am Ralph Widner, Chairman of this Panel, and I do want to welcome you. This afternoon the Panel is going to attempt to deal with the complex social and economic aspects of resource decisions on the presumption that we are plowing into a new set of conditions in our national life which will require some adjustments in our procedures for making decisions that have a profound impact on the Nation's growth and development, including resources, and that this will call for modifications in the way we govern ourselves—procedures by means of which we can make those decisions.

Now, if one were to try to summarize the present situation, particularly the rather amorphous debate underway for some years about the possibility of developing something we might call a "National Growth Policy," you might think of the policy as consisting of three basic sets of objectives and concerns—one set the economic, one set the social and one set the environmental. What we are obviously trying to grow toward is a procedure or process through which we can assess, in advance of making decisions, the probable impacts which an economic, social or resource or environmental decision might have upon the other components of the system and upon our objectives.

I think it is fair to say that for much of the Nation's history, we have tended to give overwhelming weight to economic considerations in making our decisions. Only in the very recent past have we begun to give comparable weight to social implications and still more recently to the environmental implications. Now we are trying to develop a variety of procedures and techniques by means of which we can assess the trade-offs between these. The Panel this afternoon will be addressing themselves to these issues.

I suppose we can say in a crude way that there are four rough categories of questions with which the Nation is now grappling. One set has to do with how we utilize our resources at a time when scarcity may be more of a factor in our thinking than abundance.

We are also, in the second category, concerned with the impact of human development—the distribution of human development, economic and population, either upon the face of the country or upon the resources of the country.

We also have some qualitative concerns in the third category that we call "quality of life" aspirations and perhaps we can do a better job of making our environment more habitable in the coming decade. Finally, we have the notion of anticipatory democracy, that somehow we ought to be able to assess the implications or possible consequences of major decisions in advance of making them rather than afterwards.

This morning's discussion on environmental impact assessment, of course, is one example of our groping for these techniques, but I think we will all recognize that the process of environmental assessment has now become equally concerned with the economic impacts of resource decisions and, perhaps not as overtly, with social impacts of resource decisions.

We are very fortunate this afternoon to have with us an outstanding Panel that can bring us some unusual perspectives from a number of different vantage points on these questions.

Limitations of Traditional Economics in Making Resource Decisions

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Today the discipline of economics and its practice as the basic tool used in allocating resources is being challenged on many fronts, by scientists from other disciplines and by an increasingly skeptical public. The current mis-management of our economy calls into question the basic concepts of neo-classical economics and later Keynesian variations. Briefly, as my time allows, I shall review the bankruptcy of economics, now clearly a sub-system discipline, which has been expanded in a vain attempt to embrace phenomena which its concepts are inadequate to explain. By and large, most economists have tended to ignore those social and environmental variables that do not fit into their theoretical models, such as questions concerning the distribution of wealth and income which is too often accepted as a given, or ways in which the concept of the free market and the all-knowing, ever-rational consumer are distorted by the wielding of institutional power, by the manipulation of information, by the speed-up of technological change and by those human needs that lie beyond the marketplace. Economics and its modern tools, such as the cost/benefit analysis have now begun to obscure social and moral choices and prevent a vital, new, national debate about what is valuable. Today, business cycles themselves are created by economists, rather than the market, as they alternately inflate and deflate the economy. Such aggregate demand management cannot address the structural problems of our complex, mature economy, where only vestiges of such free markets remain.

There are, of course, some economists, notably, Kenneth Boulding, Kenneth Galbraith, Gunnar Myrdal, Barbara Ward, Robert Heilbroner, Adolph Lowe, Gardner Means and Nicholas Georgescu-Roegen and others, who have kept such questions alive. However, the anomalies economists cannot address are now painfully visible, whether in global inflation, pollution or the unwanted side-effects of economic development, such as social disruption, cancerous urbanization, soaring infrastructure costs, umemployment and mal-distribution of income and wealth. Indeed, many Third World nations now question the advisability of trying to imitate the capital-intensive development of the West, as typified by Walt W. Rostow in *The Stages of Economic Growth*. Many are now looking to China as a more viable model, because its labor-intensive system uses the human resources that are abundant in all countries, and does not require the surrender of national autonomy, which often becomes the price of foreign capital. The Chinese stress that they do not maximize "efficiency," in Western terms, but rather see it as one goal to be optimised in relation to others, such as decentralized population, domestic production, discouragement of elitism and equalizing income distribution. Obviously this kind of economy, which substitutes exhortation for incentives, and utilizes the energy of its own people in mutual, non-mechanized service to each other, is a pragmatic response to the lack of capital to seed economic growth any other way; but it must also result in a resource-conserving, and therefore more environmentally-benign economy than a capital-intensive one.

Much of the new questioning of the goals of economic development has fallen into the re-hashing of the communism versus capitalism dialectics of the last century. The Chinese denounce capitalism as the root of environmental problems. The U.S.S.R. after initially taking the same position, has now acknowledged its own environmental problems and collaborates with the U.S.A. on the bi-lateral committee now set up to explore solutions to these mutual problems. Many economists reject a priori environmental arguments against capitalism and point to government-directed investments in many centrally-planned economies, such as power generation, steel and auto production and many extractive industries which create problems in the same way that they do in capitalistic settings. Furthermore, many less-developed countries without noticeably capitalist leanings, proclaim their willingness to capitalize their relatively clean environments in their understandable drive for economic growth. However, the now-famous Founex Report prepared by experts from developing countries for the 1972 U.N. Environment Conference raised the newer issues. "In the past, there has been a tendency to equate the development goal with the more narrowly-conceived objective of economic growth as measured by rises in Gross National Product. It is usually recognized today that high rates of growth do not guarantee the easing of urgent social and human problems. Indeed, in many countries high growth rates have been accompanied by increasing unemployment, rising disparities in income, both between groups and between regions, and the deterioration of social and cultural conditions." In their 1974 book, *Economic Growth and Social Equity in Developing Countries*, economists Irma Adelman and Cynthia Taft Morris reached essentially the same conclusion.

All these new issues challenge prevailing economic policies in most industrial countries and highlight the fact that economics is clearly not a science, but rather a normative discipline. How economists address these issues will determine its future usefulness, and whether the current drift toward irrelevant reductionism in the vain quest for "scientific objectivity" can be reversed, so as to permit integration of the new variables, whether the behavior of oil sheiks, multinationals or ecosystems, into their models.

Let us focus on the priorities by which a nation determines the allocation of its resources. These are a product of many factors: its myths and traditions, its cultural assumptions of "value," its stock of knowledge, its assessments of risks, costs and benefits within various contexts of space and time, the availability of land, material and human resources, as well as the mix of public and private decision mechanisms by which its citizens' needs and priorities are shaped, articulated and implemented with sufficient general satisfaction to contain dissent at manageable proportions. Under such a general description of most nations' systems for allocating resources, is subsumed the relative value-weightings between individual autonomy and societal goals, and the various centralized and decentralized configurations of power they produce. Many industrial nations in the West have opted for a greater degree of reliance on market mechanisms of allocation, on the assumption that the optimise individual autonomy while approximating shared societal goals. Other industrial nations have followed the lead of the U.S.S.R. and prefer centralized political mechanisms for resource allocation, on the assumption that overall social goals are optimised which simultaneously approximate individual needs. However, the two largest, most advanced models of these two differing value-systems, the U.S.A. and the U.S.S.R. are beginning to appear very similar in several of their major contours, for example, in their dedication to ecologically-unassessed growth, technological determinism and their increased dominance by bureaucracies, whether officially designated as "public" or "private."

A brief comparison of the environmental merits of these two major resource allocating systems is necessary because there are increasing convictions among resource economists and thermodynamicists that environmental degradation is an index of an economy's inefficiency in utilizing resources; while many social critics in market-oriented economies contend that overall efficiency and general welfare can be improved by shifting resources from the private to the public sectors of an economy. J. Kenneth Galbraith, in his 1958 book, *The Affluent Society* focused widespread attention on the public amenity problems developing in the U.S.A. through over-reliance on market mechanisms to allocate resources. We now see in many other "over-developed" countries, how over-heated consumption by an affluent stratum produces the excessive resource consumption, depletion, waste, obsolescence and pollution which Galbraith had described. He pinpointed the role of advertising in over-heating such consumption in order to keep expanding the private sector production of goods on which the major reliance for employment had come to rest. Other critics in the 1960s offered solutions to this purchasing power dilemma, such as Robert Theobald, Milton Friedman and James Tobin, who proposed new distribution devices to guarantee minimum incomes to satisfy more basic unmet needs, and to prevent these distortions in production patterns. Theobald accurately predicted that advanced, technological economies would be socially unstable and inflationary, because consumption must be continually increased, while capital-intensive production would require less and less labor input. While many service industries have grown to take up some of the slack, today, unemployment and simultaneous inflation are our two most serious problems; thus invalidating economists' traditional concept known as the Phillips Curve, which postulates a no-longer operative tradeoff between these two curses of mature, industrial economies. The issue of whether a technologically-advanced economy produces both structural unemployment and structural inflation has finally surfaced, after its successful submergence by Keynesians and their policies of general stimulation through tax cuts, easing credit, incentives for capital investment, and restraining programs for "unemployables" in the hope that if skills were increased, jobs would somehow materialize. More of the same is proposed in President Ford's new budget, where in spite of the $52 billion deficit, biggest in our history, double-digit inflation is accepted, along with unemployment rates expected to hover around 8%, as inevitable facts of life for the next two years.

Such anomalies must now be vigorously debated, especially since capital itself is now in short supply and many of our most pressing needs lie in the public sector. Market-oriented economies cannot deal effectively with these needs until potential consumers of these public goods and services aggregate themselves politically, and develop sufficient power to shift public funds into underpinning these new "markets" for mass-transit, education, health care, parks, and water-treatment facilities, as well as long term-investments to research and develop non-polluting, renewable energy sources, such as solar and wind power. Not to be over-looked when massive public works projects are proposed to cure our recession, all these public sector goods services and investments create vital, rather than make-work jobs. Not only does over-reliance on private production and consumption of material goods unnecessarily waste resources, but it cannot be relied upon as a major source of employment in an advanced economy without other straetegies to distribute purchasing power. In addition, Kenneth Boulding has pointed out that economic welfare constitutes *using*, rather than *using up* resources; the enjoyment of the stock of wealth, rather than the throughput of production, consumption and waste. Market economies, with their emphasis on private property rights encourage such accelerated throughput, because they assume that ownership confers the right to use up, rather than merely use resources.

However, the more centrally-planned economies seem to exhibit similar ranges of environmental problems, not caused by market decisions, but by bureaucratic ignorance or deliberate central decision-making that sacrifices the environment to economic goals. In addition, socialistic economies have other problems uniquely their own, particularly in finding incentives more thrilling than "plan-fulfillment" to substitute for the individual profit motive and reduce the need for costly unpopular bureaucratic regulation. Indeed, in Eastern Europe and the U.S.S.R. we now see the age-old human motive of profit slipping in again through the back door, whether as individual productivity rewards, workers' councils or in the form of royalties in deals with Western corporations. Advanced technological societies, programmed by whatever set of economic assumptions, all suffer from bureaucratic giantism, technological determinism, human alienation and environmental degradation. Marxian, socialistic and Western-style utopias all rely heavily on technological abundance, seemingly unconstrained by resource-depletion.

The new convergence in advanced economies of problems of inflation, pollution, resource-depletion together with human alienation, unemployment and mal-distribution, is forcing new assessments of our almost sub-conscious labor-oriented theories of value. Such an anthropocentric emphasis on our own human unputs to value is understandable. All economic activity is human, and it is to be expected that economic policy discussions in democratic societies stress labor's input to the production process relative to the objective role of land, resources and capital in determining value. Indeed, in the early stages of the industrial revolution, the role of these objective factors was limited, compared with the vast amounts of human toil required to produce commodities. Marx went so far as to attribute virtually all value in commodities to the labor factor. Although as technology advanced, economists have assigned increasing weighting to land and capital factors of production, their orientation toward labor inputs to value is illustrated by persistent use of concepts such as "man-hours" and "labor productivity," even though this latter term most often refers to additional *capital* placed at the disposal of the worker.

This emphasis on labor inputs to value, even in advanced, capital-intensive economies, became politically-necessary to mask the fact that jobs were becoming a distribution device of major proportions. For example, in their current plight, many industries use as a rationale for federal assistance, not their primary function as supplying needed goods, but that of providing jobs. If we were to acknowledge that in many highly-automated industries capital creates wealth unattended by anything more human than a humanly-programmed computer; we would also have to deal squarely with the need to create institutions for distributing wealth, so that the increasing welter of goods can be consumed by those who still have unsatiated needs for them. This in turn would undermine many current assumptions in market economies concerning property rights, and that only work or contributions to production entitle the equivalent right to an income and to consume (except in cases of age or disability). Furthermore, our emphasis on labor inputs still short-changes nature's contribution to production at a time when natural resources are becoming scarcer in relation to human populations. Therefore we must not only reverse our former notions of "efficiency," but also abandon attempts to neatly quantify the relative inputs to production provided by labor, land, capital and knowledge and recognize the increasingly social nature of production in advanced economies.

