The Cooperative Fish and Wildlife Research Unit Program

By

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Missouri Cooperative Wildlife Research Unit

> Modifications of environment by man have *surpassed* the tolerances of numerous species and the extreme *danger*, of course, is that man's tolerance may soon be exceeded....
>
> Thomas R. Detwyler (1971)

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Dedication

This work is dedicated to those who are or have been associated with the unit program. Included are Fish and Wildlife Service employees who helped administer the Program, personnel of the Wildlife Management Institute, state fisheries and wildlife agency cooperators, and university cooperators. A special part of the dedication is to the unit leaders, assistant unit leaders, secretaries, and administrative assistants who served on the *front lines* through good times and bad. These individuals make the Cooperative Fish and Wildlife Research Unit Program a continuing success.

J. N. "Ding" Darling had the vision to "see" the need for land-grant universities, state agencies, and the federal government to join forces to accomplish research in fisheries and wildlife to provide information for scientific management of America's vast wildlife populations. The Cooperative Units are living proof of the effectiveness of "Ding's" vision.

Appreciation

I thank many colleagues for editorial assistance. E. T. LaRoe, former Director of the Cooperative Research Units Center, permitted preparation of parts of this manuscript during office hours. Personnel currently serving in the units provided much of the information about unit histories and productivity. I thank my wife, Prudence, for constructive criticism of parts of the manuscript.

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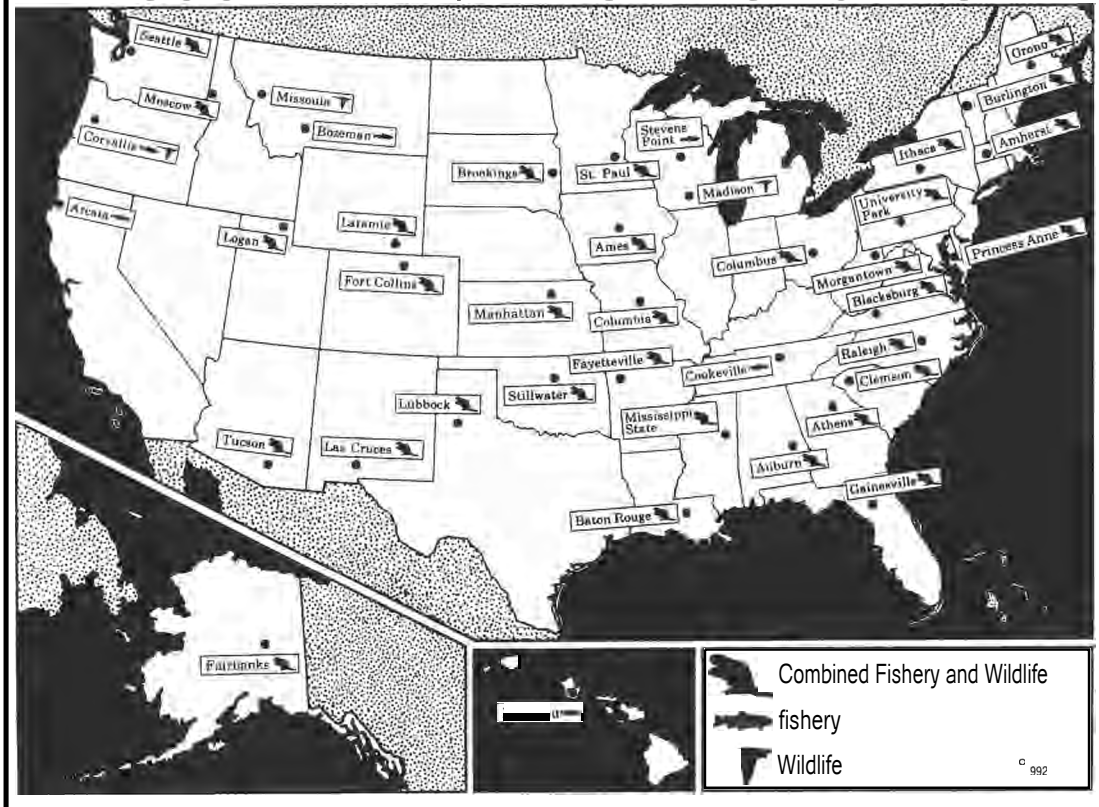
Prologue

This book is about the Cooperative Fish and Wildlife Research Units and how the program has evolved since its inception. Resource management by the states where units are located and by the U.S. Fish and Wildlife Service exhibits a co-evolution. The units influenced the evolution by providing continuingly new information from research, by actively teaching natural-resource management to new groups of students, and by working in close partnership with land-grant universities and state wildlife agencies. The future with its ever-increasing human population will continue to place new demands on resources and, in turn, will initiate new demands for information to meet the continuing challenges of natural-resource management.

This book documents the formation, activities, administration, personnel, and operation of the Cooperative Fish and Wildlife Research Unit Program and its contributions to management of natural resources. Much of the information is found only in unpublished reports, memos, and other documents in archives and files. Little information is available in published literature, which explains the sparsity of citations in the text.

* This manuscript was finalized when the Cooperative Unit Program became part of the newly established National Biological Survey. The text was not altered to reflect this new home for the units. The manuscript reflects the history of the program in the U.S. Fish and Wildlife Service.

COOPERATIVE RESEARCH UNITS



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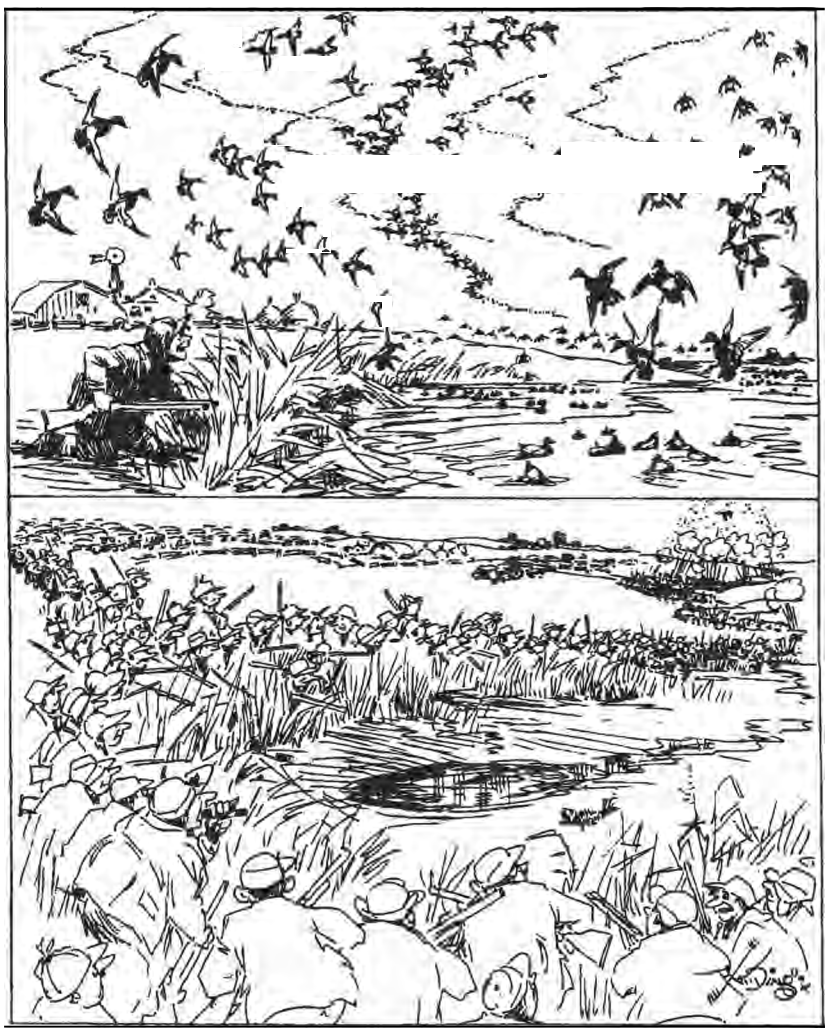
Introduction

A person of humor like J. N. "Ding" Darling, cartoonist and political satirist for the Des Moines Register of Des Moines, Iowa, in the late 1920's and early 1930's, can often get to the salient points of a troublesome problem. Darling perceived a rapid climatic change that caused extended drought, a rapid agricultural change that eliminated the traditional availability of wildlife to every United States citizen, and an absence of trained individuals in government to manage vast but declining renewable natural resources.

In 1930, at the Seventeenth Game Conference of the American Game Association, a group of conservationists (the Committee on Game Policy) presented the Report to the American Game Conference on an American Game Policy. The committee, comprised of 14 outstanding wildlife conservationists, was chaired by Aldo Leopold. The report boldly stated that wildlife demand was outstripping supply. The report listed the need for promoting cooperation between public and private interests and for incentives to enhance wildlife production on private lands. The report emphasized the dearth of trained personnel for solving problems about wildlife conservation and the need for research to develop information for wildlife management.

Individuals who became concerned by the report—Darling was among them—began to look for ways to provide better stewardship for wildlife resources. The shortage of wildlife biologists with qualifications of today's standards and the lack of information about wildlife management motivated Darling to invest personal funds for the implementation of the first cooperative unit. The unit formed a partnership of the state land-grant (agricultural) college and the state game agency to conduct research and to provide education about wildlife at the Iowa State College in Ames. Darling and the partners expected that the unit would develop wildlife biologists and conduct relevant research.

What follows is a tribute to the biologists and the support staffs of the past and present activity that is now called the Cooperative Fish and Wildlife Research Units Program. The tribute begins with descriptions of J. Norwood "Ding" Darling as catalyst for establishing the initial cooperative unit and continues with descriptions of the research and operational scope of today's program of cooperative fish and wildlife research units operational in 38 states. In honor of Darling's contribution, the text is illustrated with some of his cartoons and etchings that depict environmental subjects.



What Changes One Generation Can Make

Research by biologists (leaders and assistant leaders) and their students provides much of the common knowledge for managing wildlife populations and their habitats. Unit biologists and faculty associates continue to produce competent biologists and to provide sound information for the increasingly complex management of fishes, wildlife, and their habitats.

Europeans in the United States

In Europe about the time of American colonization, the nearest thing to game management was conducted on large private lands of royalty or the few very rich and privileged citizens. European immigrants to America brought little or no information about managing wildlife populations for either commercial or recreational harvest. In Europe, landowners owned the wildlife on the land and hired gamekeepers to produce game and to manage recreational shooting. Gamekeepers learned game production and harvest practices by trial and error, by apprenticeships, or by tutelage of an established gamekeeper on another private-land holding. European educational institutions did not offer courses to educate the public about wildlife. Commonly, game shoots were designed to place the shooter or gun at an advantageous place to intercept birds as beaters flushed them past the gun (Cottam and Trefethen 1968). Rearing game to optimize numbers for shooting is different from managing game for sustaining populations at harvestable levels as practiced in the United States today.

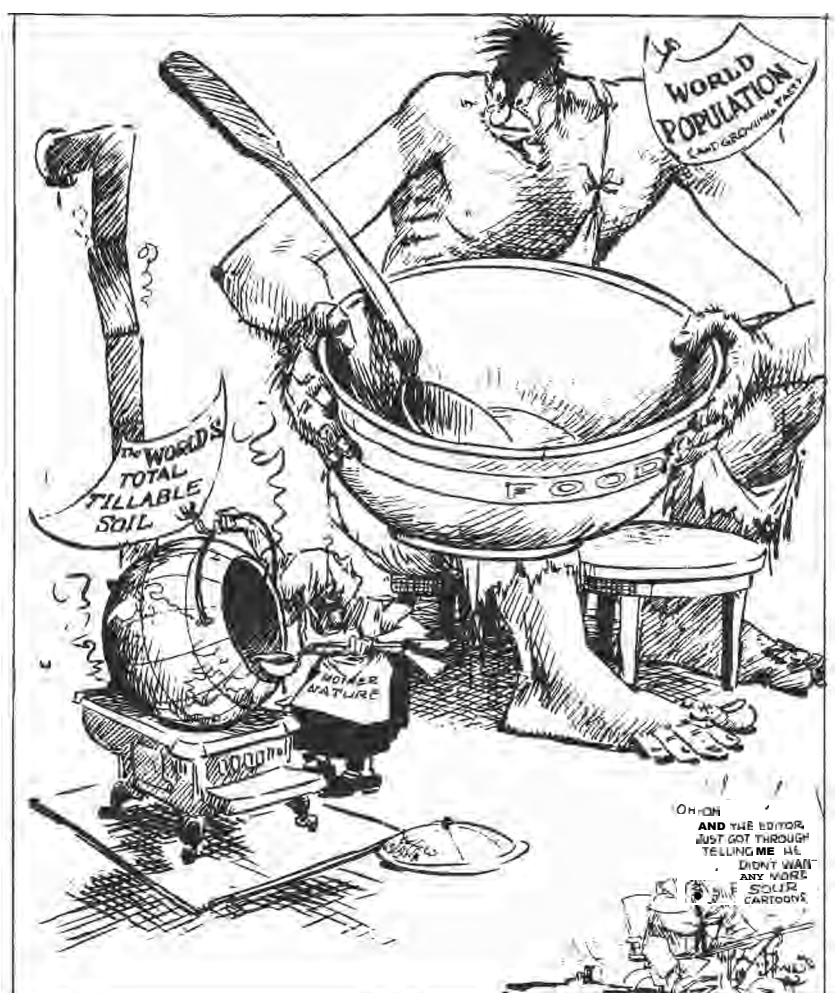
In the New World

In the new world, hunting was a privilege of the public because it owned the game as an extension of owning the government (Allen 1962). Although knowledge of game management in the New World was limited, residents recognized near the turn of the century that the United States was rapidly losing its wildlife populations. Elk had been extirpated from the eastern woodlands, white-tailed deer were scarce where once they had been abundant, passenger pigeons were virtually gone, bison were gone from the Great Plains, turkeys had been extirpated from 90% of their former range, and waterfowl populations were declining (Kallman 1987). Many places with still-harvestable populations of small game animals were becoming crowded with outdoorsmen in pursuit of hunting opportunities, a common portrayal in Darling's cartoons (Lendt 1979).

