

management methods, and basic laws are the best that we have today. To the extent that they are employed conscientiously and intelligently, you will find good management. Where they are not applied, you will find less adequate management, and in the states where the laws are still made by the legislature, you will usually find one heck of a mess.

I was asked by the director of one department where I was just finishing a survey to come and go hunting and fishing in his state. I replied, "Why, I wouldn't do it, unless I had a game warden on one side and a lawyer on the other, to be sure that I didn't violate some of the laws that you have on your books." I don't believe it would be possible for anyone to go into the field, no matter how conscientious he was, without violating some of the old, obsolete laws that still were in effect. I have been in states where it was legal to fish with one kind of a gear on one side of the stream that was a county boundary, and illegal to fish with the same gear from the other bank, although you could throw the line across the stream anywhere you happened to be fishing. There are many absurd laws, but I think one of the choicest was one found in New York State. Their basic law at that time protected all fish, mammals, birds, reptiles, and amphibians unless a species was specifically excepted. Another section of the law stated that it was a misdemeanor for anyone to disturb any of the creatures that are protected by the law of this state while on their breeding, feeding, or resting grounds. Now, just how you could go hunting or fishing, or even go for a walk, without violating that law, I will leave to you.

Too often that is the kind of thinking that becomes law when regulations are made by a busy legislature rather than by an informed management. We need much less of the first and much more of the latter.

Thank you.

SOME WILDLIFE RESEARCH PROBLEMS OF THE SOUTHEAST

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RESEARCH IN INDUSTRY

Our atomic age is one of science and research. Industry already has learned that sound and competent research is a major necessity. Two world wars have demonstrated that survival as well as political and economic security are dependent upon it. The United States currently is spending five billion dollars a year for research, or more in one year than during its long history from 1776 to 1933. Furthermore, our industrial research effort is increasing about 10% to 12% a year despite an average increase of only 3% in our gross national products.¹ Research has added a dynamic new force to our national economy by creating new products which in turn make possible new uses and new markets.

Some 3,000 United States companies today have their own research facilities and employ more than one-half million research workers. New research plants and laboratories are springing up almost as fast as new factories. The larger chemical companies such as Dow and Monsanto, estimate that from 30% to 40% of their 1956 sales came from products developed by research during the past ten years. A large oil company¹ has concluded that for every dollar invested in research they ultimately receive five dollars in gross return. Large corporations often spend from 1% to 6% of receipts on research. DuPont's huge research budget of some \$70 million averages about 3½% of sales.

Not all research pays directly. DuPont's chemical department estimates that 1/3 of the studies end in "laboratory flops"; 50% are successful in the laboratory but prove impractical for economic production; less than 10% goes to a manufacturing division for development and only a fraction of this ever goes into production. Still their research pays big dividends.

Because of inherent uncertainties and unpredictable results, basic research has not been given the financial and moral support that it deserves. Yet from it the most startling gains have been made. Our modern electrical industry was made possible because of the basic truths developed through Faraday's simple experiments with a glass rod, silk handkerchief and a cork. DuPont's lucrative nylon, dacron and urethane foam industries resulted from basic molecular studies of raw silk. Basic research into the structure of matter has revolutionized transmitter systems in communications. This came about because of Bell Telephone's discovery in 1948 that such common materials as silicon can be made to act like a vacuum tube in amplifying electrical impulses. As a result a flea-sized transmitter has made a king-sized new industry.¹ Atomic power, radar and jet propulsion are among the most startling and important basic research results in recent years.

Atomic energy use is rapidly going into the applied, commercial and medical fields. Last summer the Armour Foundation installed its \$700,000 reactor atomic energy research laboratory in south Chicago only a short distance from where the world's first atomic pile went into action only a little more than 14 years ago. This new lab will surely hasten the atomic age of technology.

Let us remember that research in all fields that has been competently, honestly and objectively pursued has always paid high dividends. The conveniences, comforts and blessings of modern life are the result of research. Let him who questions this consider an operation without benefit of anesthesia. Such were the experiences of our grandfathers and great grandfathers. New antibiotics, drugs and recent chemical concoctions are constantly expanding the human lifespan. Research products and benefits are so commonplace that they are normally taken for granted. Even such youngsters as the majority of us here can remember a great many discoveries and gadgets which add immeasurably to the comforts and conveniences of modern living that were unknown in our childhood. In the isolated rural community of my birth I can vividly recall the thrill of the first electric lights that came to town and the first queer little automobile that came bouncing down our dusty streets! These are the products of industrial research.