Since the planet's resources are finite and its processes are bound by the laws of physics, the 1st Law of Conservation, which states that matter can neither be created or destroyed, and the 2nd Law, the entropy law of gradual disordering and decay, the basic requirements of economies operating as sub-systems within it must eventually be "steady-state" economies, with constantly maintained stocks of people and physical resources. If economic growth of material wealth must be constrained at some point in time, however distant, then human development must find another dimension. Luckily, knowledge development and hopefully, wisdom is unfettered by the dismal laws of physics and is still wide open for evolutionary progress. A steady-state economy can no longer rely on employment in the production of energy and resource intensive goods as its major distribution device, but must gear its production and distribution strategies to a sustained yield system based on renewable resources. Its theories of value must embrace the subjective, changing goals of people, the role of information and human knowledge and the limits of the physical resources of the planet and its daily energy income from the sun. The new issues raised by the Club of Rome concerning the ecological and psychological limits to growth will require a major paradigm change in econimics, as we reexamine such concepts as "profit," "productivity," "efficiency," "utility," "maximizing" and "progress." None of these concepts has any meaning unless the frame of reference is made clear, and boundaries in space and time horizons clearly specified. We must know the answers to such questions as "profit for whom?"; "efficiency at what system level?" ; "maximizing in what time frame?", for such terms to be precise, and to avoid the multiple crises of sub-optimization that their fuzzy, confused use by economists, politicians and businessmen has unwittingly created.

In its dedication to scantily-defined "progress," we now see that the Keynesian enterprise of pumping up whole economies to ameliorate structural pockets of unemployment and mask distributional inequities, has now become too costly in raising rates of both inflation and resource depletion. The easy assumptions that an ever-expanding pie would provide increasing portions to the poor, no longer offers the comforting rationale whereby the world's affluent justify inequities as essential to the formation of new capital for investment. Economists and businessmen with intellectual and financial investments in the growth syndrome, can no longer defend it on the grounds that it is the only way to improving the lot of the poor and providing the "resources" to clean up the environment. There is now too much evidence that growth does not often trickle down to the poor in the proscribed Keynesian manner and using our current form of flawed, excessively polluting production to create the "resources" to clean up its results leaves us with a trade-off. Yet businessmen without prior noticeable committment to the poor, suddenly display hearts newly-bleeding with concern for them. These crocodile tears at the prospect of the dispossessed being denied hopes for increasing private consumption, to which they must aspire if private-sector prerogatives are to be preserved, are new "red-herring issues" to obscure the need for reassessment of the *nature* and *direction* of growth. The new growth debate is uncovering all the value assumptions it has relied on, and forcing us to examine whether growth of consumption in the private sector, however harmful its neighborhood effects, is the only form of growth. Of course, we are obliged to admit that it is not, and that growth could be channeled into the many public service areas of our economy mentioned previously: mass-transit, health care, education and research into new energy-conversion system and recycling with minimal environmental impact. But such a consciously-controlled readjustment would require internalizing the social costs of private production and consumption, diverting private resources through taxation, prioritizing investment and allocating credit; measures which businessmen and many capital-owning citizens still vehemently oppose.

Indeed, we must ask whether in an age of increasing complexity, without vastly more information between buyers and sellers, the simple aggregation of micro-decisions in the market adds up to anything more than the macro-chaos described by biologist Garrett Hardin in his now-famous treatise, *The Tragedy of the Commons*. In such problems of commonly-owned "free goods" such as air, water and oceans, where everybody's business becomes nobody's business, are some of the knottiest theoretical questions of how we are to make social choices in the areas where market choices fail. However seemingly abstract, the debate over social choice theory is at the heart of structuring orderly societies which optimize the general welfare without individual repression. Kenneth Arrow's "general impossibility theorem" states flatly that individual preferences cannot logically be ordered into social choices. Arrow's dismal prognosis for democracy was rebutted by economist Gordon Tullock as well as political scientist Edwin T. Haefele, who contends that Arrow's conditions can be met by representative governments with two-party systems. Herman Daly addressed the dilemma in his 1974 book, *Toward A Steady State Economy*, and states that for a society to achieve a political economy of biophysical equilibrium and non-material, moral growth will require radical institutional changes and a paradigm shift in economic theory. Daly suggests that three institutions are needed for a steady-state economy with constant stocks of people and capital maintained at a low rate of throughput; aimed at providing macro-stability while allowing for micro-variability, to combine the macro-static with the micro-dynamic. Daly endorses Boulding's earlier plan for issuing each individual at birth a license to have as many children as corresponds to the rate of replacement fertility. The licenses could then be bought and sold on the free market. Secondly, he argues for transferable resource-depletion quotas, based on estimates of reserves and the state of technology, to be auctioned off annually by government, and thirdly, a distributive institution limiting the degree of inequality in wealth and income.

Somber proposals such as Daly's may be considered impractical, or "social engineering," and yet the concepts of the "steady-state economists" are beginning to gain a hearing. Most favor theories of value based on entropy, such as

Boulding, who states in his essay "The Economics of the Coming Spaceship Earth" that the economic process consists of segregating entropy, where increasingly improbable structures of low relative entropy are created at the expense of higher entropy level wastes somewhere else. Nicholas Georgescu-Roegen in his new book, *The Entropy Law and the Economic Process* traces entropy theories of economics back to German physicist, G. Helm, who in 1887 argued that money constitutes the economic equivalent of low entropy. Georgescu-Roegen pierces the fallacy that economic processes are analogous to the mechanical Newtonian processes of locomotion. Because economic processes also produce qualitative changes, usually associated with higher entropy levels, he believes that they also elude "arithmomorphic schematization" and therefore, economics with its "arithmomania" ignores them. Basically, the problem is that although resources (matter) may be recycled, it can only be done with inputs of energy, and energy-use not only creates inevitable loss (generally heat), but it cannot be recycled. For instance, in most advanced countries, services are becoming major constituents of their economies, including communications (which often replaces the need for more energy-intensive transportation), movies, TV, insurance, health care, education and research, whether performed in the public or private sectors. Even though these services are less entropic than heavy industries, we cannot forget that they rest on a base of extraction and production which pollutes and depletes resources; although they share the chameleon quality of appearing to be environmentally benign at the point of delivery. Even pollution control and recycling services, such as electrostatic precipitators and wastewater treatment processes use a good deal of energy and resources in operation and manufacturing. In fact Georgescu-Roegen states flatly that all economic processes use up a greater amount of low entropy than is represented by the low entropy resulting in the finished product, and that in entropy terms most recycling is equally fruitless. This is why he and the other "steady-state" economists stress that the real payoffs are in *durability* which reduces this unnecessary flow of production—consumption—waste—recycling to the lowest level achievable. Therefore, we need very careful simulations of entire economic processes from extraction to refining, to manufacture, to consumption, to waste, to recycling; in order to assess their relative efficiencies in resource utilization and concomitant pollution and depletion rates.

Georgescu-Roegen's entropy theory of value cites as separate, additional factors of production natural chemical processes, rainfall and solar radiation, which are usually subsumed under the factor of land, as free gifts of nature. Since some would view this as double-counting, he adds that land, far from being inert, as in Ricardo's definition, is an agent of production in that it contains the chemical processes, catches the rainfall and the solar radiation, which is the only income, or fund source of energy available for the performance of all planetary processes from photosynthesis (the most basic and vital) to our economic activities. The energy "capital" stored in the earth's crust as fossil fuels is a rapidly-depleting stock of fossilized solar energy collected in the past by photosynthesis which is non-renewable. The chief difference in the process of agriculture as opposed to the process of industry is that traditional agriculture must rely on utilizing the unchanging rate of flow of solar energy, while industry can mine the stocks of stored energy in the earth's crust, at least while they last, at its own determined rates. Georgescu-Roegen's book analyses many current input-output models of economic processes in light of his entropy theories, and cites the omission in all such dynamic models of the representation of production of *processes*, rather than merely the production of commodities, as well as other critiques. His theory further challenges the assumption that the increase in "labor productivity" resulting from captial input is only limited by economic costs of additional mechanization and depreciation, rather than any ultimate limits of how much matter/energy nature can put at man's disposal. Such inadequacies of economics give credence to self-defeating strategies, such as that proposed by Henry Kissinger, to place a floor under oil prices to make it "profitable" to develop shale, tar sands and coal liquifaction, in spite of their dismal payoff in real net energy terms.

A shift toward entropy theories of value would require that "profit" be redefined to mean only the creation of real wealth, rather than referring to private or public gain which excessively discounts the future, or is won at the expense of social or environmental exploitation. Similarly, we would recognize that the concept of maximizing profit or utility is imprecise until qualified by a time dimension. Such realistic profits would include improvements in energy-conversion ratios and better resource management, and recycling geared to using the solar energy income available in nature's processes rather than further depleting energy "capital" in the earth's crust. As more externalities are included in the price of products. We may find that many consumer items' profitability will evaporate and these goods will disappear from the market. As I noted in "The Decline of Jonesism," *The Futurist* Oct. 1974, this is already happening as manufacturers such as Alcoa discontinue production of aluminum foil and other goods requiring large inputs of energy/matter such as high-powered cars are being replaced by smaller models and the new boom in bicycles.

Or take the question of the unalloyed desirability of capital investment itself, which is used to justify much inequality of distribution. Under what circumstances are capital investments socially and environmentally destructive; and since we must and will continue our economic activities, how can we reduce their resource-depletion rates and restrain the often arbitrary and irrational investments of increasingly scarce capital. Economists, hypnotized by their elegant equilibrium model of free market supply and demand, cannot readily handle the possibilities of absolute scarcity on the supply side. We must also question the concept of "productivity," another value-laden term, which economists seek to "maximize" by raising the level of capital invested in the worker himself or the machines he uses. Raising agricultural "productivity," for example, by mechanization and application of fertilizers and pesticides can often produce social costs, such as the income inequities engendered by the "green revolution," and environmental costs in breeding resistant pests, runoffs of fertilizer-polluted water, destroying more stable and resilient forms of agriculture and rapid soil depletion. There are also some limits to investments in machinery and automation beyond which workers rebel at the increasing robotization of their jobs and begin sabotaging the production process, as has occurred recently in plants in the U.S.A. Many useful and profitable functions cannot use much capital investment, such as private tutoring, or producing works of art or custom, handcrafted goods; and they provide workers with psychic pleasure often envied by workers in capital-intensive industries. Economist E.F. Schumacher, in his book, *Small is Beautiful*, points out the culture-bound nature of economics in his chapter on Buddhist economics, which, based on the concept or "right livelihood," would define labor as an *output* of production rather than an input, and valuable for its own sake. Schumacher also stresses the need for intermediate, labor-intensive technology to meet developing countries' requirements for rural employment, decentralization and political stability, substituting the Western economists' dedication to market-value with the concept of use-value.

All this suggests the extent to which economic theories have fallen behind the welter of changes wrought by technological innovation. All these new issues lead to a re-examination of human cultural notions of "value." For example, we in the U.S.A. tend to over-value and over-reward competitive activities, which can only exist within an equivalent field of cooperation and social cohesion. At the same time, we under-value all these cooperative activities which hold the society together, such as child nurture and the vast array of services lovingly performed in the voluntary sector, and for the provision of which women bear an unfair burden of the opportunity costs. Similarly, we and other Western countries tend to over-value material wealth, while dismissing psychic wealth. As Walter Weisskopf points out in his 1971 book, *Alienation and Economics*, the real dimensions of scarcity are not economic, but existential; that is time, life and energy, which for man are the ultimately scarce resources because of human finitude, aging and mortality. These factors and needs are similar to those identified by psychologists Fromm and Maslow: love, self-actualization, peace of mind, companionship and time for contemplation and leisure, which can never be satisfied by purely economic means, although economic activity satisfies the lower-order survival needs that permit greater emergence of these non-economic motivations. Likewise, in the U.S.A. we over-value private consumption and property rights while under-valueing public consumption and amenity rights, with which they often conflict. In short, we humans pay our measurers to collect only that data which conforms to our culture-bound assumptions of "value."

Therefore, in the last analysis, we must zero in on the normative nature of economics and how economists' often sub-conscious value-assumptions weight their analyses. I have tried to enumerate many specific instances of this phenomenon in "Ecologists versus Economist," *Harvard Business Review*, July-August 1973. Economics also attempts to deal with humans' subjective perceptions of value as well as the objective realities concerning the actual values of the complex matter/energy exchanges which maintain the viability of our global habitat. Kenneth Boulding and Barbara Ward were among the first to perceive that Spaceship Earth and its natural cycles powered by the sun, contain information on the values of these matter and energy exchanges in the biosphere, and that economics must repair to the physical and biological sciences to obtain this essential baseline data for the accuracy of its own models. Unfortunately, human perceptions of value, i.e. prices, with which economists deal, are notoriously inaccurate because they are based on 1.) our subjective, imperfect observations of the objective world and our resulting unrealistic expectations of the availability of its resources, and 2.) our subjective evaluation of what is important to us, or "valuable." If our assessments of value are either arbitrary, or erroneous, as they usually are, then our primary tool for studying their relative exchange values: economics, must be similarly flawed. Indeed, if prices reflected accurately the true survival values of humans, then why would tobacco be expensive while air is not only cheap, but free? The arbitrary nature of human expectations is familiar to all who have studied the behavior of stock exchange prices. In addition, there are often serious lag times between the reports of scientists on, for example, increasing eutrophication rates or acid-rainfall, and the incorporation of such data into economists reports to bankers and investors or policy-makers, on how they may affect prices.