World War I in the early part of the century diverted attention from problems of dwindling game populations. The economic upturn after the world war provided leisure time and money in American households. This caused a surge of interest in hunting for recreation. Approximately 6 million

hunting licenses were sold in 1920, more than twice the annual number sold 10 years earlier. Human population growth soared during this same period. For the first time, pressures on wildlife habitats from population growth, local overuse, and economic development became recognized as the greatest threat to wildlife (Lendt 1979). The severe drought of the early 30's galvanized the need for action.

Against this backdrop, concerned individuals groped for ways to improve the quality and quantity of game populations and of public hunting opportunities. The dilemma brought action from an individual well known for doing something when something needed to be done. Jay Norwood "Ding"



The Only Kettle She's Got

Darling, a political cartoonist for the Des Moines Leader and Register in Des Moines, Iowa, was the man—the action took several forms. Needed was information for managing wildlife populations and habitats for sustained production and a means to educate a cadre of individuals to understand and to use the information properly. The "doing something" turned out to be the beginnings of the cooperative wildlife research units.

Cooperative *Wildlife* Research Units

Iowa Led the Way

Darling's push for conservation reforms in Iowa had provided the groundwork for his being named the first chairperson of the Iowa Fish and Game Commission. His recognition of the need for biological information, trained wildlife managers, and dissemination of information to management agencies led to his negotiation of an agreement among the Iowa State College, the Iowa Fish and Game Commission, and Darling to form and support the first cooperative wildlife research unit. In 1932, Darling pledged $3,000 of his personal funds to finance operations for each of 3 successive years. This was an obvious measure of Darling's commitment to wildlife conservation because $3,000 in 1932 could have purchased a significant amount of Iowa farm acreage. Dr. Paul Errington, one of Aldo Leopold's students, was recruited in summer 1933 as leader of this cooperative wildlife research unit in an academic department located at Iowa State College in Ames.

Because of Darling's dedication to wildlife conservation, Secretary of Agriculture Henry A. Wallace, from Iowa, suggested to President Franklin Roosevelt that Darling be nominated director of the Federal Bureau of Biological Survey. President Roosevelt approached Darling with a personal telephone call. After some consternation and consideration of the personal financial sacrifice, Darling agreed. On 10 March 1934, Darling was appointed Director of the Bureau of Biological Survey, U.S. Department of Agriculture. Years later, the Bureau of Biological Survey was transferred to the Department of the Interior and became the U.S. Fish and Wildlife Service, then the Bureau of Sport Fisheries and Wildlife, and again renamed the U.S. Fish and Wildlife Service.

The National Cooperative Unit Program

As director of the Bureau of Biological Survey, Darling lobbied the Congress for support of nationwide cooperative wildlife research units. He also began searching for support for units from other sources. Darling invited distinguished guests to a dinner meeting at the Waldorf Astoria Hotel in New York on 24 April 1935 to solicit their philosophical and financial support of a program to produce wildlife biologists and biological information for management of the nation's wildlife. The purpose was to present and to discuss Darling's concept of cooperative units. Before the meeting, Darling worked with conservation departments and land-grant universities in several states

and secured resources for partial support of a unit in each of nine states (Lendt 1979). Pledges of $162,000 and other in-kind services had already been received as support to operate the first nine units for 3 years (Lendt 1979). Another $81,000 was needed to establish the nine units. Attending the dinner meeting were executive officers from the Hercules Powder Company, the DuPont Company, and the Remington Arms Company. By the end of the evening, the businessmen were convinced that the program was in the best interest of hunting, their companies, and the nation. As a result, they

Iowa Pioneers

committed the additional $81,000 to complete funding for the first 3 years of operation of the nine units. They also agreed to help form and support a new organization, The American Wildlife Institute, the predecessor to The Wildlife Management Institute (Lendt 1979). Important benefits from the Institute's initial formation included help with guiding the development of wildlife conservation and the establishment of a repository for donated funds from the arms-and-ammunition companies in support of units. Under Darling's guidance, the first nine cooperative wildlife research units were formed in the Bureau of Biological Survey.

The federal government supported each unit by hiring each unit leader-biologist as an employee of the Bureau of Biological Survey. Financial contributions to operate each unit included $3,000 from the ammunition companies; $6,000 in cash or in-kind services, equipment, and facilities from respective state conservation agencies; and $6,000 from the host university as in-kind services, equipment, facilities, secretarial services, and cash. Annual salaries of the biologists ranged from $3,200 to $4,600, depending on the experience and time in the organization of each individual. The nine units were in Alabama, Connecticut, Iowa, Maine, Ohio, Oregon, Texas, Utah, and Virginia. The program was officially known as Cooperative Research in Wildlife Management. The first annual report (Wildlife Research and Management Leaflet BS-38—C *Research in Wildlife Management—A Summary of the Project to February 15, 1936*) was issued by the Bureau of Biological Survey, Division of Wildlife Research, for fiscal year 1 July 1935 to 30 June 1936. It was typewritten and every page was labeled "Confidential." The report encouraged each unit to:

> attempt to maintain a proper balance of research...in life history and habits of species and practical methods of wildlife management, experimental and demonstration area problems to establish object lessons of wildlife management practice, and educational activity in training of graduate students and others.. general educational work chiefly of the extension type....

The final paragraph of the report stated:

> Outstanding among the encouraging features of the program are: (1) the genuinely wholesome attitude of game departments toward the work; (2) the general importance and sincere interest manifested in the work by all agencies interested in wildlife; and (3) the realization by colleges and land use agencies of the potentialities in the wildlife field and the necessity of studying wildlife from the land use standpoint.

THE FIRST UNITS

Darling made the states aware of the opportunity for establishing units and the expectations from units. More states expressed an interest in the program than could be supported by available funds. The first nine locations provided the best coverage of recognized ecosystems and major land forms.

The research of each unit was to have regional application, and the collective information was expected to have broad national application.

The criteria and notations of justification for those decisions were first noted in the February 1936 summary report of the project (Cooperative Research in Wildlife Management). Table 1 of the report was titled "States Cooperating" and provided the location of the unit in the state, the ecological region description, and general remarks as follows:

1. Oregon Agricultural College, Corvallis
2. Northern section of Pacific coast region
3. With problems distinctly different from the southern Pacific coast zone and typical of Oregon, Washington and northem California.

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1. Utah State Agricultural College, Logan
2. Intermountain region
3. Typical of the problems of Utah, Nevada, southern Idaho, and western Wyoming.

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1. Texas Agricultural and Mechanical College, College Station
2. Eastern section of the Southwest region
3. The State of Texas in area and scope of work is almost a region in itself but problems worked out there will serve most of Texas and Louisiana.

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1. Iowa State College, Ames
2. Northern Mississippi Valley region
3. Typical of problems for Iowa, eastern South Dakota, eastern Nebraska, southern Minnesota, Illinois, and northern Missouri.

---

1. University of Maine, Orono
2. Northern section of New England region
3. Wildlife problems in Maine cannot be compared with those of states to the south. Species and ecology are distinctly different.

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1. Connecticut Agricultural College, Storrs
2. Southern section of New England region
3. Typical problems with the rest of the New England states.

1. Virginia Polytechnic Institute, Blacksburg
2. Northern section of the Southeastern Region
3. While many species are the same as in the more southern coastal states, their ecology is distinctly different. The problems here will serve Virginia and parts of West Virginia, North Carolina, and South Carolina.

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1. Alabama Polytechnic Institute, Auburn
2. Southeastern region
3. Typical of the Gulf states section and with problems very distinct from Virginia and serving the Alabama, Georgia, northern Florida, and eastern Mississippi group.

---

1. Ohio State University, Columbus
2. Ohio Valley region
3. Typical of Ohio, Indiana, and parts of Pennsylvania, West Virginia, and Kentucky.

In 1939, the Bureau of Fisheries from the Department of Commerce and the Bureau of Biological Survey from the Department of Agriculture, including the cooperative wildlife research units, were transferred to the Department of the Interior. In 1940, these two bureaus were combined to form the U.S. Fish and Wildlife Service.

More States Obtain Units

As other states began pressuring congressional delegations, nine more wildlife units were added to the program: Missouri 1937, Pennsylvania 1938, Colorado 1947, Idaho 1947, Massachusetts 1948, Oklahoma 1948, Alaska 1950, Arizona 1950, and Montana 1950. By 1950,17 units were operating. Only units in Connecticut 1937, Texas 1954, and Oregon 1959 have closed; units were reestablished in Oregon 1971 and in Texas 1988.

Cooperative Units Act

In 1960, the Congress passed the Cooperative Units Act (PI. 86-686. This act authorized the program as a separate line item in the annual budget of the U.S. Fish and Wildlife Service. The congressional recognition increased the unit program's visibility, status, and stability. The new legislation allowed state employees to serve in units by providing a mechanism to support the incidental expenses of non-federal personnel. The most important provision of the act, however, was the addition of fisheries to the program. Before 1960, fisheries work was accomplished by cooperating fishery professors at the discretion of wildlife unit leaders. The addition of language about fisheries allowed interested parties to begin planning for cooperative fishery units.

Soon after the 1960 enactment of Public Law 86-686, three additional cooperative wildlife research units were formed—New York 1961, Louisiana 1962, and South Dakota 1963. Two other cooperative wildlife research units were formed during the 1970's—Wisconsin 1971 and Georgia 1979. U.S. Fish and Wildlife Service Director John Gottschalk wrote the foreword to *Wildlife* Resource Publication 6: Thirty Years of Cooperative *Wildlife* Research Units *1935-1965.* He began his remarks with a quote from an article by C. E. Gilham in the September 1965 issue of Field and Stream magazine.

> The great renaissance in game management really began when certain land grant colleges started teaching the subject and giving degrees to students for detailed studies of various wildlife species. Any critter, from an earthworm to a polar bear, was analyzed from A to izzard. Data on food habits, reproduction, abundance and distribution and relationships to other species were assembled.

> Years were consumed in the training of biologists, and still more years were required for studies to be made. Finally, however, state and federal game departments had good basic information to be used in the setting of seasons and bag limits on practically all species of game birds and mammals.

Director Gottschalk went on to say,

> The professional worker will accept the foregoing without debate, and should anyone have a question as to the role of the units in wildlife conservation, all he needs to do is review the amazing record of 30 years' accomplishment reported in this booklet. In these three decades we have witnessed the beginning of the profession of wildlife management, and an acceptance by the

American public that game management, like any other kind of management, is dependent upon knowledge, much of which has been gained by students and graduates of Cooperative Wildlife Research Units.

Cooperative Fishery Units

The Cooperative Units Act (P.L. 86-686), passed in 1960, included provision for proposed cooperative fishery units and existing cooperative

What Man Does To One Of The Most Beautiful Gifts Of Nature—The River

wildlife research units. The assistant director for fisheries of the U.S. Fish and Wildlife Service asked the director for approval to initiate cooperative fishery units in several states. With the approval of the agency director, cooperative fishery units were developed by regional directors in cooperation with interested state agencies and universities. Though fishery units were different in intent and supervision in the early years, the state cooperators perceived the program as paralleling that of the wildlife research units and as beneficial to the states.

The first group of 12 cooperative fishery units and their respective formation dates were: Utah 1961 , Colorado 1962 , Georgia 1962 , Idaho 1963 , Louisiana 1963 , Maine 1962 , Massachusetts 1964 , Missouri 1962 , Montana 1963 , New York 1963 , North Carolina 1962 , and Pennsylvania 1964 . Most were located at the universities that hosted cooperative wildlife research units. The North Carolina fishery unit was the only original unit in a state without a wildlife research unit. The Montana Fishery Unit was unique because it was established at a university different from the already existing wildlife research unit.

Effect of Fishery Research Unit Staffmg on the Unit Program

From inception, each fishery unit was staffed with two biologists. The senior of the two initially-appointed biologists became the leader, and the junior biologist became the assistant leader. In the late 1960's, after much lobbying by those associated with the wildlife research units, the Service director approved assistant leader positions for the wildlife research units. The formation of the two-person fishery units and the addition of assistant leaders to the wildlife units were the most significant expansions in the Cooperative Unit Program.

Federal Affiliation of Fishery Units

Differences between the fishery and wildlife units were origin of the impetus for formation and where in the Service they were assigned for management. Because fishery units were conceived with a major responsibility for extension activities, fishery units were initially administered by the regions of the Bureau of Sport Fisheries and Wildlife. Fishery units did conduct research as a component of their mission. Administrators wrestled with the special problems of coordination of research in the Bureau before the fishery units were organizationally moved to the Bureau's research grouping in 1973.

Wildlife and Fishery Units Under One Entity

All units were transferred to the newly created Division of Cooperative Research on 1 July 1973. The Division of Cooperative Research was part of the Bureau's national research organization in the Washington headquarters. Cooperative fishery units were renamed cooperative fishery research units

to parallel the name and functioning of the cooperative wildlife research units. In 1973, the fishery units numbered 25 because of the previous additions of Alabama, Arizona, California, Hawaii, Iowa, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Virginia, Washington, and Wisconsin.

Joining of the units under a single organizational entity increased cooperation among the units. The new structure emphasized the original purposes of the units: graduate education, research, and technical assistance. The 25 fishery research units, in addition to the 20 wildlife research units, totaled 45 units in 25 states.