America today is using billions of dollars worth of products that were entirely unknown even a decade ago and we are just now on the threshold of the greatest scientific advance this old world has known. Airplanes that now travel far beyond the speed of sound, radar, atomic power, guided missiles, synthetics and improved agriculture are the logical advances beyond the turbine generator, incandescent bulb and steam engine of past generations' great discoveries.²

Can there be any logical reason for assuming that wildlife is less subject to the inexorable and immutable forces of law and order that govern everything else in life? Can the present paucity of wildlife research be other than an indication that either we are working in a relatively undeveloped field or that leadership is not all that might be desired? A prophet of ancient Israel observed that "without vision the people perish." I am convinced that the prophetic wisdom expressed applies as forcibly in the field of wildlife conservation and management as it does or ever did in the field of industry, government, or religion. Our greatest need in wildlife management is that we awake to our opportunities and responsibilities.

MAGNITUDE OF WILDLIFE RESOURCES

The mammoth size of the fishing and hunting industry shows its great importance and public acclaim. According to the recent national statistical survey conducted by Crossley, S-D Surveys, Inc., and released September 15, some 20,813,000 persons, 12 years of age or older, went fishing one or more times in 1955, while 11,784,000 individuals went hunting during that same period. Combining the above and eliminating duplication it may be reported that 25 million fishermen and hunters spent 3 billion dollars in the mere pursuit of their favored recreation and enjoyed some 500 million days of sport and drove their automobiles 10.4 billion miles in 1955. One household in every three had one or more fishermen or hunters. In the southeast more than 20% of the

population, 12 years of age or older, go fishing and about 11% go hunting. The survey showed that fishing expenditures amounted to \$1,914,292,000 or an average of \$91.98 per person while the aggregate for hunting expenditures amounted to \$936,687,000 or \$79.49 per person. The above costs do not consider the high economic values of the fish and game captured.³

In addition to the astronomically high economic benefits of fish and wildlife, this resource provides great esthetic and spiritual appeal. This, reflected in better citizenship, better health, happiness and greater national solidarity, certainly is no less valuable than the economic returns.

This \$3 billion expenditure capitalized at 6% would represent a resource investment worth some \$50 billion. On August 7 by letter I attempted to obtain from the Fish and Wildlife Service the federal expenditures (including P. R. & D. J.) for wildlife research for the past year, but for reasons best known to their administrators, these figures seem to be confidential as I have been unable yet to obtain a reply. We do know that wildlife research expenditures are pitifully small and do not begin to cover the needs in any field. Can you conceive of any industrial plant or private investment in natural resources of even a hundredth part the worth of our fisheries and wildlife resources that would in this enlightened age indefinitely continue a management program based on so little research?

SOME MAJOR RESEARCH PROBLEMS

What are our major research problems of the Southeast? These "problems" include both the specific research projects and the much needed financial and sympathetic support, favorable atmosphere for research, non-political interference, wise supervision and competent researchers to make the studies. Each of you know the situation in your own states or region far better than I, and you know what is needed to correct the adverse conditions that currently exist.

Research and management have no greater need than that decisions and actions pertaining to these activities be based on biological facts rather than upon temporary political expediency. Experience should have taught us that among the worst enemies of research—and in fact of all wildlife and fishery resources—are expedient, patronage-seeking partisan politicians of all brands. All of us are painfully aware of too many examples of this. Administrators of both federal and state services should be chosen and retained solely on the basis of their competence and fitness for the job and not on the basis of political affiliation or patronage.

It seems to me that if we are to retain our national wildlife resources in this age of almost explosive human population increases, our wildlife research programs must be stepped up.

Among the specific research projects most needing attention, I believe the following could be included along with many others that each of you and I could give:

1. Determination of procedures for more effective integration of sound wildlife management into profitable agricultural, forestry, and grazing practices. Despite the past work in this field, changing agricultural practices and the growing of new and improved crops require a dynamic research program to cope with the ever-changing conditions. With rising land valuations a more intensive agricultural, forestry and grazing husbandry can be expected. Wildlife will continue to recede and finally vanish from much of its present range unless the wildlife manager, guided by sound research, keeps abreast or ahead of those inevitable changes. As agricultural and forestry practices are made more intensive we must likewise intensify appropriate wildlife practices. In few instances are we now able to meet this challenge. With our American and democratic philosophy of private industry (and may this always continue) we must rely on private agriculture and private forestry to supply the bulk of our game for our ever expanding population of hunters. Therefore, public wildlife agencies must work with the private farmer, forester and grazers and point the way for maintaining a crop of game and other wildlife without seriously affecting adversely the land owner's economic returns from his land.