However, prices still have much useful potential for allocating resources in all situations where buyers and sellers still meet each other with equal power, and have faster information on true costs, so that lags in response and price correction are reduced. As Gunnar Myrdal has stated, "We can begin to fill that empty box in our diagrams marked "externalities," so as to calculate as far as possible the social costs of production so that they too can be accurately reflected in prices. In this way more accurate pricing can still function as an alternative to bureaucracy." In the same vein, Myrdal contends that organized citizens and consumers can function as a countervailing check on the power of public and private institutions, as is evidenced in the U.S.A. by the rise of the movements for consumer and environmental protection and the direct confrontation of corporations by boycotts, the use of proxy machinery, and the politicizing of company annual meetings and institutional investment policies. Many externalities can be calculated or reasonably approximated, so as to bring us closer to determining true value added, rather than immediate but evanescent gains won only at the expense of social and environmental exploitation. Such improved calculations of what market economies call "profit" and state-directed economies call "economic growth," would vastly improve all resource allocation decisions. But in market economies particularly, the quantification of these externalities has been short-changed or overlooked, because the majority of economists are employed by private interest groups or the empire-building public agencies that often cater to them, for the purpose of preparing biased and sometimes blatantly fraudulent cost/benefit analyses in advocacy of their profitmaking or bureaucratic-aggrandizing projects. Even academic economists in both captialistic and socialistic economies tend to be influenced by the prevailing political pressures and cultural assumptions of their societies. Therefore much economic analyses suffer from unacknowledged biases, and over-estimates immediate benefits, while under-estimating more elusive social and environmental costs, whose impact may be born by the society in general or a group within it, another nation, or succeeding generations. The Public Interest Economics Center of Washington, D.C., of which I am a founder, attempts to address the need to enrich the public debate and decision process by critiquing the often frankly promotional cost/benefit analyses used to promote both public and private projects. Costs and benefits are usually averaged out per capita, which conceals who will bear the costs, in perhaps neighborhood despoilation or loss of jobs, and who will reap the benefits; the contracts, bond issue business, profits and new jobs. The Public Interest Economics Center has a roster of some 500 volunteer economists willing to perform such economic analyses for groups who could not otherwise afford economic expertise to buttress their case, either in courts or legislatures, such as citizens groups working for environmental protection, social justice or other volunteer causes. The Center has pioneered this new branch of "public interest economics," in the same way that similar movements have been established in law and the sciences, as well as in the accounting profession, which recently set up its own National Association of Accountants in the Public Interest.

In some cases, the mere collection of data and its dissemination in the most effective channels can create pressure for change. New York's Council on Economic Priorities, founded by Alice Tepper Marlin, has broadened the traditional concepts of security analysis to cover the social and environmental performance of corporations. The Council's reports and in-depth studies count among subscribers a growing number of brokerage houses, banks, mutual funds and other institutional investors, as well as socially-concerned stockholders and citizens. It publishes comparative information on the social impact of corporations in various industries in the area of environment, minority rights, military contracting, consumer protection, political influence and foreign investments. The growing political power of these multi-national corporations which now threatens national sovereignty and world monetary stability, confirms the need for this type of analysis. In addition, there are now enough U.S. investors to provide a market for these reports, as stockholders see the desirability of having portfolios that do not contradict their personal values. In response to these new stockholder pressures on their memebers' clients, the American Institute of Certified Public Accountants is attempting to develop social auditing methods for corporations. One fruitful avenue growing out of their own experience would seem to be that of expanding the familiar concept of "goodwill," which however unquantifiable, is routinely capitalized on hundreds of company balance sheets. It should also be possible to refine calculations of short and long term profit so as to elucidate the time dimensions which always qualify maximizing behaviour.

Much new and useful work on modelling externalities is now in progress, by such economists as Wassily Leontief, and those working at Resources for the Future, including Allen V. Kneese, and two of our distinguished speakers at this gathering, Charles Cicchetti and John Krutilla. Hirofumi Uzawa of Tokyo University advocates an annual deduction from GNP analogous to the capital consumption adjustment that now distinguishes Gross National Product from Net National Product. The new deduction allows for the depletion of natural resources: the consumption of the irreplaceable original capital of the planet. On the assumption that industrialized nations are exhausting resources more rapidly than nature can renew them, each year Uzawa's deductions will increase. In the U.S.A., Thomas Juster sets forth a more realistic set of criteria for restructuring our own GNP, which include in the assets: knowledge, skills and talents, physical environment and socio-political assets, which appears in the 50th Annual Report of the National Bureau of Economic Research. Resource economists, including Allen V. Kneese, argue for effluent and emission taxes as the most efficient way to control pollution through the market mechanism. Yet transaction costs also occur, and effluent taxes are more likely to be decided by the political power of corporate lobbying than the objective market. Neither can such taxes deal with toxic substances which must be prohibited, or irreversable changes. Similarly, the subsidy method also discounts true social costs of pollution, particularly the new pollution-control bonds, which are tax-exempt to encourage corporate spending on environmental improvement; but are proving to be little more than another tax loophole.

But if economics is to develop even more precise tools to assess the trade-offs in resource-allocations, it will need to incorporate much of the new data being developed by the physical sciences, concerning those actual values in the macrobiosystem of nature's chemical exchange work, which maintains global equilibrium conditions for humans. Herman Daly makes an interesting analogy between economies and ecosystems: young ecosystems tend, like young economies, to maximize production. Mature ecosystems, like mature economies are characterized by high maintainance efficiencies. From such insights came Daly's proposal for yearly depletion quotas to be auctioned off by government, which he claims are superior as a basic strategy for resource utilization efficiency than effluent taxes, which he sees as a fine-tuning tactic which only addresses itself to pollution control, rather than the primary issue of depletion.

Howard T. Odum, author of *Environment, Power and Society*, has pioneered energy modelling, a quantitative method of tracking nature's flows of energy and matter, which is fast becoming more predictive than economics. Odum's system converts kilocalories into dollars so that economists can see and account for such work performed by natural systems in their traditional cost-benefit analyses, for example, in converting carbon dioxide from combustion back into oxygen or converting industrial wastes and sewage into fuel and fertilizers. As inflation renders money an even less precise measuring rod of true efficiency, Odum's method of measuring efficiencies of production and extraction processes in the terms of "net energy" is gaining wide acceptance. Odum views inflation as the symptom of a society with a declining energy and resource base, forced to extract energy and raw materials from more inaccessible and degraded deposits. Since it takes more and more energy to extract this energy and materiel, more real wealth must be diverted from the purchase of goods and services. But the money supply is increased as if all this activity were productive, so the diminishing returns to all this energy-getting capital investment are expressed in the degradation of the currency, i.e. rising prices.

Energy-modelling is being conducted in scores of countries and by imaginative engineers, thermodynamicists and physicists, such as Stephen Berry and Thomas V. Long at the University of Chicago, Bruce Hannon at the University of Illinois and Malcolm Slesser at the University of Strathclyde, Scotland. In spite of many unresolved problems of taxonomy and differences of method, it appears to be an order of magnitude better than economics in plotting resource utilization and management processes. In 1974, the International Federation of Institutes for Advanced Study in Stockholm convened energy-modellers from all over the world to map out their research agenda and agree on their terms. Other conceptual problems still faced are outlined in my "Energetic's Short-Comings," *Co-Evolution Quarterly*, Winter, 1974, but meanwhile, it may be the best new analytical tool at hand.

However, analytical tools and reductionist methods all suffer from what Alfred North Whitehead refered to as "the fallacy of mis-placed concreteness." They cannot reveal truth which exists in other dimensions. Welfare formulas for humans cannot be derived from energetics any more than they have been successfully formulated by economists. Moral behaviour cannot be derived from data, but only from our own expanded perceptions of our true interdependent situation as a species marooned together on this small planet and our own striving for wisdom and ethical principles.

Corporate Views and Responsibilities for Public Values and Profits

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I would like to discuss this subject in the context of large corporate land owners in the United States because there are many public or social values associated with every type of corporate industrial activity, whether of a primary or secondary nature.

More specifically, I will attempt to deal with the corporate attitude toward the "trade-offs" between profits and public values in the use of *forest* land, and all the associated natural resources in supplying the material and social needs of our nation.

We need understanding of the relative significance and extent of corporate land ownership if we are to gain perspective into the relative contribution industry can make in resolving problems created by the use of our country's natural resources, so please consider these statistics.

Forty percent of the total land area of the nation is in various public ownerships, two percent in Indian ownership and 58 percent in private ownership.

Problems and conflicts associated with land use are distributed among these major classes of owners in about the same proportion.

About one-third of the United States is covered by forests (753.5 million acres), 67 percent of which is considered suitable and available for continuously growing crops of timber for harvest in the foreseeable future. Approximately 27 percent of this land is publicly owned, most of which is included in our National Forests. The balance or 73 percent is privately owned, with 4 million individual small owners controlling 59 percent and corporate forest industry owning 14 percent. The commercial forest land owned by the forest industry, therefore, represents about three percent of the total land area of the U. S. and an estimated 90 percent of all corporate land holdings in the U. S.

One more statistic is necessary to put into perspective the growing significance of our commercial forest land resource to our economy. In the decade 1952-62, the acreage of commercial forest land in the United States increased by 13.1 million acres, but this trend was reversed in 1962; between 1962 and 1970 the area of commercial forest land in the United States declined by 8.4 million acres, or almost 1 million acres annually, and it is projected that this trend will continue at the rate of 5 million acres each decade for the next 50 years. These reductions have occurred primarily among the small farmer owners in the course of clearing and converting land to other uses and in the transfer of Federal lands into wilderness areas and other special and restricted use categories.

From the beginning in America, ownership of land has not carried any obligation or responsibility on behalf of the owner to use it for the public interest. The Constitution and Bill of Rights were very specific about the rights of the people to own land and to prevent the government's taking it without "due process of law." Emphasis was on the *rights* of the land owner.

Undoubtedly, this reflected the concept of our founding fathers, that property was a positive and necessary factor in the protection and development of liberty and freedom, and vigilance against government interference was fundamental to American political and economic thought. It was assumed that individual rights and interest were automatically congruent with those of the community.

We see today a drastic change taking place in the public attitude toward land use and the obligations of land owners to recognize public values affected by the way in which land is used. Our increasing population (140 million in 1945 to 212 million in 1975, a 32 percent increase), the instant mobility of this expanded population brought about by the airplane and automobile, the proliferation of the interstate highway systems, growing public affluence and increase in leisure time have created an inordinate demand for not only our traditional commodity-type natural resources, but for the associated goods and services for which no previous demand existed.

It is the demand for the use and services of land that has generated the dramatic change in our traditional concept of property rights. Rights for pure air, pure water and the protection of watersheds, access to scenic beauty, opportunities for recreation and a share in the national heritage of open space are not provided for in the U. S. Constitution. Our courts, our legislatures and responsive governments, where they exist, are busily reinterpreting the Bill of Rights to include these entitlements. There is also a great deal of institutional uncertainty as to who is to formulate and implement land use policy—at which level of government and in what way. Until these sorts of questions receive answers, it will be difficult to formulate policies which will achieve anything approaching a consensus.

In summary, we appear to be on the threshold of a new era in the determination of the socially acceptable uses to which land can be put, and industries dependent upon its use which were born and nurtured under laissez—faire and economic pragmatism will have to adjust their sights accordingly.

We must begin to define our needs and bring about a rational balance between traditional rights and needs to achieve the quality of life that our land and resources can provide. It seems our "standard of living," in most people's minds, is measured by their *wants* and the relative ease with which these can be satisfied. Galbraith identified the majority attitude when he said:

> What is called a high standard of living consists, in considerable measure, in arrangements for avoiding muscular energy, increasing sensual pleasure, and for enhancing caloric intake above any conceivable nutritional requirement. Nonetheless, the belief that increased production is a worthy social goal is very nearly absolute. That social progress is identified with a rising (material) standard of living has the aspect of a faith.

So, the task of distinguishing between *needs* and *wants* will be formidable indeed. We have to think of land in terms of the resource that it is and not in the traditional sense as a commodity. Land as a resource introduces considerations of conservation, protection and preservation that are ignored or undervalued when land is treated as a commodity. Leopold has proposed that ". . . our value framework should be so enlarged to include room for the idea that land places obligations on us, communal obligations, which transcend economic self interest."

With this background, we can address ourselves to the views and responsibilities of corporations toward public values and profits.

Industry has a primary responsibility for the conservation of resources used in the conduct of its business, and this responsibility frequently will conflict with the maximization of profits. In extractive industry there is a point of diminishing returns, beyond which the cost of recovery and use of discarded or waste material exceed the market price. Additional costs are, therefore, increased in this process, but it is absolutely essential that maximum utilization of raw materials be achieved to reduce the overall long-run public cost resulting from less than full utilization.

Mandatory, or rather, institutionalized conservation may be the only way that we can assure efficient and equitable distribution and use of our natural resources vital to our national welfare but short in supply.