Administration of Cooperative Research Units by Various Organizational Entities

Nine major organizational events occurred within the federal administration of the unit program.

1. In the Bureau of Biological Survey, the wildlife research units were under the administration of an organization designated as Cooperative Research in Wildlife Management.
2. When the U.S. Fish and Wildlife Service was formed, the wildlife research units became a subdivision of the Division of Wildlife Research. The fishery units were later formed as part of the Division of Fisheries Management.
3. In 1973, the fishery research units and wildlife research units were combined with some other research functions in a new entity, the Division of Cooperative Research.
4. In 1976, the cooperative fishery and wildlife research units were reassigned to the newly formed Division of Habitat Preservation Research of the U.S. Fish and Wildlife Service. Organized under the Office of Cooperative Research Units, the Fishery and Wildlife units were brought together as an entity.
5. In 1979, research in the U.S. Fish and Wildlife Service was divided into three entities: the Division of Wildlife Ecology-Research, the Division of Fishery Ecology-Research, and the Office of Cooperative Units.
6. In 1983, research in the Service was reorganized into the Division of Wildlife Research, the Division of Fishery Research, the Division of Biological Services, and the Division of Cooperative Units.
7. In 1985, a major reorganization of the Service eliminated research divisions and made research center directors directly responsible to the Regional Director for Research (Regional Director, Region 8). The Cooperative Research Unit Program was designated as one of the research centers.
8. In 1978, the concept of super units was developed. In theory, a multi-discipline research unit (fisheries and wildlife) would be better able to conduct research at the ecosystem level—a recognized, rapidly growing research need. The first super units were established in Florida and in

Mississippi. Each unit was staffed with a unit leader who served mostly as a supervisor of *some* assistant unit leaders, but conducted some research and advised a limited number of graduate students. The *some* was originally interpreted as an indeterminate number (the cooperative agreement specified the appointment of at least three service employees

In The Service Of "The People"

to the unit with the initial staffing to consist of a leader, at least one assistant leader with a research background and training in wildlife biology, and at least one assistant leader with a research background and experience in fishery biology).

In 1979, negotiations were completed for the formation of a third unit with the same design in Wyoming and a fourth, but unique unit, in Pennsylvania that combined parts of two existing units. These units were designed to bring together terrestrial and aquatic research into studies of ecosystems. Because of the broadened responsibilities, these units were staffed with a GS-14 leader rather than the traditional GS-13 leader. Changes in administrations and budgets precluded the assignment of other Service biologists with backgrounds in other than fisheries or wildlife to these units.

9. In 1982, 1983, and 1984 the president and his administration removed the unit program from the administration's budget that went to the Congress. The Congress restored the funding for the unit program to the budget in each of those years. As a result of the budget crisis, the super-unit concept was abandoned. The increased visibility brought about by the budget crisis, however, resulted in the establishment of new units.

The Current Program

In 1994, combined fish and wildlife units are present in Alabama, Alaska, Arizona, Arkansas, Colorado, Florida, Georgia, Idaho, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wyoming. Wildlife research units are located in Montana, Oregon, and Wisconsin. Fishery research units are in California, Hawaii, Montana, Oregon, Tennessee, and Wisconsin. Most states that do not have units have inquired about the possibility of forming one.

A Unit and How it is Formed

The process for the formation of new units has taken unusual pathways and often has been tortuous. Logic suggests that to obtain a unit, the potential state cooperators—the state fish and wildlife agency, and the university—make a formal request to the U.S. Fish and Wildlife Service director. Requests are often made, but the Service takes minimal action. Money to pay salaries for new units would be taken from another Service program for each unit established. The Service has routinely refused requests to start new units. The usual response to requests for new units has been "we have enough units and other university programs to produce all needed fish and

wildlife biologists for available positions and enough regional coverage in the unit program to provide research into fish-and-wildlife related problems."

Historically, this stance either reflected the opinions of Service decision makers or was offered as a standard answer because of resource-allocation problems. Funds for the congressional line-item appropriation of units may be spent only in the cooperative unit program. Because of the inflexibility of this appropriation, the Service has been unwilling to transfer funds to the unit program from other program areas.

In response to the Service's position, states request new units through congressional delegations. A sympathetic congressional delegation usually requests a budget increase for authorizing and funding a unit through the congressional appropriations process. In general, a unit that was implemented through congressional authorization and appropriations increases the unit program budget to pay for personnel and basic equipment. A few units, however, have been authorized by the Congress, but with no added appropriation to cover the cost. Consequently, the program budget does not cover salary costs for all unit positions, and positions may remain vacant for a long time.

After a congressional mandate and an increase in appropriations to begin a new unit, a cooperative agreement is developed by the potential cooperators: the host university, the state wildlife and fisheries agency, the Service, and the Wildlife Management Institute. The U.S. Fish and Wildlife Service provides a prototype agreement for deliberations and discussion by the cooperators. Personnel with legal backgrounds examine the proposed agreement from the viewpoint of each agency and adjust what is necessary to conform to the laws and regulations that govern each cooperator. An agreement for a unit is a unique document. Representatives of the cooperating organizations, usually the U.S. Fish and Wildlife Service Assistant Director for Research and Development, a vice president or president of the host university, the director or secretary of the state fish and wildlife agency, and the president of the Wildlife Management Institute, sign the cooperative agreement.

Coordinating Committees: Structure and Function

The coordinating committee is responsible to guide the functioning of a unit as outlined in each cooperative agreement. The coordinating committee is composed of an official representative from each organization who signed the cooperative agreement that established the unit. Combined fish and wildlife research units and wildlife research units have at least four signatories, and therefore at least four members of the coordinating committee who represent the Service, the host university, the state agency(ies), and the Wildlife Management Institute. Cooperative fishery research units have only three signatories—the Wildlife Management Institute is not a cooperator in these units.

The working members of the coordinating committee may or may not be the signatory individuals. The individual who was the official signatory to the agreement usually delegates authority for coordinating committee activities to someone in the organization who is closer to the actual functioning of the unit. The Service's working representative to the coordinating committee is a unit supervisor from headquarters in Washington, D.C. The university representative is usually a dean, department head, or program- or school-director within whose organization the unit is assigned. The state agency representative is often the research division director but may be the director or the deputy director of the agency or another of the director's designees. Members of coordinating committees must be able to legally commit their organization to the expenditure of funds or other in-kind support for unit activities.

The Wildlife Management Institute has a standing invitation to meetings of the coordinating committee but may not always be represented. The role of the Wildlife Management Institute in the Cooperative Unit Program is, in most instances, directed at the program as a whole rather than focused on a particular unit.

The coordinating committee provides specific guidance to units. Each unit operates under a broad directional statement that the unit leader develops with guidance from the cooperators. The direction statement reflects the capabilities of the unit personnel and the types of activities (mainly the types of research) the cooperators wish to have emphasized. The direction statement for the unit is reviewed annually at the coordinating committee meeting to assure that the direction reflects current needs and wishes of the cooperators.

The direction statement provides the umbrella guidance for research activity of the unit. Unit supervisors in the Washington headquarters may use the direction statement as a reference for answering questions from the Congress and others about which units are best equipped for conducting particular types of research.

Scheduling and preparing for meetings of the coordinating committee are the responsibilities of the unit leader. Coordinating committee meetings usually have two parts—a general information and guidance session and an executive session. The general information and guidance session is the main business meeting and is open to all interested parties. An executive session is optional and, when held, is attended only by official coordinating committee members because it usually relates to personnel matters.

After the unit leader negotiates a date for the meeting, the leader is responsible for the preparation and distribution of information materials. Carefully prepared agendas, budgets, summaries of research, statements of direction, and past accomplishments must be sent to participants well in advance of the meeting. The agenda should indicate topics that must be addressed by the various attendees (see Appendix D for a prototype agenda of a coordinating committee meeting). Pre-meeting materials provide a basic understanding of what will be presented so attendees are ready to discuss

each topic. The agenda provides detailed information about special events that may include scheduled lunches, field trips, tours, or special speakers. A list of invited attendees is included in the pre-meeting briefing materials.

Some unit leaders serve as perpetual chairpersons and meeting facilitators. At some units, the coordinating committee rotates the chairperson among cooperators from year to year. Where the chairperson rotates among cooperators, the pre-meeting communique indicates which cooperator will chair the meeting. Special information the designated chair needs is provided with the pre-meeting information.

Some units schedule a separate session for student research presentations to an invited audience. Student presentation sessions may be at a time proximate to the business meetings or on a different day and in separate locations. These sessions provide students the opportunity to be heard by interested faculty members, state biologists, Service regional office personnel, and the coordinating committee. The sessions allow students to gain experience in making presentations to professional groups and to meet prospective employers.

The general information session is attended by cooperator representatives and other interested parties. Attendees may include collaborating university professors, other professors, administrators, or students who are interested in the activities of the unit. A wide array of state-conservation-agency research and administrative staff may also attend.

Service personnel, in addition to the unit supervisor and unit staff, may also attend. The unit leader sends an invitation to the coordinating committee meeting to the Service regional director of the region in which the unit is located. The regional director usually sends a designated representative to the coordinating committee meeting to make the information needs of the region known to the unit and its cooperators and to become familiar with the array of unit activities.

Attendees of the general session are presented with a summary of recent research, teaching, and technical assistance; a review of the budget status; and plans for the future. Students or principal investigators may present research reports on topics of interest or on projects funded by one or more of the cooperators.

Cooperator contributions in cash and in-kind support and other budget information are presented. In-kind services must be identified as part of cooperator contributions because most university support and sometimes considerable state-cooperator support are in services to the unit. The unit leader usually reports on acquisition of special equipment or needs for upcoming projects.

The most significant part of the coordinating committee meeting is the presentation of planned unit activities for the succeeding year. Typically, unit personnel present information about projects they request to conduct and about funding and other needs for students in conducting the investi-

gations. After these presentations, the coordinating committee members discuss and approve or disapprove all or some of the proposed activities. Directional adjustments are negotiated among the cooperators, and consensus is achieved for operating the unit for the subsequent year. Coordinating committees attempt to make all decisions by consensus. Split decisions complicate unit operations and may force the unit leader to divide loyalties between cooperators.

The coordinating committee discusses activities of the previous year and hears each member's perspective on unit performance. The evaluation of the unit's performance and the evaluation of the performance of unit personnel are occasionally confused. The difference between these two evaluations is subtle but important.

Evaluation of the unit includes performance and productivity. The performance of the unit is broader than the performance of the unit staff but obviously reflects the actions of the staff. Unit performance includes the combined efforts of unit students and of state agency personnel and university personnel who are actively involved with the unit.

The performance of the unit leader and the review of the leader's evaluation of the assistant leaders are evaluated by the unit supervisor. Any discussion of personal performance of unit personnel by the unit supervisor takes place in the executive session—if held. Cooperators use the executive session of the coordinating committee meeting to provide comments on performance of unit personnel to the unit supervisor. This information is considered by the supervisor in the evaluation of unit employees' performance.

After the coordinating committee meeting, the unit supervisor discusses personnel performance with the unit leader. Formal unit-personnel evaluation of federal employees follows the official performance evaluation procedures prescribed by the Federal Office of Personnel Management. The evaluation of personal performance determines pay, bonuses, and the subsequent year's performance expectations.

The coordinating committee functions throughout the year even though it typically meets in a formal setting only once a year. Action is needed on some research proposals during the year. Proposals that require action between meetings are forwarded in series to the individual coordinating committee members. Members may take independent action or engage in a conference call. A request for action on proposed research includes a summary of the proposed project and its objectives and contains a concurrence line for the signatures of each coordinating committee member. When all signatures are affixed, this document becomes an addendum to the official minutes of a coordinating committee meeting.

The unit leader must make judgments about staff load and decisions about which new projects may be appropriate for the unit. The unit leader must assure the coordinating committee that the unit can undertake proposed new projects and still meet the responsibilities of ongoing projects.

Unit-supervisor Visits

When the unit supervisors visit units to attend annual coordinating committee meetings, the supervisors may perform several functions. Formal performance discussions in conjunction with the coordinating committee meeting are not always appropriate, but informal conversations about performance between the unit leader and the unit supervisor are often desirable.

Dinners, luncheons, or other associated meetings or social gatherings are frequent when the unit supervisor and cooperators are present for the annual coordinating committee meeting. Supervisor visits are appropriate times for award presentations, for official praise of local cooperators, and for pointing out unique local offerings that match national priorities.

Organization and Function of a Unit

Professional Staff

All units function somewhere between the opposite ends of an organizational scale. At one end, one or more U.S. Fish and Wildlife Service (or combination of federal and state[1]) employees in an office on a university campus perform the range of tasks of any Service field station. At the other end, federal employees (unit leaders and assistant unit leaders), who conduct tasks of the unit, function as university professors. Unit biologists are integrated into the university system, respected as teachers and researchers, and acknowledged as contributing members of the graduate faculty—biologists who perform all the expected functions of state and Service researchers and function as program administrators, research supervisors, and office managers. The success of the program for these many years is largely attributable to the functioning of most units in accordance with cooperator wishes, the cooperative agreement, and the coordinating committee policies.

Unit leaders and assistant unit leaders are expected to act in the interest of the cooperator organizations. Effective unit leaders or assistant unit leaders develop programs and conduct business with constant consideration of the individual and collective interests of the cooperators.

Administrative and Support Staff

Cooperation requires positive efforts by all cooperators. Much of the success of any unit is usually attributable to university and state-agency employees who are either with the unit or closely associated. Administrative assistants, secretaries, clerks, and biologists who are hired by cooperators contribute to the productivity of a unit and to the unit program.