Because of past destructive land practices America has millions of acres that are largely worn out and low in the production of wildlife. Research should be directed toward improving these lands and making them produce a much larger crop of game.

Other studies are needed to appraise the effects of different land cultural practices of soil conservation, agriculture, grazing and forestry. For example, research should determine what effects different degrees of grazing have upon different species of game and other wildlife. Also, we need to know precisely the wildlife values of the many different soil conservation practices.

2. Basic research on environmental relationships or ecological studies of the whole biological community. We have had many splendid studies involving intensive research on various individual species. This work is essential but there has been inadequate consideration given to the whole ecology of the environment in which the species live. We must know vastly more of the inter- and intra-species relationships under differing population densities, varying land use practices, and climatic and other environmental conditions.

3. Determination of procedures for more effective use and management of our water resources and the wise correlation of use of water for agriculture and industry along with fishery and wildlife management. This should involve studies on pollution and pollution abatement in relationship to fisheries and wildlife. Much work in this broad field has already been done, but a great deal more is urgently needed.

In much of the Southeast, black or amber waters that are relatively infertile, are common. Studies need to be directed to improving their productivity. Suggested lines of attack might include temporary and repeated drainage and the planting of desirable wildlife food, carp removal, and the use of chemicals to cause organic and inorganic substance, held in colloidal suspension, to precipitate.

4. Determination of the effects of control agents—insecticides, herbicides, fungicides and rodenticides—upon fish and wildlife resources. The urgency of this problem may be realized when it is known that 65 million acres, or just a little over 1/6 of the total crop land of the United States, were sprayed last year. Even so, crop losses on untreated areas were estimated at \$7.5 billion. Over 3.4 million acres of forest lands were sprayed last year and considerably more will be sprayed during the next spraying season. A total of 3 billion pounds of formulated pesticides were applied in the United States last year at a consumer cost of nearly \$500 million.^{4,5} The development of new herbicides, including 2, 4-D, 2, 4, 5-T, TCA, and ammonium sulfamate, has been almost as spectacular as that of insecticides. Over 85 million pounds of these chemicals are used annually.⁵

Funds for the development of new control agents are almost unlimited and new chemical agents are coming out continuously. Unfortunately, there is comparatively little financial support for testing effects of these materials upon fisheries, wildlife, and their habitats. We know almost nothing of even the direct effects of many control agents on plants, animals, soils and soil organisms, and we know still less of the indirect, accumulative and long time effects these controls have upon wildlife, plants, and even upon man. Much damage has resulted from various control formulations and procedures. Chemical controls that are seriously damaging to wildlife should be used only after weighing the value of these controls against probable harm that will be done. Public support is urgently needed to bridge the wide gap between the operational use of control agents and the sorely needed research to appraise the effects of these many controls.

Recognizing this public need the Honorable Lee Metcalf introduced a bill late in the last session of the Congress to direct "the Secretary of Interior to undertake continuing studies of the effects . . ." of these control agents. A similar measure is expected to be reintroduced into the next session of the Congress and it will deserve public support. Despite the enormous good that results from chemical controls they must be considered in the category of mixed blessings. A multibillion dollar recreation and commercial fishery industry of direct interest to some 25 to 30 million Americans is involved. It is not unreasonable to expect, therefore, that reasonable precaution be given to protect

their interests. The states should expect to assist with this important research. We need to know more of the indirect, as well as the direct, effects of the use of specific chemical control agents. Also, there is need for a wider recognition of the responsibility for hazards on the part of all concerned, including industry and those who apply pesticides. More stringent laws regulating the sale and use of chemical poisons are needed in many states.

Specific herbicides represent an excellent tool of wildlife management. Their benefits, use and limitations can be determined only through sound research.

A closely related problem which may be included under the heading of agricultural fertilizers, needs study by the wildlife biologist to determine the feasibility of fertilizers to produce more and better wildlife crops, and perhaps at the same time to control pest vegetation.

5. Determine the public values, wisest use and management of our wetland resources. The drainage craze, encouraged by federal bureaucracy and stimulated by an over-generous government subsidy, has already done irreparable damage to our water supply and wildlife resources. Research pertaining to our wetland resources and the wildlife dependent upon this type of habitat is needed to afford sounder planning and management. We need to know more of the relation of these wetlands to floods, flood prevention, and ground and surface water supply, as well as to wildlife. Without question, much of agricultural drainage has been in the public interest, but too much of it has been sadly misguided and seriously damaging to the national interest. We need sound research and wiser management of our wetlands, and we need now to build on the splendid wetland inventory that recently has been made by the states and our federal service.