A higher rate of recovery of natural resources by industry resulting from greater efforts to conserve will result in increased pressure for research and development of marketable end products that can be substituted for products which have incurred a higher environmental cost in the extraction process. As Murray Gell-Mann, a 1969 Nobel Prize Winner has said, "... a major problem now confronting the nation and industry is to reorient the application of science and technology so that a major part of the application is in curing the problems that have arisen as a result of the application so far."

Specific examples of such accomplishments in that direction are the use of bark to generate stream and power as a substitute for oil, gas and coal, the use of sawmill and plywood plant waste for the manufacture of pulp and paper and particleboard, and the substitution of reconstituted particleboard for lumber and plywood, thus reducing the demand for basic raw forest products. The development of improved machinery for higher recovery of lumber and plywood has reduced the volume of logs required per unit of output. We have achieved 100 percent recovery from logs delivered to our mills, but there is still much useful fiber left in the woods following logging operations, and considerable effort is being made to recover this for some useful purpose to better utilize our forest resources.

Water, fish and wildlife, livestock grazing, soil and scenic and recreation values must be given consideration in the planning and development of forest lands. The corporate land owner has a responsibility to protect and enhance these values. We have the technical knowledge, although often not applied, to maintain and develop our resources without compromising these values.

In the past, we have too often ignored the more intangible social values in our overemphasis on single purpose use of our forest land resources, and now have to resort to intensive multi-purpose resource management for sustained production of various products and services to meet the changing public needs. Modified logging practices, or reserving certain areas which cannot be operated without jeopardizing these values in certain critical situations, are necessary.

You'll recall my mentioning that the acreage of commercial forest land in the U. S. declined by more than 8 million acres in the period 1962-1970, and is expected to decline at the rate of 5 million acres each decade in the near future.

That fact, combined with reduced timber production per acre, due to a more balanced management program, means it will be increasingly difficult just to meet the minimum housing requirements of our existing population, even without any expansion in population and demand. Indeed, these factors are likely to put home construction out of the reach of many lower-income families. (This is a social problem which has to be weighed if we are to achieve balanced multi-purpose use of our forest lands for the benefit of society as a whole.)

Because of the lead time involved in the growing of timber for commercial use and the commitments this entails for the long term use of land, more inventory and field information is essential to insure proper consideration of the effects of vegetation manipulation on other values.

Because the forest environment is so complicated and involved, and because the values represented are so diverse, in the past, the decision making process often has been carried on with inadequate information on the long range consequences of these decisions. Thus, the information gathering process has become more intensive and more comprehensive, and more costly.

The forest-land-water resource can be affected by the manipulation of the vegetative cover on the watershed. The extent to which the vegetation is modified, the type of vegetation, the exposure and degree of slope and physical characteristics of the soil can influence the quantity and quality of water discharged.

The water temperature of lakes and streams will be raised if adjacent timber is excessively cut, adversely affecting the fish population and plant life upon which it feeds. The obstruction of stream channels with logging equipment and inadequate drainage of water from road surfaces can prevent the migration of fish and the rate of flow at critical periods.

Proper consideration of the water resource is absolutely essential and will often necessitate modification of logging methods or the volume of removal and, in critical situations, foregoing timber production altogether. Additional costs are unavoidably incurred, but they are a part of the total cost involved in the achievement of balanced use of our forest resources. The choice remains, if these costs are considered to be excessive in terms of values recovered, to refrain from doing any cutting on such watersheds.

Wildlife values, which are associated with forest lands, are extremely important and become even more important as the area of forest land in the nation is reduced and wildlife is driven out of other open spaces due to the conversion of wild land to more intensive uses—(the tremendous expansion of agricultural land, due to the almost futile attempt to deal with the world food shortage, is a case in point. Some 29 million acres of USDA set-aside acreage for control of feed grain production between 1959 and 1973, is in the process of being converted back into production).

It has been traditional to think of wildlife as game, and this is still the concept attached to this resource in many areas in the western half of our nation. It is often thought of in terms of hunting license revenue to support the State Fish and Game Departments or the dollars brought into rural communities by hunters. Our tendency to try to measure the worth of resources in strict dollar and cents terms has led us to minimize their long-term real social value and to relegate them to a secondary role in planning for the development and use of our forest land resources. Far more knowledge is available for managing and enhancing wildlife habitat than is being implemented in most land use planning, public as well as private.

Industrial land managers have a responsibility to identify the extent and nature of the wildlife resource existing on their lands and to modify other land uses to give wildlife its due emphasis in a balanced land management program. Where specific land uses create changes in vegetation cover to which wildlife populations cannot readily adjust, or where the natural wildlife habitat can be perpetuated or enhanced, accommodations must be made in the planning process. To insure that proper recognition is given to this resource in our land use planning, logging plans are reviewed with representatives of the respective State Fish and Game Departments. Elk calving grounds and winter range critical to the survival of elk herds have been identified and protected by modifying cutting plans or foregoing logging altogether. We have sold critical winter range areas or leased them to the states for nominal costs when these values are dominant. Where hunting pressure is excessive due to more hunters and easier access to hunting areas, we have cooperated with the states to close company roads during the hunting season. Normally, all of our lands and roads are open to the public for fishing, hunting and other recreational uses except in periods of extremely high fire hazard.

Soil is undoubtedly our most important and vital natural resource, the abuse of which has been universal. The nation can no longer afford to be extravagant and careless in its use. Restrictions on those uses of land that result in wind and water erosion, the sedimentation of lakes, streams and reservoirs and the loss of fertility and productivity are long overdue.

No class of owner, large or small, public or private, should be exempt from tighter, mandatory controls, since voluntary controls through such programs as the National Water Conservation Districts and the Great Plains Conservation Program have not been successful in stemming these losses. The U. S. Soil Conservation Service estimates that nearly half of the "new land" going into crop production this year will be subject to excessive soil erosion, and of 7.5 million acres converted from grassland and forest to croplands in 1974, wind and water erosion on 4.3 million acres is expected to exceed the so-called allowable limit of 4 tons per acre per year. The development and extensive use of fertilizers has helped to mask the loss in fertility which we are sustaining through the farming of soils unsuitable for cultivated crops and failing to use proven methods of erosion control.

It is indeed ironic that, for a nation that produces so much of the world's food and fiber requirements, and will undoubtedly be expected to achieve even higher levels of productivity for an expanding world population in the future, we still do not have a nationwide soil survey to guide us in sound and meaningful land-use planning. Intelligent decisions cannot be made for the long term best use of land to fulfill *all* of our social, economic and environmental needs without this extremely vital information. Passing land-use legislation without at the same time providing for implementing a nation-wide soil survey would force the planning process without the basic tools to make the proper decisions and achieve the desired results. Many corporate land owners, including my company, have undertaken soil surveys of their lands to identify the more productive soil types and critical areas of instability and erodibility as a basis for long-range planning. Certain timber growing areas have been identified as of marginal productivity, incapable of supporting successive crops of trees. These and other areas, because of the degree of slope and susceptibility to erosion, are not being logged. In still other areas, cutting practices are modified to prevent excessive runoff and sedimentation of downstream waters.

Because of the diversity of soil types, our soil surveys indicate that in adapting land use to soil capability we are going to have a greater variety of land uses and more diversified vegetative types which should enhance the scenic, recreational and esthetic values and provide support for a higher and more diversified wildlife population. The restriction or curtailment of activities of a commercial nature in certain critical soil types will produce higher carrying costs to industrial land owners, and is being accepted as a part of the full and true cost of properly managing forest land for multiple use.

The importance of the scenic and esthetic values of industrial forest lands is unquestioned, and this is particularly true in the Northern Rocky Mountain and Cascade Mountain regions, where some of our greatest conflicts occur.

Zoning, which was perhaps the nation's earliest tool for land use control, was concerned with the adverse effects of land use by one owner upon the property of another owner, and we are now seeing legislation passed in many sates for the expansion of this concept to control not only the detrimental effects, but also to enhance the beneficial effects of private land use in areas of critical public concern. The impact of this legislation has not been fully felt by private land owners, but with or without it, it is my view that large corporate land owners do have a responsibility to recognize and accommodate the legitimate public concern about "visual pollution" in the use of land.

Since most industrial forest land is open to the public for recreational use, and public transportation corridors pass through these lands, considerable acreage, particularly in the mountainous regions of the West, can be affected. Modified cutting practices on reserve areas along public thoroughfares and trails are used to protect the scenic values, and development roads are carefully located and constructed to minimize their visual impact.

Continuing research to better understand the complex relationships which exist in our natural environment and to measure more precisely the impact of certain land activities upon this relationship is essential, and corporate land owners have a responsibility to participate in and financially support such activities in cooperation with Federal and State research stations. The allocation of capital dollars to resource oriented research has been far too small in terms of the values involved and the complex interrelationships which must be better understood to achieve the best balanced use of our land and associated resources.

The changing nature of the markets in which the services of land are traded raises some basic questions about the extent to which traditional market processes can be relied upon to achieve land uses in the public interest. We are increasingly regarding access to certain types of land services as rights that are not properly distributed by sale to the highest bidder. An attempt to promote land use in the public interest through the conventional market process probably will include a larger role for the Federal and State governments than one has thought necessary in the past. It is an inevitable consequence of the changing nature of the market. Evidence of this change is implied in much of the land use legislation under consideration by Congress and almost every state legislature in the nation.

To achieve the balanced use of our nation's resources will undoubtedly require some effort to also control or manage the demand. It is possible to manage the demand as well as the supply, and far too little attention has been given to this aspect of the unbalanced use of our land and resources, probably because of the political sensitivity of legislation, cutting across the entire population. It is easier and less sensitive, politically, to restrict and control the supply at its source than to tinker with the public demand. However, in the final analysis, this is the only way out of the trap of ever-rising consumption of finite resources. Demand management can be based on trade-offs between different uses of the land resource and different uses of the products of this resource. Planners would have to evaluate the trade-offs, for example, between special uses for wilderness versus timber production, or grazing versus wildlife. The goal would have to be to control demand to a level within or closer to the capacity of the nation's long run forest growth potential after due consideration has been given to the non-timber public services provided by our forest lands. Social policies embodying these decisions will be based on an assessment of the social costs and gains of alternative materials policies. These policies will require continual adjustment to keep abreast of changing economic, technological and social realities.

My views on the responsibility of corporate land owners for protecting and enhancing public values may not be shared by others responsible for making these decisions in the managing of private forest land, but if not, I believe it is the result of failure to recognize or respond to the subtle changes taking place in the traditional relationship between private rights and public need. The validity of the laissez-faire doctrine is being questioned and debated throughout the land, and our laws and their interpretation are being changed and reinterpreted to accommodate this growing public concern. If corporate land owners fail to recognize this trend, we can expect to have restrictions imposed upon us which could never begin to accomplish the results desired or achievable because of the difficulty of devising laws and regulations applicable to the diverse conditions found in our forest land environment. The best long term results can be achieved when decision making is done at the local level by responsible land owners, sensitive to the social, environmental and economic consequences of their decisions, seeking to achieve a balanced land-use plan based upon knowledge of the local conditions.

Significant progress in the development of balanced multi-purpose plans for the use of industrial forest lands has been made in a relatively short time, and I believe this trend will continue at even a faster pace as better information and knowledge is acquired. These lands will probably have an impact far in excess of the acreage involved because of the concentrated contiguous ownership and the availability and exposure to the public for recreational use. Some incentives for encouraging the noncommercial use of these lands is already occurring in the form of scenic easements along classified waterways, which provide for tax concessions, green belt laws to ease the tax burden to retain land in certain socially desirable uses, and timber yield taxes which defer annual ad valorem taxes until the timber is harvested. Fire protection taxes on private industrial lands could be shared by the public in exchange for more intensive wildlife management and expanded public recreational programs in cooperation with the states.

In the final analysis, if we are to achieve balanced multiple use of our forest land resources, under large and small, and public and private ownership, it is essential that we keep in mind that a viable, dynamic productive economy is a precondition to any program of environmental enhancement and balanced land use. Economics deals with the distribution, allocation and uses of limited resources, and the quality of life will depend upon our success in achieving a practical and realistic balance between the material, social and environmental services obtainable from our forest land resources. A strong economy is the best tool we have for achieving our social goals but, in identifying and defining these goals, we have to distinguish between our *needs* and *wants*, deemphasize *high* in deference to a *reasonable* standard of living, impose selective incentives and controls for the conservation of our resources and establish some priorities in our changing sense of values.

Discussion

CHAIRMAN WIDNER: Thank you, Bob.

It seemed to me there were a couple of points common to Hazel's remarks, and to Mr. Binger's remarks, that give us some different ways of looking at the same problem. In alluding to the decline in the commercial forestlands of the United States, he alluded to the impact that this had on housing production, particularly for lower income groups.

Hazel was talking earlier about decisions that emphasized economic considerations over social and environmental consequences. Our problem is to devise a system that gets away from the topheavy bureaucratic and equally ineffective allocation procedures of the Soviet Union and comparable cultures and, at the same time, gets away from what all of us have come to call the tragedy of the commons in our society. Now we have time for a couple of questions for either Mr. Binger or Miss Henderson.

MR. HENRY CLEPPER [American Forestry Association, Washington, D.C.]: I am not addressing my remarks to Bob because he and I are fellow professional foresters. I understand most of what he had to say.