When research or other schedules preclude the daily presence of a Service biologist in the office, the unit administrative and support staff of the university maintains the flow of unit business. A challenge for support personnel is dealing with multiple-agency requirements. Each cooperating

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[1] In the early years of the unit program, an assistant leader was often an employee of the cooperating state agency.

organization is a bureaucracy and has its unique size, complexity, organization, goals, missions, and administrative requirements. The varied and unique personalities throughout each organization add to the complexity of a unit's operation with each cooperator. Each cooperating organization expects different services from the unit in support of its own missions.

Typical Unit

The response to a request for a description of a typical unit is always the same; *there is no typical unit—each is unique.* Each is shaped by the interface with its cooperators and the Cooperative Agreement, the services by the cooperators, the expertise and the personalities of cooperating faculty and state-agency personnel, and the personalities of the Service leadership. These interfaces and the local laws and traditions give each unit its unique character.

State Agency Support

The state-agency cooperators support units in several ways. The most visible and sometimes most valuable support is the annual cash contribution to cover basic operational expenses. In addition, states commonly contribute funds for research that is of special interest to them. Frequently, states also provide part-time employment for students who work on specific projects, housing near field sites, and vehicles or other equipment for use by student researchers or unit personnel involved in specific projects.

The nature and extent of state participation, including base contributions and research funding, vary widely. The difference reflects variation in the philosophy of the decision makers in the state agencies, the kind and amount of research expertise in the state organization, and the differences in state laws or agency regulations. The key to a productive relation between the unit and the state cooperator, however, is not based entirely on the level of monetary contribution by the state. Working relations between the unit and the state personnel may be close because of mutual interests in issues or species or groups of species, irrespective of the level of funding by the state. The willingness of state biologists to work closely with unit personnel and students is highly variable, can make a major difference in relations between the state and the unit, and can affect the productivity of the unit. The relations between the unit and the state cooperator may influence acceptance of unit students in agency jobs, or even the students' interests in agency positions in the state where the students were educated.

University Support

The university cooperator has the greatest influence on day to day unit operations and affects morale, philosophy, and support. Unit leaders and assistant leaders function as university faculty (teacher-researcher-administrator) for much of their daily activities. In general, the more productive units are well-integrated into the university system. The unit must maintain

its identity as a Service entity, but it is essential that professional personnel are accepted by the university as full-fledged members of the host department or school. Unit personnel must be qualified by education and experience for appointment to the graduate faculty of the host university so they can serve as major professors for graduate students and can guide the research and overall educational programs of those students. Unit personnel must be capable of teaching graduate courses in their area of specialization.

In various universities, units are in schools, divisions, or colleges or institutes of forestry, ecology, natural resources, life sciences, or aquaculture; or departments of biology, fisheries, wildlife, fish and wildlife, physiology and zoology, or range and wildlife. Units are commonly allied with a faculty group whose research interests are similar to those of the unit. Several units are related in some manner to agriculture experiment stations of colleges of agriculture or other university entities that facilitate handling of the cooperator financial accounts of the unit.

Unit leaders and assistant unit leaders serve the host university in all capacities expected of any university professor. Most universities extend all faculty privileges to unit employees except tenure. Tenure is not granted because the university has no salary obligation for professional unit personnel. Many universities, however, extend progressive professorial ranks to unit personnel by the same criteria used for state-employed faculty. Unit staff serve on university committees, are major professors of graduate students, serve as committee members for graduate students other than their own, have a voice in graduate curriculum development, and may serve on promotion and tenure committees.

In return, the university receives multiple benefits from the unit. The university gains additional professorial services for research and graduate students and close working relations with the state agency and federal agencies that conduct natural-resource research and have connections with other federal agencies in the same or related fields. The presence of a unit and the professional stature of unit employees often attract high-quality graduate students.

The Wildlife Management Institute

The Wildlife Management Institute, a cooperator of wildlife research units, represents the units on a national basis. Initially, the Institute provided $3,000/year to each unit. The amount was reduced to $2,000/year in 1941 and to $1,000/year during 1943-84. The reductions resulted from a fixed institute budget and increasing numbers of units. Although small, the annual $1,000 contribution from the Institute was highly valued by unit leaders. The Institute funds were used for support of the unit and could be spent at the discretion of the unit leader. In 1985, changes in its funding base forced the Institute to cease making direct financial contributions to the units.

The efforts of the Institute are frequently exercised at the national level on behalf of the Cooperative Units Program and various other programs and issues with potential for direct or indirect effects on the unit program. This function of the Institute—although less visible than annual cash donations to individual units—has been the most important benefit for the unit program from the Institute and is of greater value than any monetary contribution by the Institute for the support of the units.

Shortly after the incorporation of the American Wildlife Institute, the Institute began sponsoring on 22 July 1935 an annual meeting of biologists, administtators, politicians, and others interested in fish and wildlife conservation. The national meeting is currently referred to as the North American Wildlife and Natural Resources Conference (the North American) and is sponsored by the Wildlife Management Institute (the American Wildlife Institute became the Wildlife Management Institute).

A unit-cooperators meeting is held annually in conjunction with the North American. Until the mid-1970's, this meeting served to bring cooperator-representatives of the university, the state, and the unit personnel up-to-date on unit program happenings; to provide a forum for the expression of concerns or needs; and to promote esprit de corps among the unit personnel, the state, the university, and the federal representatives in the program. The meeting provided the only forum for orations by cooperators and unit personnel, collectively. Regulation of attendance of national meetings by the Service that began in the 1980's allowed only selected attendance by unit leaders at subsequent national meetings.

The U.S. Fish and Wildlife Service

Some of the benefits for the Service from units are similar to those derived by the state—the opportunity to become familiar with the capabilities of graduate students for potential future employment, the enhanced insight into regional resource issues, and the results of research. The greatest value beyond the work of the unit scientists, however, is the access to the faculties of nearly 40 major universities. This access has inestimable value that expands the research capability of the Service and assures the Service of access to leading researchers in every segment of natural resources. Units conduct mostly applied research but, because of their location and university affiliation, have great potential for fundamental research.

Everyone Gains

Cooperators often discuss who gains the most from their unit. The working relations among the cooperators determine the net value of the unit, and truly cooperative units provide the most gain for all cooperators. Some states use units for their regular research program and some use units for occasional consultations. Because of the tripartite support, the lower cost of supporting graduate-student research than full-time researchers, and the

ability of a unit (because of its university association) to stay at the leading edge of information discovery and development, a unit is frequently the most efficient means for the conduct of research by the Service. Evidence continually demonstrates that all cooperators receive a dollar's worth of services and products for each dollar *any one of them* invests in the unit.

Students are probably the greatest benefactors from their association with a unit. They receive an education at a major university, they usually receive a stipend, their tuition is usually waived, and they work with a potential employer.

A cooperative unit is designed to add talent to an already strong university program in fishery and wildlife biology but not to be the main component of the overall university program. Participation in the university program by Service biologists in the units is limited by law to graduate level education. One of the original criteria for positioning a unit is that the suggested host university already has a strong fisheries and wildlife undergraduate curriculum as a foundation for the graduate program. Placement of unit students in fishery, wildlife, and related professions has consistently exceeded 95% (Appendix I).

Functions of Unit Positions

All unit personnel must hold a doctoral degree. Furthermore, the Cooperative Agreement permits unit employees to teach one university graduate-level course per year in the area of their specialty. These two points make it possible for unit personnel to serve as professors with graduate-student advisement, research, and teaching responsibilities. Upon entering on duty, unit leaders and assistant unit leaders are appointed to the general faculty of the host university. Each individual presents the appropriate credentials to university committees who recommend an appropriate level of graduate faculty appointment or who recommend withholding an appointment until the desired level of achievement is reached.

Salaries of Unit Professionals

Current salaries for federal scientist positions generally are not competitive with university salaries, although the high variability between salary scales at different universities causes exceptions. Discussions with unit personnel indicate that salary level is one of the least influential factors of tenure among unit scientists but is a significant factor when recruiting new scientists for unit positions. Unit salaries were competitive with university faculty salaries through the 1970's. In an informal, nationwide survey of salaries for beginning assistant professors in 1979 (Goforth, unpublished), new assistant unit leader (GS-11, step 1) salaries exceeded the average beginning university assistant professor 12-month salary by approximately 9%. A similar survey in 1987 revealed that salaries of assistant unit leaders (GS-11, step 1) were 26% below the 12-month average salary

of a beginning assistant professor. In comparative terms, the federal salary scale for scientists at beginning level had regressed by 35% during this 8-year period. Two major factors seem responsible: Most university salaries escalated while increases in federal salaries were held well below the inflation rate as part of constraints imposed on federal salary increases during the early 1980's.

Attributes of the Unit Positions

Some universities include unit staff in all decisions, especially in research and graduate-student affairs. On the other end of the spectrum are a few universities that insist on adjunct designations of unit staff—a title that may restrict the privileges for unit staff and may curtail their participation in various activities, including curriculum planning, serving on university standing committees, and having a voice above the host-department level in university staff meetings.

The multiple-agency connections of unit personnel provide access to various sources of support and information. The opportunity to have collegial working relations with others that are motivated for research purely for discovery is stimulating and leads to the sharing of information and enthusiasm that often motivates researchers toward renewed efforts. Unit employees can live and function in the intellectually stimulating university atmosphere, usually away from metropolitan centers. This combination is not offered by most other governmental positions, not even in most research centers. In recognition of the importance of the academic atmosphere, many new federal research facilities are being located on or adjacent to institutions of higher education.

Research

The unit biologist has an opportunity to conduct, guide, and otherwise influence fundamental and applied research by the host university. The Service research organization generally focuses on support of needed applied research to solve problems in resource management. Unit research is conducted to provide an essential bridge between fundamental and applied research for management-oriented cooperators.

Unit Business

Business in a cooperative unit involves complex accounting procedures, personnel regulations, budgeting, acquisition policies, and the need to prioritize research for three distinct entities. The most complex of these is the federal component. Because the unit staff are federal employees and because federal funds are expended in unit activities, unit business must be conducted in a manner that conforms to federal regulations. Units are usually

physically removed from any other federal facility, and the unit leader must be familiar with federal procedures for conducting business.

Recruiting and Hiring Unit Leaders

Recruiting and hiring leaders and assistant leaders for cooperative research units is unique because of the cooperative nature of the unit program. The advertising for leaders is restricted to the issuance of internal vacancy announcements that recruit employees from the federal government. Unit experience, whether as a leader in another unit or as an assistant leader, is strongly preferred for leader candidates. If a candidate with unit experience cannot be found, candidates with experience in working for research centers in the Service research organization are sought. Center-research experience gives the candidate the necessary preparation for Service and broader federal research but provides no guidance for operating in the university and state administrative systems. If a candidate with suitable scientific credentials cannot be found in the Service, attempts are made to recruit experienced candidates from other federal agencies.

The recruitment of assistant leaders is different from the recruitment of leaders. Recruitment of assistant leaders is an attempt to bring new expertise into the Service by searching for newly trained scientists with expertise applicable to future research needs. Position vacancies for assistant leaders are advertised in standard internal vacancy announcements and through the Office of Personnel Management (OPM), which is a source of candidates without previous federal employment. Assistant leader positions are considered entry level and are advertised at the entry level for research scientists with recently earned Ph.D. degrees (GS-11 or 12).

Cooperator Involvement

The cooperative nature of the unit program makes the governmental hiring processes for both leader and assistant leader positions unusually awkward. The cooperators must be involved in the federal selection processes. The complications arise because no compensatory mechanism exists in the Office of Personnel Management recruitment system to account for the needs and desires of the cooperators who conduct the on-site interview portion of the recruitment process.

The Recruitment Process

The following is the process for recruitment:

1. Cooperative unit headquarters personnel in Washington D.C. (collectively referred to as the unit office by field personnel) work with the appropriate federal personnel office to identify candidates for each vacancy through the federal advertisement procedure (vacancy announcement and OPM register issuance).

2. Standards of the Service and the unit are applied to the background of applicants by cooperative unit headquarters staff to determine acceptable candidates.
3. The headquarters staff presents the credentials of candidates who are acceptable to the Service, to the university, and to state cooperators for review by local selection committees that represent the cooperators.
4. The local selection committee schedules interviews and seminars in the host state for final candidates.
5. University and state cooperators present rankings of candidates to unit headquarters.
6. The unit headquarters staff requests that the appropriate federal personnel office hire the recommended candidate.

The hiring procedure often takes 2 to 3 months after the list of candidates has been received from OPM by the unit headquarters office. The OPM requirement commonly is for selection from the register within 30 days of issuance to the Service. The OPM time frame meets requirements for filling most federal positions, but it does not allow time for cooperator involvement in the selection procedure. Requests for time extensions are normal for recruitment to units. Personnel recruitment registers sometimes must be reissued to complete the selection process.

Selection of individuals that are new to the Service for assistant unit leader positions presents some problems because of differences between the objectives and priorities of the university cooperator and of the Service for the position. Universities prefer individuals with the highest possible level of scientific expertise; the Service views the positions as appropriate for a new Ph.D. A secondary issue may be a difference in emphasis by each cooperator on hiring females or minorities for these positions.

The Service desires to hire newly graduated Ph.D.'s as assistant unit leaders. Reasons include (1) recent Ph.D.'s are trained in the most recent ecological concepts, research approaches, and techniques that are important to the agency in a time when new issues, new problems, and new techniques of inquiry are important in the ever-changing field of environmental sciences; (2) individuals with less experience can more easily adjust to a new research course that meets the agency's priorities; and (3) the budgetary constraints of the unit program favor the beginning scientist level. Hiring senior or experienced scientists, eligible for a higher salary levels, works hardships on the unit program by causing a reduction in available funds to fill more vacancies.

Universities, on the other hand, seek candidates with mature credentials to increase the stature of the university department that hosts the unit and to increase the department's grantsmanship ability by accepting someone with an established research record. Service budget constraints make the difference in cooperator objectives a real problem and often limit Service flexibility.