6. Research is needed to objectively measure and appraise all of our regulations and laws pertaining to harvest. With changing conditions and more factual data I have a feeling that some of our regulations could be improved and brought up to date, and perhaps enable us to safely take a larger harvest. Regulatory authority should be placed in the hands of the responsible administering agency. A research program objectively measuring the effects of each regulation should aid the states in obtaining that needed authority.

7. Appraise and determine the soundness and effectiveness of state programs. Wouldn't the state be moving ahead if it objectively subjected its own programs to scientific scrutiny? A progressive department or commission should want to build the most efficient, economical and effective program possible. I believe such a program would be sound politically. There is need for some artificial propagation program for quail or fish, but there definitely is a limit to their value. Might these and the planting programs, the refuges, predator programs, and the efforts at habitat improvement be materially improved if these programs were subjected to competent and objective analysis by trained research personnel? I believe they would.

8. Establish procedures that will effectively control bird and rodent depredations and permit direct seeding of forest trees and grazing lands. Too frequently in the past, poisoning or other means of killing has been the only successful means of control. Recent studies by Don Spencer, Johnson Neff and Brooke Meanley and others of the U. S. Fish and Wildlife Service, gives great promise for resolving much of this economically important problem. They have progressed far enough to know that chemical deterrents can be found to prevent significant damage to the seeds and still leave them viable. This problem is particularly important at this time because of the new federal soil bank program. Research in this promising field should be stepped up immediately for without it the important but costly soil bank program will be seriously handicapped.

9. Wildlife disease, nutrition and pathological research justifies far more public and private support than it has yet received. There is no reason to feel that competently conducted studies in these related fields would be relatively any less rewarding than has similar research on domestic livestock. Many basic studies are urgently needed. Disease is inextricably tied in with cycles and population dynamics. We yet know little of the cause or control of cycles that periodically remove much of our game. There is urgent need to study the ecology of disease and investigate the latent and epizootic diseases in relation

to animal numbers. We know far too little of the role of nutrition and other stress factors in relation to population reductions. Far too little is known concerning disease virulence, disease resistance, reservoirs and vectors. Experimental studies on disease control are profoundly important in sound management.

As I recall, it was about 1949 that upwards of 10,000 deer rather abruptly died off in the Southeastern states. In the main the studies of the cause or causes of this loss were sporadic, casual and mainly of a post mortem nature, and the conclusions reached were nearly as varied and as numerous as were the investigations conducted. To stock deer in a depleted range costs about \$100 per liberated individual, and I suspect the average cost of deer harvested amounts to approximately \$100. The death of the 10,000 deer would, therefore, approximate a million dollar loss. In an average year we probably lose upwards of 100,000 ducks from botulism and other very large numbers from lead poisoning, fowl cholera, nutritional deficiencies and still larger numbers from other unknown causes. The yearly economic value of game loss is staggering, and it leaves one with the feeling that we cannot afford to remain aloof from disease research. From an economic viewpoint we have no alternative but to pay the necessary price and uncover the facts which are basic to sound management.

A definite relation of wildlife diseases to domestic livestock and even human beings is known to exist, yet the details of these relationships are obscure and indefinite. Certainly, this broad subject deserves public support on both the state and national level.

10. Determine the need and economy of introducing exotics. Indiscriminate introductions can be extremely costly and wasteful, but a planned program to fill a vacant niche might ultimately prove highly advantageous.

In conclusion I cannot too strongly emphasize the profound importance of research. If your state is not concerned with this, your fountain of information is sure to dry up and your administration, if it long continues, is likely to be mediocre. We live in an age of research, and this is as basic to sound wildlife management as it is in the fields of agriculture, chemistry, medicine or industry. To be successful the research personnel must be competent; and to assure this the salary scale must be reasonable and commensurate with training, abilities and responsibilities. Much can be said of the shortcomings of research. They are many and some are serious, but that is a subject for another day.⁶

Constantly changing conditions always will require new information and new techniques to meet new problems. Hence, research always will be an absolute necessity, and this is as true in the field of wildlife and fishery conservation and management as it is in those fields where the science is more mature. Scientific research gives us daily assurance that our opportunities for future progress are limited only by our breadth of vision, powers of imagination and by our will to work together for peace and progress, and it proclaims anew that "without vision the people perish." Are we equal to this challenge?

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