However, Miss Henderson, it took me a little while to think about your scholarly remarks, and I think that your comments are quite convincing, that there are limitations and conditions on economics to solve some of our problems. We know that the American Economics Association, the Brookings Institution, Resources for the Future, for example, have helped to solve many of the problems over the years. The individuals you mentioned are not familiar to me, I am sorry to say, but are doubtless contributing greatly to our new mode of thoughts about these things.

However, in the absence of some of the organized means of influencing thought, such as the American Economics Association did forty to fifty years ago, what possibilities do you see for bringing to the American public, through Congress, state and federal organizations, the adoption of new methods instead of these traditional ones?

MISS HENDERSON: Thank you for giving me an opportunity to make two brief commercials for two public interest organizations on whose boards I serve.

I am most critical, for example, of the American Economics Association and many other professional organizations for not having impressed upon government the fact that they believe that GNP is not a very good measure of economic welfare. Indeed, it was never intended to be. For example, in Japan they are switching, as you may know, from GNP to net national welfare, where they are attempting to come out with a better net figure to measure whether society is going backward or forward.

Now, through my own efforts as an individual, I helped form an organization in Washington three years ago, the Public Economic Center, and we now have 1500 volunteer economists who help quantify disadvantages and disservices for all the citizen organizations who cannot afford economic consultants to help them prepare their cases. In other words, most of these activities involve voluntary activities on the part of economists in trying to critique fraudulent cost-benefit analyses used to promote various projects for the public and private sector.

Another group I would like to give a little plug is the Council on Economic Priorities, which was founded in 1970 and which measures corporate performance, not by economic standards, but by assessing social performance or environmental performance and performance in relation to minority rights, in consumer protection and in other areas that are receiving social concern. We put out reports on a very vigorous basis, industry by industry, and on all sorts of subjects.

MR. STEVE MONTGOMERY [Hawaii]: I give you this point more for emphasis than anything else. I just wonder what the impacts of organizations like this are and maybe you are saying that this involves some sort of administrative remedy. For example, when you assess corporate responsibility, the government, in turn, could examine durability of products to see if we could eliminate a lot of the built-in obsolescence of these. Would you care to comment on that?

MISS HENDERSON: I think you are raising a problem in the context of containers, and this is very appropriate because in our whole approach to materials resources, unfortunately, corporations, most of them, have more incentive to create recycling programs than they do to support reductions in manufacture. This especially is one thing you cannot afford to do in the container business. Of course, I do believe we need to recycle everything that we can recycle.

MR. MONTGOMERY: Of course, I think the first emphasis has to be on source reduction and durability of goods and I think some very imaginative chemists are working now on the problem of creating materials which can be scrapped very easily. I think there is a tremendous payoff in relation to this.

MISS HENDERSON: I would entirely agree with you. For example, a chemist told me last week at the University of South Carolina that when you make synthetic rubber, you can make it in a way that is very difficult to recycle it other than heating it and using up a tremendous number of BTU's in the process of recycling it. He is working on a solution to this problem; they use a solvent which would be less thermal dynamic, less costly and you would end up with the same rubber to use over again. Therefore, I think there is a real difference involved here in relation to these two approaches.

MR. GERALD SVENDSEN [Ohio]: Sitting here listening to you, Mr. Binger, I have appreciated your views, but I would like your estimate as to how many corporate heads in this country do you think would follow the same line of reasoning that you just presented to us.

MR. BINGER: I think I answered that question in my talk. I said I don't know how many people would share my views, but I do think the trend is in that direction. I think it is in various degrees, but I do think people are beginning to move in the right direction—especially after looking at some of the proposals that we have made and also some of the land use practices that we now practice.

Realizing Renewable Resource Opportunities

Robert E. Wolf,
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Our Nation has come a long way, as the phrase goes, from the era in our beginning when we had so much and our problem was that we did not know how to go about getting to it. We still have more of many renewable and nonrenewable resources than many other nations. We also have the highest consumptive rate of any nation. We are feeling the pressure and the pinch of constant conflicts over competition for resources and uses. There is wide debate over the wisdom of some of our use styles.

It would perhaps be well to set the stage by detailing the changes that have taken place—but this would take all the time and it would not deal with the issues we confront. It is sufficient to say that we, as most other peoples, have had more concern for the present than we have for the future when it comes right down to decision making time. Faith and hope interact with fear. We usually decide that if man made it to today, he will make it on into the tomorrows.

This 40th North American Wildlife and Natural Resources Conference is really the proper place to talk about resources. North American wildlife started our Nation on its way. It was the fur traders—the Voyageurs—and the insatiable market for fur that opened the vista of resources beyond imagination. It was the search for beaver, the otter, the lynx, the mink, the moose, the caribou, the buffalo, and the deer, plus the plumage of countless birds that excited and kindled interest in the majestic forests, the endless plains and the riches they held.

So if, in this era of chemically fabricated furs, we face problems with some of our other resources, it is perhaps because we thought that our supply of renewable resources could always be willed to meet whatever the demand.

It would be inaccurate to suggest, however, that we don't think about the future, or care about what it will be like. It simply is hard for us to apply as much consideration to what may occur in 3, 4, 5, or 10 decades ahead, as we do to the very immediate year or two ahead. Nor would I imply that we have never tried to look ahead. The shelves are full of studies that forecast the future. We dust them off regularly and use them when we want to prove the wisdom of a not too ancient seer.

Last year, Congress enacted and President Ford signed Public Law 93-378. It is now codified in Title 16 of the U. S. Code as sections 1601-1610. It carries the formidable title of the "Forest and Rangeland Renewable Resources Planning Act of 1974." Some people refer to it as "Humphrey-Rarick Act" for the principal Senate and House sponsors. Others have developed the shorthand title—"The Resources Planning Act" and this is what it is all about.

Before the ink was hardly dry, some were calling it the most significant law to be enacted in 25 years. It is pleasing and reassuring to have this accolade fall on the ears. It is comforting. I would suggest, however, that if we do not use the Act to meet its purpose, it will become just another pile of legislative sand, blown away by the winds of time.

What is this Act about? It applies to the 1.5 billion acres of forested land and rangeland, private and public, and the renewable resources on them: Trees, grasses and other plants, animals, birds and fish, the water and the soil. What does the Act do about them?

In the past we have had inventories of specific resources and most of them have been narrowly single resource and single use based. For example, the forest inventory of the United States dwells almost exclusively with the forest as a timber resource. The Resource Act calls for inventories to be fundamental and comprehensive. Each resource will be inventoried. All inventories will be related. The result should produce a two part, integrated Assessment—one for tree covered lands and one for rangelands. Having defined the lands and the resources, the next part of the process will be to assess the "State of the Resources," looking at the patterns of use. This will involve analyzing where we now are and where are our patterns of resources and uses taking us. This will raise key questions for us to answer in making decisions. Is this where we want to go? Is this where we should be heading and why?

The way the Act is set, the assessment will be Nationally available so that the States and the private sector can also utilize it for their decision making. On the Federal side, it will be the basis for the Forest Service in the U.S. Department of Agriculture to develop a Renewable Resource Program covering the 187,000,000 acres it administers, its extensive programs of research and its important State and Private cooperative activities.

The Program is to have a long range focus and prescribe a series of annual actions that are recommended for the decade ahead to meet both short and long range opportunities.

Let us consider a couple of salient points. The first Assessment and Program is due December 31, 1975. It will, of necessity, rely largely on existing information. The Committees on Agriculture and Forestry, which reported this bill, were motivated by two thoughts. One is that it was essential to promptly get at the task. The other was that the first Assessment and Program would illuminate problems that would improve the second effort due at the end of 1979. Thus, the first Assessment and Program will be used only until 1980. The first decade long Assessment starts in 1980. What will be happening between now and 1980 will be important. However, a most significant point is that this is a learning period, recognizing that developing an integrated renewable resource Assessment and Program is easier said than achieved.

The Program in the Act applies only to the Forest Service. The Act neither discourages nor forbids other Federal agencies from developing a similar Program based on the lands they administer and their renewable resource responsibilities. It was believed that the best results would be obtained by making a concentrated Program effort for one major agency and to determine later whether the Act should be broadened. Rather than impose coordinating machinery, it was hoped that, given the same broad body of information in the Assessment, other Federal agencies, as well as private and State agencies, looking at their lands, resources and authorities, would be able to consider courses of action.

Those who think that there should be a coordinated Program should carefully note that each class of lands, public lands, Federal and State, not only has its own set of characteristics but also, each set of owners and managers may have distinctive operating policies. The Act should thus be viewed as one that encourages exploration of the best ways to set National Policy and thus to reach National Goals.

Let us turn to what will happen after December 31, 1975 when the National Assessment and Forest Service Program are completed. Section 7 of the Act covers "National Participation." The President will transmit both documents, with recommendations, to the Congress. Congress may accept or modify them and adopt a Statement of Policy. It is contemplated in the Act that the Congress will hold public hearings. In any event, the Statement of Policy becomes the document that will be used in framing Forest Service budget requests for the period ahead.

The Act then defines a new approach to framing budgets. The President is required with each budget, to the extent that it recommends a course which fails to meet the established policy, to set forth the reasons for asking the Congress to approve the lesser programs or policies presented.

As many of you know, the Constitution requires that Congress authorize appropriated funds needed for the Federal government. Presidents have had a tendency in recent years to view the recommended budget as presented to Congress as the best budget that has ever been presented. Time and again, presidents contend that their budgets cannot be even moderately revised. The fact is that a President's proposed budget is a recommendation not a command. This Act will require a more candid expression of the strengths and weaknesses of each proposed renewable resources budget, weighing the consequences of its adoption on these resources as well as the other important considerations that both the Congress and the President must weigh.

The Resources Planning Act is closely tied to the just enacted Congressional Budget and Impoundment Control Act. Together they seek to improve both the methods by which policies are fashioned and the ways in which budgets are planned.

There are a number of other significant and special features to the Act which are important. Time simply will not permit discussing all. One will be touched—the goals in Sec. 8 of the Act. This sets the year 2000 as the target year when the renewable resources of the National Forest System shall be in an operating posture whereby all backlogs of needed restorative treatment have been reduced to a current basis and the major portion of planned intensive multiple-use, sustained-yield management procedures shall be installed and operating on an environmentally-sound basis.

In the Act, the Congress deferred reaching judgements on *what* should be done, *where* it should be done and *how* much should be done. It did, however, decide *when* it should be done by the device of setting a target year as the time guide.

There was a great deal of Executive effort made to soften this section, but it was one of the points on which the Congress had very strong views. Fundamental to achieving a sense of national direction is the determination of critical dates. On the other hand, Congress avoided prejudging the "what, where and when" of the national effort until the Assessment and Program, with recommendations, are before it for decision.

What then is this Act all about? It seeks, by combining realism and optimism, to meet opportunities. The 1.5 billion acres of Forest and Rangeland is a tremendously diverse but amazingly vigorous renewable resource base. Over much of our history it has been viewed as the boundless land and resource base capable of providing us with all that we need. To suggest that our use of resources has been well above sustained yield levels and that there have been strenuous use conflicts would hardly border on heresy. Time and again, short term needs have overwhelmed long term considerations.

To realize the full potential of our renewable resource opportunities requires that we come together to define them and work together to achieve the goals we have set.

At the root of our problems are two differing points of view. One is that demand will create the needed supply. Economists point this out, telling us that price rises will define the need and influence demand and supply. This is only partially true. When our supply was far above demand, whatever the price impact, it did not assure future supplies. Nor is it likely that one can establish that the theories of economics have determined the world's human population. The sheer growth in the number of people has placed a stress on our renewable resources no matter what the economic conditions of the society. In our own case, it is clear that our generally affluent condition has not resulted in an ample future supply of renewable resources.

But even if one accepts the effects that economics has, there are other considerations that must be recognized in dealing with renewable resources.

Over the past few centuries as our population has exploded, man has always been able to find a new geographic frontier to extract needed resources. The "voyageur" of the 21st Century is going to have to focus on the ecological relationships, recognizing that there are biologic limits; but even more that there are opportunities that can only be secured if we appreciate what the outer limits are and recognize that reaching potential outputs takes time.

The laws of nature were here a bit before the economists. There are interrelationships between these renewable resources that are well beyond economists' capacity to regulate. There are also levels of output that cannot be exceeded by pouring on more greenbacks.

Finally there are combinations of natural changes. Man is one of these nature changers. He influences the condition of resources and their ability to renew themselves or to reach a certain level. It matters little to the salmon whether the effluent of a paper mill, a log drive, or 40 days and nights of rain and floods have wiped out the spawning grounds in a river. The grassy plant seeking to grow on the range does not survive better because a domesticated horse is there,rather than a wild horse. None of these plants feel any better or worse upon discovering that it was man who brought the horse here, rather than natural forces creating a land bridge with Eurasia. The young Douglas fir seedling, seeking to grow on a harsh South facing slope in Oregon, is little comforted by knowing that man's logging made this site a hotbox, rather than a lightning induced fire. Nor does a tree feel any better when it is gnawed, bucked and hauled by a beaver for its food and shelter than it does when a power saw sends it on its way to become a combination of plywood, lumber and paper.

What this legislation seeks to do is help us bring to bear on our need for renewable resources the best social, economic and esthetic knowledge we can assemble. It aims to help us establish the relations between our resources, the condition of our resources, the capability of our resources. In one sense, there is nothing new in this Resources Planning Act. In a variety of ways we have been seeking to do all of these things. What is new in this Act is that it designs the policy machinery to turn our hopes into reality and our plans into achievements.