Application by Candidates

Individuals interested in unit positions may receive information about available openings through any of the three cooperators. A clear statement of salary limitations may not be made available to candidates because of the differing levels of information among the cooperators. Presumably, fully informed individuals would not apply if the salary level did not meet their expectations. Even the federal position announcement creates a problem for applicants not used to federal recruitment procedures. Assistant leader positions are often advertised as *slash graded* (GS 11/12 , which means to the federal establishment that the entrance is to be at the 11 level and that later promotion to the 12 level is possible or that more highly qualified individuals may be hired at the 12 level. Applicants often presume that either grade is available through negotiation, and many believe the salary can be set at any level (grade and step) of the salary range of the two grades.

The selection of new staff for a unit is the most important decision for the program. Adherence to the prescribed procedures, involvement of all cooperators, and full agreement with the selection by all cooperators are indispensable.

Flexibility is Effective

Complications occasionally arise because each cooperator has different operating styles, procedures, administrative requirements, and objectives. Differences include travel regulations, business hours, holiday schedules, bookkeeping requirements, staff performance expectations, accounting regulations, equipment acquisition procedures, inventory reporting, use-of-vehicle regulations, program reporting, and a host of others. These differences may also provide operational flexibility and efficiency to the programs of a unit. They may also provide management opportunities for program managers and unit personnel.

Areas for Program Improvement

Areas that may need attention to make the Cooperative Units Program even stronger usually relate to differences in cooperator policies or cooperator expectations. Unrealistic expectations by cooperators are a prominent concern. Constant communication is needed to make all cooperators aware of the multiple demands on unit personnel and on support services for optimal operation of units.

Multiple Demands of Cooperators

The development of the Research Work Order RWO; Appendix F process that allowed federal government entities to fund research studies at the cooperating universities increased Service demands on the units. The university and the researchers benefit from additional funding for research through the Research Work Orders. However, administrative capabilities of

a unit may be stressed. Unit leaders must guard the extent of the obligations by a unit and assure the fulfillment of contractual obligations. One of the primary tasks of the unit leader is to diplomatically and continually communicate with each cooperator to balance the efforts.

The University Cooperator

Staff Support

The level of staff support for a unit depends on the work generated. The university cooperator should be aware of a unit's volume of work and funding and should be ready to assist with additional personnel if needed. Units require a significantly higher level of support than do regular faculty members because of the complicated administrative procedures, the different requirements by each of the three primary cooperators, the increased administrative load in administering operational finances and Research Work Orders, and the amount of required outreach by an effective unit. The provision of adequate support staff by the university cooperator allows a unit to achieve an effective and efficient level of productivity.

Storage of Equipment

The availability of adequate storage facilities is under constant negotiation. Units have federal equipment, state-agency equipment, and university equipment for travel and field research. Boats, boat trailers, travel trailers, nets, large traps, all-terrain vehicles, and other vehicles require accessible and secure storage. The field orientation of most unit research reduces the requirement for expansive and expensive laboratory facilities, but creates a demand for storage. The few unit scientists who conduct primary research in a laboratory, however, do need expansive and expensive laboratory facilities.

Basic Support

Basic support by the cooperators must be stable for efficient operation. Sometimes basic support by a hosting university is neither stable nor predictable. The escape clause in the Cooperative Agreements is used rather liberally in times of financial hardship because some university cooperators give lower priority to support for units than to other responsibilities.

The Federal Cooperator

Possessiveness

Unit headquarters must keep the Service aware of the special nature of the cooperative unit program. The Service often expects unit personnel to show allegiance to the Service by being available for special tasks and responsibilities. The employees of the units are on the federal payroll, and the Service must provide central administrative support for the program and

insure that federal employees follow federal regulations. The headquarters program belongs entirely to the Service and must function in all capacities that are expected from any Service program including management of the federal program budget. The individual units, however, are cooperatives in the truest sense and, by virtue of the individual Cooperative Agreements, the influence of the Service is only equal to that of each of the other cooperators of any given unit. It is the interface between these two entities, units and headquarters, and the attempt to manage both as a single entity, that makes management of the unit program challenging (Appendix E).

The Cooperative Unit Program

Unilateral Service decisions that reflect the line authority of the Service over most research centers sometimes interferes with the responsibilities of the unit or of the unit personnel to their other cooperators. The reorganization of Service research in 1985 and subsequent reclassification of unit headquarters as a research center was for administrative convenience of managing research subdivisions with the same administrative protocols. The cooperative nature of the unit program places many administrative controls on unit activities through university and state cooperators that make it nearly impossible for units to meet the Service administrative and reporting requirements of research centers (Appendix C).

The unit program attempts to conform to the needs of the Service, but special consideration must be provided by the Service because of the nature of the cooperative program.

Federal Duties and Research Duties

The initiation of the Research Work Order process allowed the Service greater use of units for research. From some units, the Service requested numerous research projects, and most research of some units was for Service work. The shift toward the Service was a natural move toward a source of funding by researchers. A more balanced funding of research by the cooperators would alleviate imbalances created by the Research Work Order process.

The State Agency Cooperator

Opinions and use of units are most diverse by the state fish-and-wildlife-agency cooperators. Some state agencies view the unit as an integral part of the agency and expect unit employees to function much the same as state biologists. At the other extreme, some state agencies see the units as competitors for research funding. Ideally, the state agency is an active, professional, and interested partner in the unit. The presence of synergism between unit and state biologists is highly important to unit productivity and to the benefits from the unit to all cooperators.

Approaches to Program Improvement

The most productive units have cooperators with avid interests in the unit. Large attendance at the annual meeting of the coordinating committee, participation of unit personnel in cooperator programs, involvement of the Service in cooperative research, several Service organizations that fund research by the unit, and open lines of communication are signs of a productive unit. All cooperators lay claim to all unit accomplishments. The understanding and compliance with the Cooperative Agreement by all parties enable the unit to meet the needs and expectations of all cooperators and the support base continues to grow.

Service Organizational Homes for Units

The cooperative research units have been assigned several locations in the Service organizational structure. Each location had an influence on the program.

Cooperative wildlife research units were initially established to train wildlife managers and to gather biological data for wildlife managers. By the time the Cooperative Units Act of 1960 (P.L. 86-686) was considered by the Congress, natural-resource managers recognized the need for similar help for fishery managers. The biological information base was further developed in fisheries than it was in wildlife sciences when the wildlife research units were established. The proposal for the formation of cooperative fisheries units, made by the Chief, Division of Fishery Management Services, was developed by individuals who understood the need to exploit the information base in fisheries. Although research was included in the mission of fishery units, the highly visible needs were for dissemination of information and for technical assistance with complex problems. The Fisheries Management Division of each region served as individual bases for the cooperative fishery units.

Research Funding

1935-1960

From the inception of federal involvement in cooperative units through 1960—when the Cooperative Units Act gave formal federal sanction to the program—federal funding was made available for salaries of unit leaders through the annual appropriations bills that funded the Service. The Cooperative Units Act of 1960 authorized the Secretary of the Interior to enter into cooperative agreements with colleges and universities, state agencies, and with nonprofit organizations for business *relating to cooperative research units.* The act, however, limited the Department of the Interior to assigning federal personnel to units—supplying some operational equipment and paying incidental expenses of federal personnel and employees

of cooperating agencies assigned to units. Units constantly had to seek research funding from elsewhere.

1960-Present

The Unit Program Review Task Force of *1972* studied optimal funding of unit research. The task force recognized that potential research, training, and technical assistance by the units exceeded available funding. The states could not fund all research that was important to them, and the Bureau of Sport Fisheries and Wildlife had no mechanism to regularly provide research funds to units because of the restrictive provisions of the Cooperative Units Act. The task force recognized that the agency could and did contract for research projects and that universities with units could bid on these, but it also recognized the limitations of this process. Usually, the absence of direct research funding precluded full use of expertise of unit researchers by the agency. The task force recommended finding ways to increase research budgets of units.

Amendment of the Cooperative Units Act in 1978

Amendment of the Cooperative Units Act in 1978, as part of the Fish and Wildlife Improvement Act, created a direct mechanism for the use of federal funds for research by the units. The amendment added enabling language for direct funding of research by the federal government (Appendix A).

The enabling language allowed use of the Economy Act for the transfer of funds between agencies and the extension of research expertise of the units and their cooperators to the federal government at large. The purpose of the Economy Act was to circumvent the necessity for hiring duplicate expertise in multiple federal agencies. Unit research capability and structure required a mechanism for funding research that could take advantage of the cooperator expertise, yet focus on the unit leader and assistants. With the passage of the 1978 amendment, the Service only had to work out the appropriate guidance mechanism to allow federal funding of research by the units.

The Research Work Order

The guidance for putting provisions of the 1978 amendment into practice was developed by the Division of Cooperative Units with the assistance of Service contracting personnel. The mechanism is known as the Cooperative Unit Research Work Order (RWO) Process (Appendix F). A RWO document is developed to define explicitly a part of the research in a unit cooperative agreement and establishes guidelines for the funding and conduct of specific research.

A RWO is an extension of the Cooperative Agreement and incorporates all of its provisions. Participation in RWO projects is limited to unit

personnel and other researchers of the formal cooperators of the unit. The application of the RWO process extends to the Service the right to expand its participation in the program of cooperative research units by funding research by unit employees and unit cooperators.

The development and exercise of the RWO process significantly affected the Cooperative Unit Program. More Service attention was focused on the unit program. The RWO process provided the Service with a select corps of highly qualified researchers in the units and cooperating organizations for research of interest. The Cooperative Unit Program provides the Service the opportunity to cooperatively direct unit research and to influence

the research direction of faculties at 40 major universities to benefit the Service.

The Cooperative Agreement and Research Work Orders

Cooperative Agreements for the establishment of cooperative research units provide for the use of federal funding for research with the following language:

> The Service Agrees To:
>
> Periodically provide funds through this Cooperative Agreement to support specific research or educational projects which are of primary interest to the Cooperators. On the basis of statements of work that are mutually agreeable to all Cooperators, funds will be obligated through this agreement to the cooperating agencies to carry out the work.

Continual education of potential research sponsors about the appropriate use of RWO's is essential. Information must be provided to all federal agencies that may wish to use RWO's for accomplishing research. Newly appointed managers of Service research facilities and Service line-managers must be kept aware of the RWO process. Elements of the needed information are the limited time constraints of each fiscal year for the development and processing of RWO's by the unit headquarters staff and Contracting and General Services personnel, the need for solid commitment of funding for multi-year projects to protect student researchers, and the restriction of the RWO process to research that does not supplant the federal work force (Appendix F).

Epilogue

The formation in 1993 of the National Biological Survey from research components of seven agencies of the Department of the Interior, including the Cooperative Units Program, by the Clinton administration will change the Cooperative Units Program. In addition to the cooperative research units of the Fish and Wildlife Service, the new unit program will include entities of the National Park Service and the Bureau of Land Management. The emphasis by the new agency on biological research in natural ecosystems should make the Cooperative Unit Program a key player in the development of needed natural-resource research.

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Why Call Them Sportsmen?

Appendix A. The Cooperative Units Act as Amended. Facsimile of Act Establishing Cooperative Units

Public Law 86-686
86th Congress, S. 1781
September 2, 1960

AN ACT

74 STAT. *733*

To facilitate cooperation between the Federal Government, colleges and universities, the States, and private organizations for cooperative unit programs of research and education relating to fish and wildlife, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources, the Secretary of the Interior is authorized to continue to enter into cooperative agreements with colleges and universities, with game and fish departments of the several States, and with nonprofit organizations relating to cooperative research units: Provided, that Federal participation in the conduct of such cooperative unit programs shall be limited to the assignment of Department of the Interior scientific personnel by the Secretary to serve at the respective units, to the provision of assistance (including reasonable financial compensation) for the work of researchers on fish and *wildlife* ecology and resource management projects funded under this subsection, to supply for the use of the particular units' operations such equipment as may be available to the Secretary for such purposes, and the payment of incidental expenses of Federal personnel and employees of cooperating agencies assigned to the units.

SEC. 2. There is authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act.

Approved September 2, 1960.

[1] Includes amendments (italics) added by Fish and Wildlife Improvement Act of 1978

Appendix B. Unit Program and Cooperative Units: Two Distinct Entities.

We incorrectly refer to the CRUC (Cooperative Research Units Center) as including both the Service headquarters and the units themselves. Each unit is unique and does business according to the traditions of the university and state systems within which it operates. Headquarters personnel provide little direct supervision of individual day-to-day unit operations.

The only commonality among units is that they are all staffed with Service employees. The headquarters staff assists unit employees with reporting and helps them interpret the federal guidelines and regulations. The headquarters staff feeds results of unit research into the federal system at large.

The unit headquarters staff provides supervision and services to unit employees and gathers information needed by the federal system related to use of federal funds. There is no Unit Research Center—the unit headquarters staff oversees the budget process for the budget line-item called Unit Program. The most appropriate way to envision both entities is to envision headquarters staff as support for individual units.

The individual unit Coordinating Committee is the official mechanism for Service input to individual units. A unit supervisor from headquarters serves as the official Service representative on the Coordinating Committee. Service input is made in concert with the other cooperators during the annual meeting. Some Service actions are unilateral to the unit leaders. Where unilateral input should start and stop is unanswered and most effectively handled on an individual basis as need arises.

Appendix C. Cooperative Units Differ From the Research Center Mold.

Conceptually, and within the Service guidelines, a research center is a gathering of expertise, facilities, and equipment designed to focus on a predefined issue or set of issues. This concept is followed by the Service for the 12 research centers. This is in contrast to the 13th center, the cooperative research units.