Discussion

CHAIRMAN WIDNER: I suspect that all of us have begun to see a picture emerging out of these presentations about some of the things said earlier in this Conference. Now Bob's talk is indicating that other things are falling in place—namely, some innovations in the way we make decisions about the resources that may help us make better decisions. The lands that Bob was talking about are one of them. Also, natural water resource activities are parallel activities being carried on under the Water Commission. We have reasonable assessments of each of the major regions of the United States now getting underway throught the auspices of the Federal Recreational Council, brought together by the Office of Management and Budget, who are slowly moving toward a social reporting system.

Shortly, we are going to be talking about some legal constraints that we need to give some attention to, but before we do that, does anyone have a question that they would like to address to Bob Wolf?

MR. L. E. BEYER: I am also a forester, and I have a question about the paper policy aspects of the laws. One of the things that we have been doing is inspecting a lot of data and information in reference to resources that are supposed to be on a continuous basis, and yet we find agencies, such as the Forest Service, who have not been funded adequately, trying to fulfill the mandates of the previous laws. On the other hand, we have other laws on properties insofar as paper goes.

Now, what can be done toward actually doing the work in getting the data you are talking about, when the budgets have not been approved for hiring anybody in this area in a long, long, time?

MR. WOLF: Of course, this is one of the types of problems that the new act seeks to get at. There are, as most of you know, many levels of authorization written, and in time the program sometimes grows out of all proportion to what was looked for when a dollar limitation was first put in.

What this act tends to do is to look at the authority and deal with levels of authorization which are proper in terms of national goals. We are not just changing and testing things and managing them because thirty or forty years ago somebody passed a law saying it should be done and there should be some measure of federal-state financing of it. However, we do it because it has a future value and we know why we are doing it. This also involves a traditional budget problem, that of authorizations written beyond the funding level.

Another thing that the act does is require that the present budget ask for specific kinds of money that are needed to implement a policy agreed on for ten years ahead. However, in the final analysis, Congress always retains the prerogative to provide the funds.

Importance of Legal Constraints in Maintaining Public Resource Values

Carl H. Reidel

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For those of us concerned with the management of natural resources, the remaining decades of the 20th Century will be a completely new ball game. Times are-a-changing, and they are changing at a rate never before experienced.

We are entering an era of unprecedented conflict between those committed to economic growth based on material consumption and those committed to protecting public resource values. Demand to increase food and energy production, and to accelerate resource exploitation, will be fierce. Resolution of these conflicts will require more than slogans from conservation leaders and do-good presidents. These conflicts will require profound revision of our legal traditions and government systems *if* we are to protect those natural resource values that are the very foundation of our society.

In the past, when natural resources were relatively plentiful, legal constraints on land development and resource use could be limited to the control of obviously wasteful and destructive practices. Laws were adequate that controlled pollution, directly affecting specific individuals or groups. The common law traditions of Old England were sufficient, backed up with Smokey Bear slogans and "motherhood" pronouncements from Washington. But times are changing. General statements of national policy like the Multiple Use Act of 1960 and The Environmental Policy Act of 1970 are not enough. They were good ideas in their time, but are fast becoming inadequate in the face of new pressures.

The Multiple-Use Proverb

The Multiple Use Act of 1960 is just such an example. The idea was good. It mandated management of the National Forests for a variety of uses and encouraged management plans that sought an optimum mix of material production and non-consumptive uses. A noble goal indeed. But it also gave the Forest Service the impossible task of protecting broad public values while continuing to respond to the powerful special interests on whom the agency depended for political support. And, with no legislative direction as to what standards of environmental quality were to be maintained. That was left to the professional forester. Even if he was well qualified to make resource management decisions, the system required that he seek political compromises between conflicting demands. Environmental quality came out second best. So-called multiple-use plans had laudable preambles, but little force of law when special interest groups used predictions of economic crises and resource scarcity to override management plans. Professional ecologists and laymen conservationists learned that "multiple use" is a nice proverb, but far from the needed legal constraint on resource exploitation.

NEPA to the Rescue

Then came the National Environmental Policy Act (NEPA). It was the Congress' best effort to rescue the environment, and to correct the limitations of proverbial legislation like the Multiple Use Act. As Richard Andrews of the University of Michigan puts it—"The principal problem which gave rise to NEPA . . . was the pervasive failure of government administrators to consider adequately the full range of values and purposes affected by their actions." (Andrews 1974)

NEPA told public agencies to weigh *all* the impacts of their decisions; to look at alternatives and tell us the comparative impacts of alternative plans.

In one way, NEPA has been a resounding success. It was the biggest continuing education effort ever launched by Washington. It forced professionals in government to look beyond their specialized training and single-purpose responsibilities, and dragged many a biologist and engineer screaming and crying from their familiar haunts. The multi-volume Environmental Impact Statements (EIS) flowing through the Council of Environmental Quality are grand testimony they tried hard to meet the mandate of NEPA.

It was a giant step beyond the Multiple-Use proverb, but it had the same fatal flaw. While NEPA mandated a realistic evaluation of impacts, it did little more in the way of setting *standards* for protecting public resource values. While some complementary legislation set standards for air and water pollution, the resource manager found little comfort trying to walk the tightrope between dozens of uncoordinated pollution-control laws and the wrath of an environmentally-aroused public. And, unfortunately, there were few new laws that went beyond traditional pollution control to provide standards for managing our wildland resources. He had to improvise and second-guess environmental advocates and special-interest lobbyists alike. His defense has been to prepare increasingly complex and lengthy impact statements. He's learned to adapt—to live with NEPA in a world where the power of well-financed special interests speaks loudest. He's learned to bury the facts in a maze of statistics, technical jargon, and sheer volume. Its getting to the point, as the Boston Globe suggested recently, that the E. I. S. could be this Depression's W. P. A., "coming along just in time to provide the kind of gutwarming boondoggle that every profession needs." (Campbell 1975)

Like the Multiple-Use Act, NEPA gave us little in the way of legal constraints to protect resource values. We are presented the alternatives and can choose the worst of two evils. But we do not have the criteria necessary to demand the right alternative, nor to reject a proposal altogether.

Don't misunderstand my wrath. The National Environmental Policy Act is fine legislation vital to resource planning. Every state should enact companion legislation. But the point is that it isn't enough. It doesn't pack enough clout, nor does it free the professional manager from his special-interest leash. Nor does it help the public defend vital resource values unless they are willing to launch expensive legal battles that only delay the inevitable.

The State and Local Impasse

The situation at the state level is no rosier. While "land-use planning" is a more popular slogan, in most places it's just a new code word for zoning. Colorful maps hang on many court house walls, but they too-often serve a single purpose: They provide a handy reference to look up the appropriate variance to permit a developer to build in an inappropriate zone.

Some states have sought to regulate development through a permit process. In Vermont, a developer is required to present his plan to a local environmental commission for approval, showing how he plans to manage adverse impacts in response to criteria set forth in the law (known as Act 250). However, these criteria are general and unspecific. Phrases like "will not result in undue pollution" . . . "will not cause unreasonable soil erosion" . . . "will not have adverse effect on scenic or natural beauty . . . " provide little in the way of clear standards for laymen commissioners or local judges to test a proposed development against the goal of maintaining environmental values. The State Environmental Board is authorized to write more specific regulations to refine the general criteria set forth in the law, and to prepare a state land-use plan. Such action is needed to account for broad impacts often overlooked in the review of local projects; to make the process prospective and positive, rather than prohibitive; and to eliminate uncertainty that often leads to lengthy adversary proceedings.

But every attempt to strengthen the process or to write a land-use plan has been thwarted. Special interest lobbyists continue to encourage underbudgeting of natural resource agencies whose expertise is vital to sound planning. As experience at the National level has repeatedly shown, good laws can be emasculated by inadequate appropriations. And, a fossilized judicial establishment resists efforts to reevaluate basic legal principles regarding property ownership and consumer rights. Yet opinion survey after survey indicates the majority of Vermonters want a strong state land-use plan.

Certainly Vermont's land use regulation laws have vastly improved the new development in the state, but we've a long way to go. Like NEPA on the national level, Vermont's Act 250 has had an enormous educational impact. As local environmental commissions have grappled with individual applications, they've learned a lot about resource capability and the limitations of ecosystems. This new awareness has converted many a skeptic to the realization that a land-use plan is essential. But we still lack such a plan. Growing panic over energy shortages and economic decline are overshadowing the need to get on with the job in Vermont, just as it is at the national level.

As President Johnson once demanded, in response to a list of problems from his advisers: "Therefore, What?!" I'd like to focus on two sets of issues that I believe deserve serious consideration: First, the reform of some long-revered legal traditions—a fundamental issue at the heart of the crisis in resource management. And, second, several recommendations for over-hauling the role of government in the management of natural resources.

Land and the Law

Never before has the natural resource professional been so aware of the complex and anachronistic nature of the law regarding land and natural resources. As Russell Brenneman has said so well: "Any lawyer involved in natural land use issues has to keep asking himself whether the law is part of the problem or the solution. ...The law is a conservative tradition. The land law is probably the most conservative tradition." (Brenneman 1974)

Lynton Caldwell puts it even more bluntly in a article in the *William and Mary Law Review,* attacking what he calls "land law rooted in the conventions of Tudor England." He says:

> The conventional concept of 'ownership' in land is detrimental to rational land use, obstructive to the development of related environmental policies, and deceptive to those innocent individuals who would trust it for protection.
>
> . . .
>
> The existing. . . laws and practices pertaining to land ownership and use are beneficial primarily to persons interested in exploitation or litigation. . . . Moreover, (these) laws are even less helpful to communities and the general public in maintaining or restoring the quality of the environment. (Caldwell 1974)

The crux of Caldwell's argument is that ownership is a misleading word with regard to land; that the ideas of property and title are relative concepts. A person does not own land in an absolute sense, but rather owns a package of rights to the land. This is asserted in the Constitutional principle of eminent domain. The community ultimately owns land.

Clearly, the 5th Amendment requires that private property shall not be taken for public use without just compensation. But it is time for some new and forthright legislation, and some enlightened views from the bench, as to exactly what rights of use are included in the private property package. But such revisionist action is unlikely unless concerned resource professionals and environmental activists get together and begin challenging some of the archaic ideas of private property—especially as related to the taking issue. Why, for example, should the right to cause long-term ecological damage be part of a property title? Should the Constitution protect the "right" to permanently downgrade prime agricultural soils or vital watersheds? Why should a landowner automatically take title to the increased development value of his land derived solely from *public* investment in roads and utilities, and then claim a taking when prevented from erecting obnoxious signs and shoddy strip developments?

As Caldwell argues, "rights of ownership (should) be redefined to apply not to land itself but to specific rights to occupy or use particular parcels of land . . . in accordance with publicly established criteria." This, he says, would "assure that publicly created values in land would accrue to the public." (Caldwell 1974)

Radical! Not at all. No other society in history has ever left the fate of land so completely in the hands of private individuals, nor allowed individuals to make irreversible alterations in the natural environment of a nation without public review and consent. Environmental Impact Statements may be enough to reveal the evils of such a system, but only reform in our archaic land laws will protect us from that evil.

The Role of Government

But even if we are too timid to battle for new Constitutional interpretations of property rights that would reconcile the rights of individuals with the needs of society, there is much to be done that's well within traditional legal limits. We may not be ready for a new interpretation of the law, but we can start by overhauling the vehicle of government.

Tax Reform for Resource Protection

Tax reform is a good place to begin, especially in the realm of real property taxes. Much of the failure to protect critical resource values in many states can be traced directly to outdated property tax systems. These 18th Century revenue-raising systems are preventing the use of such creative land-use management tools as development easements, special reserves, new community planning, and transferable development rights. Land assessment, based on speculative land sales, are fragmenting prime agricultural and forest lands into unmanageable small tracts and rapidly undermining years of work to improve resource management on private land.

If citizen conservation groups want a good crusade for the next few years, I can't think of a better target than to seek legislation to replace *ad valorem* property taxes with a system based on land productivity and use. Needless to say, this will mean land-use planning that codifies land and resource capability and backs up local zoning and development regulations. That will require some toughminded foresters, geologists, and other resource scientists willing to take on aggressive development and real estate interests in the courts—scientists willing to put their reputation on-the-line for what they believe. But, until we specify *in the law* meaningful criteria and standards that spell out what we mean by such "apple-pie" phrases as a quality environment or conservation, all the EIS's and zone maps in the world will mean nothing.

Changing old ideas of property taxation to support sound land management will be a long, hard job—perhaps impossible. But other avenues of tax reform are also available to control glaring and obvious waste of energy and resources. Economists have long advocated selective taxation as one way. For example:

(1) Resource-scarcity taxes that set tariffs on critical natural resources proportionate to supplies.
(2) Amortization taxes on short-lived, disposable products to encourage craftsmanship and quality.
(3) Deposit levys that penalize throw-away products and encourage re-use of containers.
(4) Reclamation taxes that include, in the price of the new product, the cost of returning it to recycling centers when discarded.
(5) Energy taxes and revised electricity rate structures that provide incentives for energy conservation.