The cooperative research units are multifaceted research entities located at 40 different and distinct universities by virtue of individual Cooperative Agreements. Units have no defined area of expertise nor are they field stations of a core research center with defined disciplines and geographical area. Each unit is a minicenter supported by a skeleton crew in Washington that provides primary services for the federal responsibilities. The broader concept of program is more applicable to the units. The title and role of center is inappropriate when applied to the unit program.

Research administration in the Service applies the same controls to unit and center employees. All must conform to Service reporting and other administrative requirements. The result is costly and sometimes overburdening to unit researchers. The differences between unit operational needs from one location to another are great, as are the differences in cooperator needs and demands on individual units. The units must respond to all cooperators. All cooperators hold them to agency requirements. This uniqueness requires a different administrative philosophy and operational regime when contrasted to research centers.

Unit employees are expected to teach graduate level courses annually. Unit leader performance standards state that unit leaders "may teach...", but no performance credit is given by the Service for this major activity, nor is any consideration given to relieve the burden of other Service requirements to compensate for this time-consuming job requirement.

The original (and current) objectives of the unit program are aimed at education through teaching, guidance of research conducted by graduate students, and technical assistance. States and universities influence the individual units far more than the Service because Service administration is more remotely located. The location at a university provides each unit with flexibility to conduct research in a university setting and that alone is responsible for the high level of productivity of the program. Care must be taken to maintain the flexibility and productivity. Service administrators must be ever vigilant to protect units from over-control by the Service. The cooperative nature of the units must be maintained to maximize their individual effectiveness.

The Research Work Order (RWO), exclusive to the unit program, adds a major dimension to unit administration that does not exist in any other government entity. The RWO provides the Service with a large measure of flexibility in working with individual units.

Some of the center management requirements that must be modified for units include

- Annual Work Plan

  The unit program uses a different format for development of the Annual Work Plan because of the high numbers of projects that are not federally funded or directed.

-Meeting attendance requests

  Restrictions on meeting attendance could preclude unit scientists from exchanging ideas and maintaining skills needed to advance Service research. Participation in scientific meetings is a professional requirement for scientists. Their employer should recognize the importance of attending and facilitate their attendance at national meetings.

- Last minute requests for information

  The wide distribution of units and the limited professional personnel at each unit makes it difficult to quickly obtain information from all units. E-Mail and FAX machines have increased administrative expectations of rapid response to inquiries. Greater lead time is preferable for the units.

-Approvals for travel on non-federal funds (ethics reporting)

  Cooperators expect, under the cooperative agreements, that unit personnel may expend funds derived from non-federal sources in support of research efforts including required travel. However, travel to controlled meetings still requires federal approval, and unit personnel must compete for available approvals. Federal employees traveling to controlled meetings using non-Service funds should not be counted in federal quotas for meeting attendance.

-EEO goals for hiring Unit employees

  Federal employees of units work closely with local cooperators to locate and promote qualified minorities for unit positions.

-Extension education requirements

  Unit headquarters staff oversees the requirements of the Service for assistance in extension education. Much of the unit efforts are related to extension (technical assistance).

-Environmental education projects

The same comments apply as for extension education. Units expend much effort in this area and the Service should take full credit for the results.

-Safety inspections, inventory inspections, animal care facilities, etc.

Duplicate inspection and reporting requirements occur because the same federal regulations affect both federal and state entities. Host universities and the Service should work to coordinate efforts in these areas.

-Units compete for their research funding

While Service research centers are funded with federal monies, units raise funds for most of their research projects. Unit personnel must compete for research funding with other university researchers.

-Unit supervisors have 20 or more units to supervise

True supervision cannot be provided to 20 unit leaders in 20 different states by one supervisor located in Washington D.C. Unit supervisors serve as coordinators to provide guidance on Service issues and work to help units meet cooperator needs. Experience at a unit is highly desirable for a unit supervisor.

-Regular meetings of unit personnel

An annual meeting of headquarters staff, unit personnel, and selected others should be planned and executed. Currently, the cost, logistics, and travel restrictions related to maximum costs for any meeting prevent the unit personnel from coming together for discussion of problems, opportunities, coordination, training, and other opportunities experienced by other Service entities.

-Uniqueness of the program

Recognition of the units as a distinct entity rather than the 13th research center would facilitate administration of the program. Cooperators are a major part of the program, share the responsibilities and rewards, and should be recognized in program administration by the Service. The Coordinating Committees should be given more responsibility and latitude in directing the individual units.

Appendix D. Topical Agenda for Coordinating Committee Meetings.

Introductions of participants

Participants include the official Coordinating Committee members, several interested state fish and wildlife biologists, several university professors, several graduate students, one or more representatives of the U.S. Fish and Wildlife Service region in which the unit is located, the unit leader, and assistant unit leaders.

Reading of the minutes from previous meeting (with call for corrections)

Overview of unit activities for the past year including

Research projects completed (may be made by student researchers, unit personnel, or other investigators).

On-going research (may be made by student researchers, unit personnel, or other investigators).

Significant presentations made during the year by students or unit personnel.

Courses taught by unit personnel.

Extension, adult education, and technical assistance activities accomplished during the year by students or unit personnel.

Discussion of any or all of these topics.

Information about students graduating in the near future.

Budget'

Overview of past year's budget exercise.

Budget for the year ahead.

Outstanding budget needs.

Equipment'

Inventory of major items and statement of condition.

Statement of needs (commonly emphasis is on vehicles).

Cooperator expressions of priority information needs (research and technical assistance)

Each cooperator makes a presentation outlining their needs.

Open discussion about research needs and unit direction.

Planned research projects for the coming year (new starts). Approval or rejection of individual project proposals by Coordinating Committee members.

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* Unit leaders should send budget statements, program direction statements, agenda, and equipment inventories to cooperators prior to the meeting date.

At-large comments about any facet of the unit program.

Adjournment.

Executive Session (if needed)

Held when sensitive items need to be dealt with by the official Coordinating Committee without public exposure.

Appendix E. Prototype of a Cooperative Agreement.

Cooperative Agreement No. _____

AGREEMENT FOR ESTABLISHMENT AND OPERATION

of the

_____ COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

by the

FISH AND WILDLIFE SERVICE, U.S. DEPARTMENT OF THE INTERIOR

and the

_____UNIVERSITY

and the

_____DEPARTMENT

and the

WILDLIFE MANAGEMENT INSTITUTE

This agreement, effective on the date signed by all parties, is entered into by the Cooperators: the United States Fish and Wildlife Service, hereinafter referred to as the "Service", [redacted]niversity, hereinafter referred to as the "University", the [redacted]epartment, hereinafter referred to as the "Department" and the Wildlife Management Institute, hereinafter referred to as the "Institute".

I. Authorization

The Service is authorized under Public Law 95-616 (92 Stat. 3110) November 8, 1978, to enter into cooperative agreements with colleges and universities and State fish and wildlife departments relating to Cooperative Fish and Wildlife Research Units for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources.

The University is authorized by the laws of the State of [redacted] to enter into agreements or contracts with the Federal Government or agencies thereof, as well as into agreements or contracts with agencies of other governments, and other colleges or universities, where such agreements or contracts, in the judgment of the trustees, will promote the objectives of the University.

The Department is authorized by the laws of the State of [redacted] to enter into agreements and investigate questions relating to fish and wildlife, to initiate and conduct inquiries pertaining to such questions, and to conduct such biological research that in its opinion will conserve, improve, and enhance the status of the fish and wildlife resources in the State of _____

The Institute is authorized by its charter to enter into cooperative agreements for the support of research at the Cooperative Research units.

II. Purpose

The Cooperators enter into this agreement to provide for active cooperation in the advancement, organization, and conduct of fish and wildlife research, graduate education, in-Service training, technical assistance, public relations, and demonstration programs as outlined in the following sections.

Objectives

1. To conduct research into the ecology of fish and wildlife resources and to investigate the production, utilization, management, protection, and restoration of such resources. This re-

search will be relevant to the needs of the State, the geographical region and the Nation.

2. To provide technical and professional training on the graduate and professional levels, in the fields of fishery and wildlife management, administration and research.

3. To make available to resource managers, land owners, other researchers, and other interested public, such facts, methods, literature, and new findings discovered through research.

4. To disseminate research findings through the publication of reports, bulletins, circulars, films, and journal and magazine articles. These may include scientific, technical, semi-popular and popular media at all levels.

IV. The Service Agrees To

1. Designate up to three full-time employees of the Service to staff the Cooperative Unit. One of these employees shall serve as Unit Leader, one shall serve as Assistant Unit Leader for Fishery Science, and one shall serve as Assistant Unit Leader for Wildlife Science. Other Service employees may be appointed to carry out specific education or research assignments. Such appointments shall be made with the concurrence of the University and the Department. All Service employees shall meet the qualifications for graduate faculty status within the University, including the possession of an earned doctorate degree, unless otherwise agreed upon by the Cooperators.

2. Provide sufficient funds for the salaries of Service personnel assigned to the Unit, and to pay incidental expenses of these personnel. These funds shall be expended in accordance with Federal laws and regulations.

3. Make available such services, and facilities, including equipment, buildings, and land under control of the Service, as may be mutually agreed upon.

4. Cooperate in the planning and development of research, education, in-Service training, and the preparation of publications and demonstration programs.

5. Permit the Service scientific personnel assigned to the Unit to participate in teaching graduate courses and seminars in their areas of specialization. This commitment is expected to be limited to the equivalent of one formal course per year per person.

6. Call Coordinating Committee meetings for the purpose of coordinating the activities and programs of the Unit and cooperating agencies in accordance with local, regional, and national requirements.

7. Recognize as "participating cooperators" those faculty, staff, and students of the University and employees of the Department participating in an approved activity of the Unit.

8. Periodically, provide funds through this Cooperative Agreement to support specific research or educational projects which are of primary interest to the Cooperators, and which meet the terms of the 1978 amendment to the Cooperative Units Act of 1960. The principal purpose of supporting such projects through this agreement will be to stimulate practical training of students through joint research projects aimed at providing basic information on natural resource issues of common concern to all of the Cooperators. On the basis of statements of work that are mutually agreeable to all Cooperators, funds will be obligated through this agreement to the cooperating agencies to carry out the work.

V. The University Agrees To

1. Make available to the Unit at least one and one-half full-time positions for secretarial and administrative assistance; offices, laboratory and storage space; computer facilities, including appropriate terminals and main frame access as are regularly made available to other University faculty; publication channels; museum facilities; library; equipment; utilities including telephone services, both local and long distance where Federal Telecommunications Services are not available; indirect cost waivers on Service supported research as defined in V.4 and other personnel and facilities as may be mutually agreed upon for the efficient conduct of the Unit program. Monetary equivalence for services and facilities will be shown in reports of annual Cooperative Unit budgets.

2. Recognize as members of the University staff those personnel of the Service who are assigned to the Unit. These personnel shall have full faculty rights and privileges and be given professorial rank appropriate to their qualifications. Service personnel shall be given graduate faculty appointments, providing such personnel meet the standards and requirements of the University. Service personnel shall be eligible for promotion in Univer-

sity rank in accordance with normal University standards and procedures but will not be tenured or salaried by the University.

3. Recognize that graduate students who receive financial and logistic support through the Unit will be members of an appropriate graduate program and subject to all established admittance review and evaluation procedures of that program. All normal graduate support facilities of the program accrue to those individuals by virtue of their being regular members of the graduate program.

4. Make available the means for the Unit to establish accounts with the University through which operating and research expenditures may be transacted. This service will be provided by the University without overhead charges on the annual contributions from the Department Cooperator (as defined in section VI. 3). Indirect costs at a rate of 10% will be charged on all Fish and Wildlife Service supported contracts. The difference between the 10% rate and the University's regular indirect cost rate on contracts will be considered as part of the University's contribution to the Unit. Indirect costs charged on grants or contracts coming to the Unit from non-Cooperator sources will be negotiated on a case-by-case basis.

5. Cooperate in planning, developing, and executing research, education, in-Service training, publications, demonstration projects, and other programs of the Unit.

VI. The Department Agrees To

1. Make available such personnel and facilities, including equipment, buildings, and land under its control, as may be mutually agreed upon for execution of the program.

2. Cooperate in research, education, in-Service training, public relations, and demonstration on approved projects.

3. Cooperate through the Unit program in carrying forward approved research projects on fishery and wildlife resources. For furtherance of Unit operations, the Department agrees to provide annually, through a University account, a minimum of $40,000 to be used for operational expenses of the Unit and/or for research projects as mutually agreed to by the Cooperators. This amount will be supplemented by additional funds or in-kind contributions of services or facilities for specific research projects as mutually agreed upon. The Department will periodically reexamine the amount of its annual contribution and

may make such adjustment as deemed appropriate after consideration of current economic conditions and revenues available.

VII. The Institute Agrees To

Contribute toward the activities of the Unit, on the basis of requests for individual research projects, in-Service training programs and related activities.

VIII. It is Mutually Agreed That

1. The Unit shall be administered by the cooperating agencies through a Coordinating Committee, consisting of a designated representative of the Service, University, and the Department. The committee shall meet annually or as mutually agreed. At its meeting the committee will

   a. Review and modify, as necessary, the Statement of Direction for the Unit. The Statement of Direction is a declaration of the research and teaching areas mutually agreed upon as needing primary emphasis and attention in the Unit.

   b. Examine, and approve or modify, the annual budget, which shall include new funds each year and any gift or unexpended funds of the previous year not reverting to the contributing agencies. It shall review annual statements of financial expenditures and balances, and other financial reports or information needed for evaluating the Unit's research program. These budget statements and reports will be prepared by the Unit Leader and provided to each member of the committee in advance of the annual meeting.

   c. Examine, and approve or modify, the Unit plan of activities, including proposed starts for all new projects.

   d. Integrate, insofar as practicable, the research and training programs of the Unit with the research and training programs of the agencies cooperating in the Unit, and with the general land and water use programs of the State and the Service.

   e. Exchange information so that the cooperating agencies will be informed of the plans, programs, progress, needs, and probable future trends and patterns of development of the research and training programs of the Unit.

   f. Open the General Session of the Coordinating Committee meeting to any parties having a vested interest in the activities of the Unit. A closed Executive Session, attended

only by the official Coordinating Committee members, may be held following the General Session, upon request of any of the cooperating entities, for the purpose of dealing with sensitive issues that should not be made part of the public forum.

2. The participation of the Federal Government in this project is not intended to place it in a position of incurring liability for any claims that might arise as a result of Unit activities. Each party hereto shall have complete responsibility for acts of and injury to, or injury and damage caused by its own personnel and its own property occurring incidental to the conduct of the projects permitted hereunder.

3. Participation of the Institute in this project shall not place it in a position of incurring liability for any claim by anyone that might arise as a result of Unit activity at which the Institute is not present.

4. All equipment purchased by or for the Unit shall be the property of the contributing agency in the event of dissolution of the Unit. An equipment inventory indicating ownership, costs, and condition of each item under the auspices of the Unit shall be maintained by the Unit Leader and made available annually to the Cooperators.

5. The obligations of the Service are contingent upon the appropriations of Congress; of the University and the Department upon appropriations by the State Legislature; and of the Institute on contributed funds. No cooperative funds shall be spent except in furtherance of the program of the Unit as approved by the cooperating agencies through the Coordinating Committee. Proposals for research to be undertaken by the Unit shall conform to the project protocol of the University and/or granting agencies.

6. The acquisition of special funds (contracts, grants, gifts, bequest funds, etc.) is encouraged and their use is also subject to Coordinating Committee approval.

IX. Publications

1. The principal investigator designated for the conduct of a specific project supported by the Unit shall have primary responsibility for the quality of work being submitted for publication, as well as for adherence to the publications guidelines of the cooperating agency supporting the project. The Unit

Leader shall be given the opportunity to review, prior to publication, all publications arising from work sponsored or coordinated by the Unit. Time for such reviews will be limited to 30 days. Publication restrictions that may be incorporated into grant or contract research will be observed. The Unit Leader will clear the manuscript through the cooperating agencies as appropriate.

2. Publication may be independent or joint as agreed upon, always giving credit for cooperation of the Unit and of contributing agencies where appropriate, yet recognizing within proper limits the rights of the individual doing the work.

3. In case of failure to agree as to the manner of publication or interpretation of results, each party may publish data after due notice and submission of the proposed manuscripts to the other parties. In such instances, the party publishing the data will give credit to the cooperators, but will assume full responsibility for any statements on which there is difference of opinion.

X. Officials Not To Benefit

As provided in applicable federal and state statutes, no person prohibited from doing so shall be admitted to any share or part of this agreement or to any benefit that may arise therefrom.

XI. Nondiscrimination in Employment

In connection with the performance of work under this agreement, the cooperators agree not to discriminate against any employee or applicant for employment because of sex, race, religion, color, or national origin. This provision shall include, but not be limited to, the following: employment, promotion, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

Certification Regarding Drug-Free Workplace Requirements

By signing this Cooperative Agreement the signatory certifies that it will provide a drug-free workplace by

1. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Cooperator's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

2. Establishing a drug-free awareness program to inform employees about
   a. The dangers of drug use in the workplace
   b. The Cooperator's policy of maintaining a drug-free workplace
   c. Any available drug counseling, rehabilitation, and employee assistance programs
   d. The penalties that may be imposed upon employees for drug use violation occurring in the workplace;
3. Making it a requirement that each employee to be engaged in performance of work under this Cooperative Agreement be given a copy of the statement required by paragraph 1 ;
4. Notifying the employee in the statement required by paragraph 1 that, as a condition of support under this Cooperative Agreement, the employee will
   a. Abide by the terms of the statement; and
   b. Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than 5 days after such conviction;
5. Notifying the Fish and Wildlife Service within ten days after receiving notice under subparagraph 4 b from an employee otherwise receiving actual notice of such conviction;
6. Taking one of the following actions, within 30 days of receiving notice under subparagraph 4 b , with respect to any employee who is convicted
   a. Taking appropriate personnel action against such an employee, up to and including termination; or
   b. Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;
7. Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs 1 , 2 , 3 , 4 , 5 , and 6 .

XIII. Effective Date And Termination

This agreement shall become effective on the date of last signature and shall continue in force until terminated through mutual agreement following a written notice to the other cooperators 90 days in

advance. It is the intention of the cooperators to review and update this agreement in 10 years.

Approvals

_____

Wildlife Management Institute Date

_____

XXXXXX University Date

_____

XXXXX Department Date

_____

Fish and Wildlife Service Date
U.S. Department of the Interior

The Kidnapping—Or More and More Democracy

Appendix F. Research Work Orders: Authorization and Process.

Research Work Orders
The Mechanism for Obligating Federal Funds for Research Projects at Cooperative Fish and Wildlife Research Units

Research Work Orders (RWO) are extensions of the Cooperative Agreements that establish units. The RWO process was developed to provide the mechanism to implement the Cooperative Units Act Amendment of 1978 which reads ... "to the provision of assistance (including reasonable financial compensation) for the work of researchers on fish and wildlife ecology and resource management projects funded under this section." This amendment allows the Fish and Wildlife Service (FWS) to pay for research projects being conducted by Cooperative Fish and Wildlife Research Units through obligation of funds to the cooperating university. Funds for specific research projects are supplied to the cooperating university through a standard format document that specifies how and for what those funds may be spent. RWO's provide a mechanism to reach the expertise of all unit cooperator staff, and thus provide access to expertise not otherwise available within the FWS. RWO's provide funds to cooperating universities to be used for research of the unit employees and for other cooperator university professors. Once funds are obligated to the university they can be spent throughout the specified life of the project, in future fiscal years as well as the fiscal year in which the funding obligation is made. This allows for realistic support of natural resource research that almost always requires multi-year research efforts. The RWO is a simplified statement of what research is to be done, by whom, at what cost, and within what time frame. Because the FWS has special Congressional authority to provide research funding as extensions of unit Cooperative Agreements, sole source statements and justifications are not required for these awards. Other federal agencies can provide funds to the FWS for research projects to be conducted at Cooperative Research Units by utilizing the Economy Act, 31 U. S. C. 686, that was passed to allow federal agencies to use the expertise of sister agencies by transfer of funds through reimbursable agreements, eliminating the need for federal agencies to hire duplicate expertise.

In executing RWO's, the university is responsible for the fiscal accounting, workforce hiring, purchasing, reimbursement for travel expenses, and in general facilitating the accomplishment of the research. Universities provide a waiver of part or all of the indirect costs as their contribution to the cooperative effort.

RWO projects must be designed to stimulate practical training and information development through research projects aimed at natural resource issues of concern to unit cooperators. The projects must involve research and should involve educational activities (most often graduate students, including postgraduates); must be of interest to the cooperators; and should include the involvement of the cooperators. Involvement can include staff time, technical assistance and advice, facilities, and indirect cost waivers. RWO's must not be used for augmenting staff at FWS installations (i.e., secretaries for field stations, laboratory technicians at research centers, etc).

The FWS Cooperative Research Unit RWO process is unique and must be carefully protected from misuse. It is the responsibility of unit program personnel to see that both the development of RWO's and their execution are performed in a professional manner with regard to research and education quality, timeliness, and adherence to the goals of the financing sponsor. Guidelines that are used to evaluate the appropriateness of any given RWO include

1. A unit leader or assistant unit leader must serve as project officer, principle investigator, or liaison officer (see following definitions), and is responsible for ensuring that the terms of the RWO are met. Quality, completeness, and timeliness are all important.
2. The project must be important to cooperating agencies. Broadly interpreted, this means that research, training in the application of research results, and other activities that relate to gathering or interpreting information of concern to cooperators are legitimate endeavors to be pursued through RWO's.
3. The project may involve university or state fish and wildlife agency cooperators. Physiologists, geneticists, or other scientists from elsewhere on campus or biologists of the state fish and wildlife agency might collaborate on a wildlife or fisheries problem.
4. Research and educational benefits are to be derived from involvement in RWO projects. This may include research experience for graduate and post-graduate students. It may also include technicians, professionals on temporary assignments, and permanent university professors.
5. The RWO's must not be used to supplement the FWS work force or to avoid prescribed federal work force limitations.
6. The RWO's may not be used for hiring outside consultants. Consultations by cooperator staff are considered part of the unit research process.

7. A RWO should be written to address a complete project. The budget should indicate all funding necessary to complete the task.

RWOs must have a designated project officer (PO) and a designated principal investigator (PI) and may have a liaison officer (LO). The PO may be an administrator or scientist of a sponsoring FWS research center or operational office, a supervisor in the cooperative unit headquarters or a unit leader or assistant unit leader. The PO must always be a FWS employee and may not be a subordinate of the PI. The PO ensures that the government gets a timely and quality product, is responsible for approving products generated from the RWO, monitors work progress, and certifies that reimbursement vouchers submitted by the university are appropriate for payment by the FWS. When a non-unit headquarters entity sponsors a project through a RWO, an employee of the sponsoring entity will usually be the PO.

When a RWO is funded by a reimbursable agreement from another federal agency, the PO may be the unit leader when the PI is not a unit staff member. When the PI is a unit staff member, the PO will be a supervisor in the unit headquarters. When the PO is someone other than a unit staff member (i.e. a unit supervisor or a sponsoring entity Service staff member), then it is appropriate to have a LO on site for project monitoring. The LO may be the unit leader or assistant unit leader and serves to provide requested information to the PO to further the POs understanding of the work in progress. The PI actually conducts the research or directly manages those who are conducting the research and is responsible for the timeliness and quality of the research being performed, the progress reports, completion reports, or publications as specified in the RWO.

Appendix G. Service Administrators From the Units.

Several individuals have gone from serving in cooperative research units to become administrators at Fish and Wildlife Service (or Bureau of Sport Fisheries and Wildlife) research centers and laboratories. Others have moved to positions in the central administration.

Thomas S. Baskett	Chief Division of Wildlife Research
Henry E. Booke	Scientific Director, Northeast Anadromous Fish Research Laboratory
James P. Clugston	Director, Gainesville Fisheries Research Laboratory
Eugene H. Dustman	Director, Patuxent Wildlife Research Center
Alfred C. Fox	Director, National Fisheries Research Center—Seattle
W. Reid Goforth	Assistant Director, Northern Prairie Wildlife Research Center Director, Northern Prairie Wildlife Research Center Supervisor, Cooperative Research Units
Gerald A. Grau	Assistant Director, Northern Prairie Wildlife Research Center Assistant Director, National Wetlands Research Center
Richard J. Graham	Supervisor, Cooperative Wildlife Research Units Assistant Director, National Fisheries Contaminant Research Center—Columbia
Richard W. Gregory	Chief Office of Information Transfer
Bernard L. Griswold	Supervisor, Cooperative Fishery Research Units Director, National Fisheries Research Center—Great Lakes

Jack R. Gross	Branch Chief Western Energy and Land Use Team
F. Eugene Hester	Chief Division of Fishery Research Associate Director, Research Deputy Director
Daniel L Leedy	Head, Cooperative Wildlife Research Units
Charles M. Loveless	Assistant Director, Denver Wildlife Research Center Assistant Director, Research Regional Director, Region 6 Director, Denver Wildlife Research Center
James A. McCann	Chief Division of Population Ecology Research Director, National Fisheries Research Center—Gainesville
John D. McIntyre	Assistant Director, National Fisheries Research Center—Seattle
A. William Palmisano	Director, Alaska Fish and Wildlife Research Center
Garland B. Pardue	Scientific Director, National Fisheries Research and Development Laboratory
H. Randolph Perry, Jr.	Chief Branch of Endangered Species Research, Patuxent Wildlife Research Center
Thomas G. Scott	Director, Denver Wildlife Research Center
William K. Seitz	Assistant Director, Alaska Fish and Wildlife Research Center
Raymond C. Simon	Director, Fish Genetics Laboratory
Robert L Smith	Chief Migratory Bird and Habitat Research Laboratory Chief Branch of Surveys, Office of Migratory Bird Management
Rollin D. Sparrowe	Chief Division of Cooperative Research Chief Office of Cooperative Research Units Chief Division of Wildlife Research Chief Office of Migratory Bird Management Deputy Assistant Director for Wildlife Resources

Paul F. Springer	*Assistant Director,* Northern Prairie Wildlife Research Center
Clair B. Stalnaker	*Chief* Aquatic Branch, National Ecology Research Center
Robert E. Stevens	*Chief* Division of Fisheries Research *Chief* Office of Research Support
Robert G. Streeter	*Head,* Cooperative Wildlife Research Units *Chief* Office of Information Transfer *Deputy Director,* North American Waterfowl Management Plan *Director,* North American Waterfowl Management Plan
Jon G. Stanley	*Supervisor,* Cooperative Research Units *Director,* National Fisheries Research Center—Great Lakes
Stephen H. Taub	*Head,* Cooperative Fishery Research Units
Paul A. Vohs, Jr.	*Supervisor,* Cooperative Wildlife Research Units *Director,* Denver Wildlife Research Center
Lee E. Yeager	*Head,* Cooperative Wildlife Research Units

Several other individuals who have served at unit headquarters also have served in other administrative positions in the U.S. Fish and Wildlife Service.

Appendix H. Unit Formation Dates and Tenure of Employees.