These aren't new ideas—but they are ideas whose time has come, only awaiting courageous legislators to put them to work. We need to begin using these powerful taxation tools, especially to protect vital resource lands, both by revising property tax systems and by pricing unique resources out of the marketplace. The need, for example, to protect critical natural areas should no longer be defended on aesthetic and emotional grounds alone. In an era of rampant world famine and the spread of energy-intensive hybrid agriculture, the need to protect diverse genetic resources is obvious. This requires the protection of natural habitats where invaluable genetic stocks can remain subject to normal environmental pressures. Similarly, there is ample evidence of the need to protect other vital resource areas such as marine estuaries, aquifer recharge areas, critical watersheds, and prime wildlife habitats. These resources deserve clear, decisive legal protection—protection in the law books and through selective tax disincentives, not simply in a local multiple-use plan or the appendix to a ten-volume impact statement.

The Role of Public Participation

But like the need to reform our legal traditions, meaningful tax reform is unlikely to take place unless concerned citizens can gain access to decision makers in government. If recent national events have taught us anything, it's that centralized government, well-insulated from public opinion, is a critical problem.

NEPA, for example, has not solved the problem it was designed to address because of close ties between single-purpose agencies and their special interest constituencies. We are learning that NEPA will only work with sustained pressure from the public. In Vermont we recently had dramatic evidence of this fact. The State Highway Department was upgrading segments of U.S. 7. New bypasses and land acquisitions along this corridor in Vermont and connecting routes in Connecticut and Massachusetts were beginning to look like the pieces of a giant jig-saw puzzle falling into place. The emerging picture was a new interstate highway from Canada to Long Island Sound. However, impact statements for the various segments dealt only with local effects, with no mention of plans for the entire 300-mile corridor. Only after an aggressive lawyer, Harvey Carter, of Pownel, Vermont, did a thorough investigative job did the real plan emerge. His work led to a ruling by a U.S. District Court, upheld recently by the 2nd U.S. Court of Appeals, that the Federal Highway Administration must prepare an E.I.S. for the entire three-state corridor before further construction. This will be a landmark decision if upheld by the Supreme Court, and not undermined by legislation being circulated by the highway lobby. NEPA did the job, but only because the public used it forcefully.

The point is that public participation has to move beyond perfunctory hearings conducted after plans are completed, and beyond the situation where time-consuming courtroom confrontations are the only forum for public involvement. Public review boards must have direct access to the decision-making process. Open Planning is a hollow promise unless the public participates at every stage—in the setting of goals and time tables, and even in the selection of personnel and methods. At present, most government advisory boards are a farce. It's time for legislation that makes meaningful public participation and open planning the way-of-life for every agency of government, from the Army Corps of Engineers to the county highway department, with provision for judicial enforcement at the initiative of conservation groups in the public interest.

Government Reorganization for Ecological Reality

It's also time to dust off the many reorganization studies that have been long discussed, but seldom given serious legislative consideration. In an age of ecological awareness, how can we continue to allow single-purpose agencies to manage the natural environment as if it were made up of unrelated departments in a supermarket? The answer is all too obvious. Resource-hungry corporations would rather buy their raw materials in such markets. It's a lot easier to buy wood from a state agency charged only to grow wood, than from an environmental agency charged with overall resource management. Single-purpose agencies may have the most competent of professional personnel, but if their organizational goals and range of expertise are prescribed in narrow, single-mission legislation, they are powerless to coordinate activities across organizational lines. No amount of interagency cooperation will solve the problem, nor will the creation of super agencies that are merely holding companies for the same old single-purpose bureaus.

If we are to maintain public resource values, we need a government structure capable of adjusting consumptive demands to resource capabilities in the broadest possible environmental context. That will require major government reorganization—reorganization that cuts across the present single-resource structure to create a structure reflecting ecological reality.

Perhaps I've overstated the problems. Perhaps the medicine prescribed is more dangerous than the illness. But as I began the final edit of this paper, I recalled a few words of wisdom from my secretary's husband, a Vermonter by birth and disposition. He said that over the years he's become convinced that "the only aptitude you can depend on in most legislators and bureaucrats is the ability to see lightning and hear thunder."

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Discussion

CHAIRMAN WIDNER: Thank you, Carl, for an excellent and very provocative paper. Would somebody like to address a question to Carl?

MR. JIM GILTMIER [Washington, D. C.]: I have to question what you said about the timber industry and its unlimited staff and resources in relation to the United States Forest Service. I happen to know this is not true. They are just as frustrated by lack of resources and lack of personnel as the conservation organizations that we work with and, secondly, I have to argue with you that the Forest Service is still a single purpose agency.

However, my question is this—as someone who works in a legislative body, I have become very fearful of writing very, very rigid regulations in this respect. Since I have been here, all I have heard is that resource managers have to have the flexibility to manage a resource at a given time and in a given situation and I am concerned that if we strengthen the legislation too greatly in some areas, even though I may agree with you about taxes and some of those other things, we will lock the hands of the resource managers so that they cannot react to these situations. Would you care to comment on that?

MR. REIDEL: I think that is always a failure of trying to write prescriptions in legislation, but I think we are so far from that danger now that through a list of things such as reform of property taxes, we would enhance the ability of the Forest Service to function. This is likewise true in relation to zoning critical areas. In my state, we have no provision for flood plain zoning. There are some critical areas in which we can, through legislation, I think, greatly strengthen and protect the resource. I would agree that what we need to do is legislate a process by which decisions made by professionals can be enforced. However, I am certainly not suggesting we pass specific laws for specific resources at this point.

CHAIRMAN WIDNER: To close out this Panel and to really, I think, bring to a head the central theme which we are supposed to address, we have asked Neil Cheek, who is currently a Professor at Texas A& M University, to talk about how we might evaluate the social dimensions in development projects.

I think it is worth knowing that if we look across the national landscape at the moment, as was done within the last five or six years, in terms of growth management, land use control, critical areas, legislation, etc., that by and large we would have to characterize those facets as essentially negative or prohibitive. In other words, they are designed to protect something and to stop something from happening. Yet, I think we have to recognize that, with respect to housing supply and the impact of some of the shrinkage in our commercial forests, the growth policy,if we had one, would have to be essentially positive in not only having to specify places where we did not want something to happen, but also places where we want something to happen because we do have social aspirations and we will continue to have economic aspirations. The trick is to balance these off against our environmental aspirations and the resource realities within which we must live.

Evaluating Social Dimensions in Developmental Projects

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There appears a curious disease, particularly virulent, rampaging throughout the halls of the public consciousness these days. I confess both confusion and consternation at this "happening." I am not surprised that my fellows attempt to anticipate their futures, for such appears to be a commonplace in all known human societies. While not all known cultures place the same value upon the ability to predict the future, few ignore the activity entirely. Some men deal with weighty matters concerning the course of the nation; some with the condition of a giant corporation in the next fiscal quarter; some with attempts to choose the ideal vacation time; but most men deal with issues as to whether the bus will be on time so they do not lose any pay that day or find the notorious "pink slip" in the weekly envelope signifying a "furlough" of indefinite duration about to commence. I am not surprised that different men are concerned with the prediction of different kinds of events in different cultures. I am not even surprised that some societies evolve particular social statuses with expectations of being specialists in prognostication. Such men are known variously as soothsayers, priests or even market analysts. No, I repeat, I am not surprised that men are concerned about futures. Nor am I surprised that some cultures evaluate the "tomorrows" as differing in importance from the "todays" and "yesterdays". What does surprise me is the contemporary hue and cry about the necessity for the planning of futures, the anticipation of their outcomes and the requirement of assessing all possible aspects of proposed actions before such are taken. I suppose what surprises me about all this is why this issue has surfaced in this particular period of this nation's history and why those "specialists" who already possess, in my opinion, all the tools necessary to handle the issue seem so befuddled by it all? Let me treat each of these matters in turn.

The Emergence of Issues

One of the many unresolved matters in Occidental civilization is the matter of what is to be the appropriate metaphor for guiding thought, utterances and analyses about existence. All civilizations and cultures have preferred metaphors, those concepts which we substitute in our thought processes to increase our understanding of a more incomprehensible matter. The metaphors most often used are known to all of us, and despite their many nuances are reducible to either the "organism" or the "machine." Is the world, existence and the universe to be better understood as an "organism" with a discoverable evolutionary trajectory, internal non-observable processes, fragile reproductive requirements and so on *or* as a "machine" with its knowable constituent parts, neatly fitted together with accurately predictable lifetimes? Perhaps peculiarly, while the use of metaphors often increases understanding of analytical differences in intellectual debates, their consequences for everyday life appear remarkably similar. Or at least so it appears in the history of this society. For regardless of the metaphor, we are a nation of "tinkerers." We are products of a culture emerging in the richness of the subcultural diversities of the migratory waves lapping upon these shores throughout the last several centuries. While we have evolved a reverence of a sort for a variety of beliefs and values, that which retains supremacy is the belief in American "know how" or "can do." It mattered little, and still does, whether a man is neat in a way I think he ought to be if he, in fact, can hang a door in my barn better than anyone else. A colleague recounted to me his conversations with some Wisconsin farmers in the trade orbit of Madison, during its recent notorious days, about the "hippy" like appearances of many of the workers he observed on the farms. The farmers replied "it is not how a man looks, but how he works that is important to us." But despite some moments of hesitation it has been the emphasis on the "machine" which has pervaded much of our times and indeed sets our "course" even today. But it is more than this as well.

There exists a bridging concept which forces one into neither the necessary strengths nor absurdities of the organismic or mechanistic metaphor. This is the metaphor of the "system" and in my opinion it is perhaps *the* metaphor of our era. Systems can be either "open or closed." I suspect that it is the emerging dominance of the metaphor of the "closed system" which influences the concerns with the consequences of development about which so much is being said in so many ways today.

Closed systems are containers with fixed boundaries. Moreover, these boundaries are comparatively impermeable. That is, once the "system" is established, its ability to incorporate "directly" additional elements and functions is limited. The interdependency of its various parts is usually quite great. Thus, if there is but a single part to carry out each necessary function for the system as a whole and that part "fails", the entire system is immediately in grave jeopardy. Unless the system has self-regenerative capacities, it will likely break down. "Breaking down" does not necessarily imply that all of the parts will cease to exist. Some may be capable of going into business for themselves, so to speak. Hence systems are often comprised of parts variously related to each other, some in such distinctive manners as to comprise identifiable subsystems. When self-corrective mechanisms become inoperative for whatever reasons, the system faces what is often thought of as a "crisis." The crisis exists because, if the system is to perpetuate itself in its currently approximate form, then quite possibly major reallocations of the resources available within it are likely to occur. The consequences of such allocation variations are not always predictable. This is usually a matter of incomplete knowledge about the comparative functional autonomy of the parts of the system. (Gouldner, 1958). Whenever the object of study involves culture, as is the case in assessing social dimensions of development decisions, there are usually observed unanticipated consequences of purposeful action. It is not merely a matter that short term considerations are weighted more heavily than long term ones, though this may be so. Systems have "histories" if you will. Unless a current "crisis" is similar to some previous one, then it is usually unclear as to exactly which parts and subsystems will be able to successfully accommodate to the overall stress being experienced.

By now it is apparent that I view the emergence of the concern with such issues as the "social consequences of development" as an indication of the triumph of a particular metaphor over older, though somewhat less useful ones for contemporary times. The key is the dominance of the "closed" as contrasted to the "open" system. It matters little whether the "crisis" is one of population, food, famine, energy or fiducial. Each requires alterations in the existing interconnectedness of existing parts, especially in closed, finitely bounded systems. If we are at the historical moment where such major shifts in conceptualizations of reality occur, as was the Renaissance, when new metaphors take charge so to speak, then our futures are likely to be quite unlike what we have previously anticipated.

The Matter of Social Dimensions of Development

The second aspect of the current situation of evaluating social dimensions in developmental projects if seen against the backdrop of the waning and waxing of metaphors comes, I think, into somewhat sharper focus. As Professor Alvin Gouldner has so succinctly indicated, all fields of human knowledge and endeavor, be they called science or practice, rest upon certain domain assumptions (Gouldner, 1970). These are those broad sets of beliefs which we acquire in our early lives that help orient ourselves to the existing shared definitions of what constitutes reality. Such domain assumptions normally retain a high degree of stability during the lifetimes of most individuals. But as history has recorded, occasionally there is a generation who must undergo the process during which those domain assumptions into which they were born are no longer the "stuff" of reality when they are older. Perhaps such is our destiny. If so, the apparent befuddlement of so many competently trained men and women to apply tested and verified procedures to the study of social change may be somewhat more readily understood. Caught in the throes of the public questioning of the basic elements by which reality has been normally recognized, a moment or two of hesitancy is not to be seen as incompetency but as caution of a disciplined nature. Why should we expect social scientists to rush into situations when their colleagues in other areas of knowledge are in such intellectual and practical turmoil? For the rules which constitute verification alter just as surely as the winds of policy move about the points of the compass. It is my opinion that to assess such "disciplined hesitation" as an indication of lack of rigor of inquiry or not being in touch with reality or any of the many various labellings heard *ad nauseum* now currently in vogue when referring to the apparent failure of social science to shoulder its share of the burdensomeness of developmental accountability, is to sadly misread the matter. For the drive for power is ever present in human affairs and an open invitation as the current situation offers is not frequently given to occupational groups by history. So what is new about developmental change?

Frankly, nothing! It is a commonplace of existence, both in our everyday lives and in the systematic acquisition and evaluation of knowledge. What is "tricky" is correctly assessing the relevant dimensions upon which change, however construed, is to be assessed, much less guided. But why should this be such a dilemma for social science and sociology in particular? Basically, the difficulties lie in the definition of the problem to be assessed. What are judged to be the salient dimensions? Given competing metaphors, which "reality" is to be the better and for which audience and for what duration of time? If this latter strikes us as a "laundry list", it is because it is precisely that! But such is the nature of "policy" not the failings of the bodies of knowledge upon which we call for "answers" to the questions we as citizens formulate. Confusion is easy enough in a world of symbols, but when the meanings attached vary from one subculture to another for the apparently same symbol, then communication is not confused. It simply does not occur! Neither "side" is to be blamed, for it is simply one of those marvelous excesses of species who adapt primarily to environments through cultures.

Policy reflects the distribution of power within a social system during some period of observation. It is the child of everyday existence, not the product of reasoned, dispassionate deliberation, though a form of reason is often invoked in defense of its scenarios. This statement is not intended to mean that I condone the avoidance of engagement in the exhiliration of compromise often characteristic of many social scientists. I merely wish to suggest that like you and I they generally opt for that moment or set of circumstances most likely to make their entry onto the field most advantageous for *their* definitions of what the game is about. It is my opinion that such has not yet emerged with respect to the assessment of social dimensions of developmental decisions and may or may not ever do so. Permit me to try to develop this point somewhat further.

There is a peculiar aberration in the public consciousness with respect to various bodies of knowledge. For some reason we are rarely disturbed when we fail to understand the technical talk of physicists, geologists or chemists. We do not even become too distraught when we loose track of the meanings of the symbols commonplace to the discussions of biologists and botanists. We even forebear the mystical incantations of economists, as they pronounce their wisdom concerning the operation of that mythical beast, "the market." Yet, the moment we hear the suggestions of the anthropologist, the sociologist, the social psychologist, the psychologist or the psychiatrist we immediately define such as obscure jargon of little relevance to the operation or solution of the real problems of our worlds. And perhaps we are correct. But then again perhaps we are not *quite* as correct as we would like to think ourselves. The relevance of this commentary lies in the fact that instead of listening to these men and women of knowledge, we readily dismiss their observations as of no use, perhaps the worse epithet we lay on another in this "can do" culture. Now there are the proverbial two sides to every coin and perhaps also dispute. The social scientist needs to understand the vernacular if his advice is to be heeded just as we ourselves must court patience in the interest of harnessing their available knowledge which may make our efforts maximally efficacious in the face of newly arising demands. Besides our difficulties with jargon, there are those arising from our own domain assumptions about reality.

We tend to believe that a man or woman who does what he can and must is the operational unit of society as we know it. Some seem to become leaders; some followers; some hewers of wood; some haulers. We tend to account for such differences in a variety of ways—differences in natural abilities; differences in opportunities; differences in fate; differences in efforts. But when social scientists begin to suggest that none of these may be the "real" explanation we tend to dismiss such observations as "misguided" to use the more polite expletive. Peculiarly we seem able to accept concepts like "market segmentation" and "commodity futures" but are considerably less attentive to concepts like "social role conflict" or "structural differentiation." In part this is because all scientists use language which is abstract, hence making it possible to communicate rapidly large amounts of information among those persons similarly trained in an efficient manner. Yet we seem to feel such violates our standards of decency when we speak similarly of men. Like it or not we as resource managers, planners, overseers or what have you have as much *obilgation* to learn about the abstract characteristics of human social orders as we do about animal populations, rates of silvicultural rejuvenation or gaseous compositions conducive to various igneous formations. For such are just as much a part of the structure and nature of our reality as are these latter examples.

Now, so as not to avoid entirely the challenges of the titular advertisement of this session, allow me to turn to some suggestions about the appropriate social dimensions of development projects. While the nature of the empirical universe of such projects is almost beyond the bounds of brevity, I want to emphasize that my suggestions are applicable to the entire spectrum of such, albeit a new town in a remote area of some state; the establishment of some recreational complex; the location of an industrial operation; the innundation of lands for flood control purposes; the canalization of streams; the forced migration of populations for various reasons, and so on.

The social dimensions salient to assessing the consequences of such actions are only partially enumerated in the usual socio-economic "hodge podge" now being used as "filler" for many legally required developmental impact statements. What is peculiar is that such measures are correct in that they are not about individual interpersonal relations, but are incorrect in that they are statistical aggregates and hence rather fallacious as indications of actual change likely to transpire in the social organization of the area being studied. Let me use an example from a somewhat different area. If one wished to measure the social impacts of changes in medical service availability to a community, one does not measure the physician/patient ratio as an indication of basic sociological change. Instead, as Professor Frank Young has suggested, one measures the availability of the number of various medical specialties between several different areas. (Young 1972). The presence of greater differentiation usually suggests a more complex medical institutional arrangement in a community than one with a lower ratio. In short, what is to be assessed is the impact of developmental actions upon an existing closed social system. The parts and their interrelationships are the object of interest, not interpersonal nor demographic variability per se. Economic indices tell us only a very, very small part of the story. I am continually amazed how our ideological commitments overshadow our systematically obtained evidence about the limitations of economic considerations in understanding crisis situations. Despite the chronic economic dilemmas of Appalachia and the persistence for many years of the apparently destitute and deprived peoples resident in this region, we have perpetually ignored in public policy the tenacity with which they were bound to the social organization of their communites. Even when given the opportunities, with almost certain economic benefits guaranteed to them, comparatively few departed. Now why was that? One reason was we seldom offered to move the entire extended kinship network to the new setting of the promised economic activity. On the other hand, social anthropologists and comparative macro-economists have been able to document in the so-called developing nations now taking the production unit, such as a factory, to the people did not necessarily insure that the locals were likely to become the immediate mainstay of the necessary labor force. There are many, many other examples of similar kinds of variables and situations extant in the considerable literature of social anthropology, the sociology of modernization, rural development and so on. Yet we rarely see such suggested as the place to begin our own development of social indicators for *this* society. Perhaps it is not so much "social indicators" that we require as it is sociological and anthropological assessments. Such assessments begin when we ask: how will existing aspects of the social organization of this system be altered? The answers are not formulated in how many new jobs will be created, but in terms of if there are new jobs, how will the presently existing patterns of visitation between members of extended kin groups resident in and out of the impact area be altered? How will the presently existing social rules (norms) guiding relationships between various categories of persons in certain social roles such as the young and old be altered? For example, are high rise apartments more conducive to criminal acts going unnoticed than are low density clustered developments? Are the costs of a larger "formalized" police function offset by the attentuation of the normative policing of a neighborhood by its residents, including roving dogs and children? Can emergencies experienced by a family group such as needing assistence in the event of a household fire be successfully handled in the new system as well as in the old? The examples may appear trite, but I assure you the social science literature abounds in studies with direct transferability and application to natural resource development decisions.

All of the answers are far from known. But the correct manner in which the questions are to be formulated is known, at least in my opinion. Why then are they so seldom heard or asked appropriately? I have tried to suggest several reasons why such exists today. As succinctly as I can reiterate, it is a matter that existing allocations of power have not yet been assessed in terms of whether the consequences of asking the "right" kinds of questions will or will not alter the functional autonomy of parts in a way more or less desireable. The interesting race to watch is one in which we are apparently to simultaneously be participants and observers and to observe whether unanticipated crises will accelerate or reduce rates of change such that existing social systems will be reorganized spontaneously in ways beyond the deliberate intentions of some, simply for reasons of overall system stability. Perhaps at this gathering a year from today the answer will be somewhat more discernible than it might seem today.

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Concluding Remarks

RALPH R. WIDNER: I think we have detected in what Neil and the other Panelists have said, that one of our problems is a physiological one. One can make the argument that our system is sufficiently complex and its elements so great that we are never likely to have sufficient comprehension of how the parts fit together, whether as an organism or machine, to effectively anticipate the consequences of major decisions. Perhaps we are condemned forever to hindsight. There are some thoughtful persons who have written recently on that subject and who have recommended that we not attempt to establish some rigidly designed heirarchal planning system that would attempt to anticipate and lay out goals for the long term and to conduct society basically in accordance with a plan that has been stipulated and clearly set forth. They see grave dangers in that kind of thing, including one of some sort of public monopoly.

Others have looked at the problem slightly differently. An individual at the University of Chicago, for example, has attempted to summarize three or four different ways we might look at planning under the kind of conditions that we now see prevailing. This is the ameliorative approach which is characteristic of American society in the area of problem solving. In effect, we wait until something goes wrong and then we try to fix it.

Then there is also the sort of futurist adaptation of that—an attempt to project trends, perhaps do a little tinkering in advance, in anticipation that something might go wrong. This can go all the way over to the other extreme of trying to speculate what the future is likely to be twenty years from now or what we want it to be like and then trying to lay each tie in place a step at a time. When you begin to think about these things, it gets back to some of the most profound philosophical issues we have been debating for several thousands of years. They really are not original with our society.

I find it useful sometimes to go back to my younger days when I was an assistant navigator on a large ship. We had charts, which is something maybe we don't have in a social sense, and we knew what was generally on the other side of the sea and we also knew generally what landfall we wanted, so we could plot a course before we left port. However, we also knew full well that when we got out to sea there were going to be unknown currents, winds and a variety of other factors that would move us off course. But if we were lucky and the skies were clear, we had instruments that we could use to make adjustments and get us back on our general course. Frequently, however, the skies were not clear and so we resorted to dead reckoning and that usually enabled us to plot where we were, our speed, where we were traveling, etc.

Now, perhaps our society is a little bit like that. Maybe the truth is not with any single metaphor, but somehow there is a little bit of truth in every one of them. It is perhaps characteristic of this society that we can mix these together and constantly adapt them and learn through a kind of social learning process, rather than one epistomology that could serve all purposes if we impose it on our political process and on what we do.

One individual, for example, said that as long as we had a lot of resiliency left in the environment, we were operating and we had not used it up, in effect, that we had a cushion of ignorance and we could continue on. In other words, if we made a disastrous mistake it might make the Mediterranean rather sterile, but the rest of the planet could go on. However, more and more we are hearing the argument that the planet itself is ingested by some of man's activities—that we are indeed on a limited spaceship, that we have used up that cushion of ignorance—that we no longer have the alterntives. But then try to anticipate and ingest that, which brings us to the problem of what to do.

We started out castigating the economists. Interestingly, in December of 1973, when the American Economic Association met, the Chairman of the Council of Economic Advisors, devoted to the dissolution and decentralization of power, speculated that maybe we had about reached the end of the road insofar as the utility of the Council of Economic Advisors was concerned—that perhaps we needed to create some kind of new mechanism, a horizontal mechanism of some sort, such as the kind of thing that Carl was talking about, that had substantially greater capability than the Council of Economic Advisors. They used as a reference the Japanese and French experiences, but I must say that while they may have mechanism, I am not sure they have the experience.

Therefore, here we are now at the stage in our national existence when a considerable amount of social invention is required. The concept of property, private property, the concept of man's responsibilities, not only to nature but between man and man and man and society, that all of this has now brought us to the state when society is, in many ways, having to rethink itself.

We are apt to be engaged in this during most of our lifetime. However, during the last several years we find that we are finally, I think, conscious of the fact that the limits of our planet impose certain constraints, certain restrictions upon us and that somehow we have to find a way, through use of technology, to make wise use of our resources, to duplicate cyclical, self-renewing cycles that enabled our planet to develop over these last five million years.

Obviously, this panel has not come up with answers, but raised provocative questions we have all been wrestling with for many years back in our own occupations. However, I think we owe them all a debt for raising them effectively and for presenting some controversial issues for us to chew on as we return home. Therefore, on behalf of all of us, I would like to thank the panel members for their valuable presentations.

Closing Remarks

Laurence R. Jahn
Vice President, Wildlife Management Institute
Washington, D. C.

You have been a most persistent audience. We come to the close of the 40th North American Wildlife and Natural Resources Conference. Again, we are indebted to the many individuals who have contributed much time and effort to plan and stage this successful international meeting. The Program Committee offered invaluable suggestions for the overall conference theme and nature of the individual sessions.

Keith M. Schreiner, representing The Wildlife Society, served as vice-chairman and provided valuable contributions for the content of the well-attended sessions.

A personal acknowledgment will be forwarded in the near future to the many other individuals who assisted in providing the accommodations, facilities, and services required to make this conference a pleasant and rewarding experience. Through their efforts, services were provided to 1,000 to 1,400 people at some of the best attended sessions.

In 1976, the conference will be held in Washington, D. C. from March 21-25. Nine cosponsoring organizations are designing the meeting to commemorate the Bicentennial of the United States. The Program Committee will meet later this month to assemble the agendum. Your constructive suggestions for topics and speakers to highlight critical international, national, and regional resource problems will be welcome. They should reach me by next week.

On behalf of the Wildlife Management Institute, many thanks for your participation in this important conference. Have a safe and enjoyable trip home.

The 40th North American Wildlife and Natural Resources Conference stands adjourned.

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