Unit Name (year established) (university)
o Leaders, tenure (specialty)
Assistant Leaders, tenure (specialty)

Alabama Wildlife (1935) (Alabama Poly. Inst. now Auburn U.)
- Harold S. Peters, 35-37
- Allen M. Pearson, 37-49
- Arnold 0. Haugen, 49-57
- Maurice F. Baker, 58-67
- Dan W. Speake, 67-84

Frank W. Fitch, Jr.,* 49–55
Dan W. Speake,* 55-67
Edward P. Hill, 67-80

Alabama Fishery (1966) (Auburn U.)
- John S. Ramsey, 67-84

James M. Barkuloo, 69-70
William L. Shelton, 71-82

Alabama Combined (1984) (Auburn U.)
- Nicholas R. Holler, 85—date (wildlife)

Dan W. Speake, 84—date (wildlife)
John S. Ramsey, 84-86 (fisheries)
Mark B. Bain, 86-91 (fisheries)

Alaska Wildlife (1950) (U. of Alaska Fairbanks)
e Neil W. Hosley, 50-51
- John L. Buckley, 51-58

e Robert F. Scott, 58-61
o James S. Lindsey (acting), 61
- Frederick C. Dean (acting), 62

o David R. Klein, 62-91

Peter C. Lent, 68-76
Philip S. Gipson, 76-84

Alaska Fisheries (1978) (U. of Alaska Fairbanks)
- James B. Reynolds, 78-91
  Jacqueline D. LaPerriere, 80-91
  Stephen L. Tack,* 78-81
  Robert H. Armstrong,* 81-84

Alaska Combined (1991) (U. of Alaska Fairbanks)
- James B. Reynolds, 91-date (fisheries)
  Jacqueline D. LaPerriere, 91-date (fisheries)
  Dave R. Klein, 91-date (Senior Scientist)
  Daniel Roby, 92-date (wildlife)

Arizona Wildlife (1950) (U. of Arizona)
- Lyle K. Sowls, 50-62, and 63-86
- Charles R. Hungerford,* (acting) 62-63
  Norman S. Smith, 68-87

Arizona Fish (1964) (U. of Arizona)
- William J. McConnell, 64-71
- Jerry C. Tash, 71-86
  Charles D. Ziebell, 66-86

Arizona Combined (1986) (U. of Arizona)
- O. Eugene Maughan, 87-date (fisheries)
  Norman S. Smith, 87-92 (wildlife)
  Charles D. Ziebell, 86-89 (fisheries)
  Carol C. McIvor, 93-date (fisheries)

Arkansas Fish and Wildlife (1988) (U. of Arkansas Fayettville)
- James Johnson 88-date (fisheries)
  Cynthia A. Annett, 89-92 (fisheries)
  Thomas E. Martin, 89-93 (wildlife)

California Fish (1967) (Humboldt State U.)
- Roger A. Barnhart, 67-date
  C. Fred Bryan, 67-71
  Thomas J. Hassler, 72-date

Colorado Wildlife (1947) (Colorado State U.)

- Lee E. Yeager, 47-63
- Charles M. Loveless, (acting) 63
- Vincent H. Reid, (acting) 63–64
- Fred A. Glover, 64-71
- Jack R. Gross, (acting) 71-74
- Kenneth R. Russell, 74-80
- William K. Seitz, (acting) 80-81
- Fred S. Samson, 81-84

Charles M. Loveless, 61-62
Jack R. Gross, 67-71
Robert G. Streeter, 71
William W. Mautz, 75-76
William K. Seitz, 76-80,81-83

Colorado Fish (1964) (Colorado State U.)

- Robert E. Vincent, 64-71
- William J. McConnell, 71-82
- Eric P. Bergersen, (acting) 82-84

George Post, 64–66
Robert J. Behnke, 66-74
Eric P. Bergerson, 74-82

Colorado Combined (1984) (Colorado State U.)

- David R. Anderson, 84-date (wildlife)

Fred B. Samson, 84-85 (wildlife)
Eric P. Bergerson, 84-date (fisheries)
Kenneth P. Burnham, 88-date (wildlife)

Connecticut Wildlife (1935) (U. of Connecticut) (closed in 1937)

- Paul D. Dalke, 35–37

Florida Fish and Wildlife (1979) (U. of Florida)

- Richard W. Gregory, 79-85 (fisheries)
- Wiley M. Kitchens, 85-date (fisheries)

H. Franklin Percival, 81-date (wildlife)
Carol C. McIvor, 88-93 (fisheries)

Georgia Fish (1962) (U. of Georgia)

- Roger A. Barnhart, 64–66
- Melvin T. Huish, (acting) 66-68
- Alfred C. Fox, 68-75
- James P. Clugston, (acting) 75
- Robert E. Reinhert, 75-79
- Ronnie J. Gilbert, (acting) 79-81
- Michael J. Van Den Avyle, 81-84

Melvin T. Huish, 63–66
James P. Clugston, 68-75
Ronnie J. Gilbert, 78-79,81-84

Georgia Wildlife (1979) (U. of Georgia)

- James C. Lewis, 82-84

Georgia Combined (1984) (U. of Georgia)

- Michael J. Van Den Avyle, 84-date (fisheries)

Vickie S. Blazer, 84-92 (fisheries)
Michael J. Conroy, 86–date (wildlife)

Hawaii Fish (1966) (U. of Hawaii)

- John A. Maciolek, 66–77
- James D. Parrish, 77-date

Leighton R. Taylor, Jr., 72-75

Idaho Wildlife (1947) (U. of Idaho)

- Paul D. Dalke, 47-67
- Maurice G. Hornocker, 68-88

Elwood G. Bizeau, 67-89

Idaho Fish (1963) (U. of Idaho)

- Donald W. Chapman, 64–73
- Theodore C. Bjornn, 73-85

Robert N. Thompson, 64–66
Theodore C. Bjornn, 66–73
Robert G. White, 74-80
James L. Congleton, 80-85

Idaho Combined (1985) (U. of Idaho)

- James Michael Scott, 86-date (wildlife)
- Theodore C. Bjornn, (acting) 85 (fisheries)

Theodore C. Bjornn, 86-date (fisheries)

James L. Congleton, 85-date (fisheries)

Iowa Wildlife (1935) (Iowa State U.) (Iowa started a state supported unit in 1932) (Paul L Errington* led this unit, 32-35)

- Logan J. Bennett, 35-38
- Thomas G. Scott, 38-42,45-48
- Carl J. Drake,* (acting) 42-45
- Edward J. Kozicky, 48-56
- Arnold 0. Haugen, 57-73
- Robert B. Dahlgren, 73-85

Erwin E. Klaas, 75-85

Iowa Fish (1965) (Iowa State U.) (Iowa started a state supported unit in 1941) (Reeve Bailer led this unit from 41-47 and Kenneth D. Carlander* led it from 47-65)

- Robert J. Muncy, 65-79
- Wayne A. Hubert, (acting) 78
- John G. Nickum, 79-85

Ross V. Bulkley, 67-78
Wayne A. Hubert, 79-82

Iowa Combined (1985) (Iowa State U.)

- Robert B. Dahlgren, 85-87 (wildlife)
- Paul A. Vohs, Jr., 87-92 (wildlife)
- Erwin E. Klaas, 92-date (wildlife)

Erwin E. Klaas, 85-92 (wildlife)
John S. Ramsey, 86-90 (fisheries)
Clay Pierce, 93-date (fisheries)

Kansas Fish and Wildlife (1991) (Kansas State U.)

- Timothy C. Modde, 91-92 (fisheries)
- Philip S. Gipson, 93-date (wildlife)

Christopher S. Guy, 93-date (fisheries)
Jack F. Cully, Jr., 93-date (wildlife)

Louisiana Wildlife (1962) (Louisiana State U.)

- John D. Newsom, 62-81
- Phillip J. Zwank, (acting) 81-85

Robert H. Chabreck, 67-72
A. William Palmisano, Jr., 72-74
H. Randolph Perry, Jr., 75-79
Phillip J. Zwank, 80-81

Louisiana Fish (1963) (Louisiana State U.)

- William H. Herke, (acting) 63–64, 67, 71
- R. O'Neil Smitherman, 64–67
- Jerry C. Tash, 67-71
- C. Fred Bryan, 71-85

William H. Herke, 63-85

Louisiana Combined (1985) (Louisiana State U.)

- C. Fred Bryan, 85-date (fisheries)

William H. Herke, 85-94 (fisheries)
Alan D. Afton, 88-date (wildlife)
Richard M. Pace III, 89-date (wildlife)

Maine Wildlife (1935) (U. of Maine)

- Clarence M. Aldous, 35-40
- John Pearce, 40-42
- Howard L. Mendall, 42-78
- James A. Sherburne. 78-83
- John A. Bissonette, (acting) 83-85

Gustav A. Swanson,* 36-37
Howard L. Mendall,* 37-42
Charles Brown, 42-44
Jay S. Gashwiler,* 44-48
Malcolm W. Coulter,* 48-68
Voit B. Richens, 68-79
John A. Bissonette, 81-83

Maine Fish (1962) (U. of Maine)

- Richard W. Hatch, 62-77
- Jon G. Stanley, 77-83
- John R. Moring, (acting) 83-85

Paul A. Haefner, Jr., 63-69
Richard W. Gregory, 69-74
Jon G. Stanley, 75-77
John R. Moring, 79-83

Maine Combined (1985) (U. of Maine)

- William B. Krohn, 85-date (wildlife)

John R. Moring, 85-date (fisheries)
Dennis B. Griffith, 88-90

Maryland Fish and Wildlife 1992 **(U. of Maryland-Eastern Shore)**

Steven Hughes, 94—date fisheries

Massachusetts Wildlife 1948 **(U. of Massachusetts)**

- William G. Sheldon, 48-72
- Wendell E. Dodge, 72-88
- Rebecca Field, 88-90

Joseph S. Larson, 67-69
Wendell E. Dodge, 70-72
James J. Kennelly, 73-79
Douglas S. Miller, 81

Massachusetts Fish 1963 **(U. of Massachusetts)**

- James A. McCann, 63-72
- Roger J. Reed, 72-79
- Boyd E. Kynard, acting 79-80
- Henry E. Booke, 80-88

Roger J. Reed, 63-72
James D. Parrish, 75-77
Boyd E. Kynard, 78-79,80-89

Massachusetts Combined 1990 **(U. of Massachusetts)**

- Rebecca Field, 90—date wildlife

Jay B. Hestbeck, 89—date wildlife
Martha E. Mather, 91—date fisheries

Minnesota Fish and Wildlife 1987 **(U. of Minnesota)**

- Mary G. Henry, 88—date fisheries

David R. Andersen, 89—date wildlife
Bruce C. Vondracek, 91—date fisheries

Mississippi Fish and Wildlife 1978 **(Mississippi State U.)**

- Robert J. Muncy, 79-89 fisheries
- Edward P. Hill, acting 89,90-92 wildlife
- L. Esteban Miranda, acting 92-93 fisheries
- Harold L. Schramm, Jr., 93—date fisheries

Edward P. Hill, 80-89 wildlife
L. Esteban Miranda, 86-92 fisheries

Missouri Wildlife (1937) (U. of Missouri)

- Paul D. Dalke, 37-47
- Rudolf Bennitt,* (acting) 47-48
- Thomas S. Baskett, 48-68,73-84
- W. Reid Goforth, (acting) 68,69-73
- Rollin D. Sparrowe, (acting) 73

W. Reid Goforth, 68-69
Rollin D. Sparrowe, 69-76
Fred S. Samson, 76-81

Missouri Fish (1962) (U. of Missouri)

- David I. Foster, (acting) 63
- Richard O. Anderson, 63-84
- Charles F. Rabeni, (acting) 84,85—date

David I. Foster, 63-66
Daniel W. Cobel, 67-71
James P. Reynolds, 72-78
Charles F. Rabeni, 79-84

Missouri Combined (1985) (U. of Missouri)

o Charles F. Rabeni, 85—date (fisheries)

Ronald D. Drobney, 86—date (wildlife)
David L. Galat, 88–date (fisheries)

Montana Wildlife (1950) (Montana State U.)

- E.L. Cheatum, 50-52
- Philip L. Wright,* (acting) 52
- Melvis S. Morris,* (acting) 52
- John J. Craighead, 52-77
- Bart W. O'Gara, 78-92
- Joe I. Ball, 93—date

Bart W. O'Gara, 68-78
Joe I. Ball, 79-93
Thomas E. Martin, 93—date

Montana Fish (1963) (Montana State U.)

- Richard J. Graham, 63-73
- Richard W. Gregory, 74-79

o William R. Gould, (acting) 79-80

- Robert G. White, 80—date

William R. Gould, 63—date

New Mexico Fish and Wildlife (1988) (New Mexico State U.)

e Phillip J. Zwank, 89-date (wildlife)
Bruce C. Thompson, 89-date (wildlife)

New York Wildlife (1961) (Cornell U.)

• Daniel Q. Thompson, 61-75
• Milo E. Richmond, (acting) 75-77,77-84
Milo E. Richmond, 68-75
Richard A. Malecki, 78-84

New York Fish (1963) (Cornell U.)

• Alfred W. Eipper, 63-75
• John G. Nickum, (acting) 75-76,77-80
• Steven P. Gloss, 80-84
Henry A. Regier, 64–66
Clarence A. Carlson, Jr., 66-72
John G. Nickum, 73-75
Steven P. Gloss, 78-80

New York Combined (1984) (Cornell U.)

• Milo E. Richmond, 84-date (wildlife)
Richard A. Malecki, 84-date (wildlife)
Steven P. Gloss, 84-87 (fisheries)
Mark B. Bain, 91-date (fisheries)

North Carolina Fish (1963) (North Carolina State U.)

• F. Eugene Hester, 63-71
• Melvin T. Huish, 72-88
Robert E. Stevens, 66-70
Garland B. Pardue, 71-74
J. Howard Kerby, 75-88

North Carolina Fish and Wildlife (1988) (North Carolina State U.)

• W. James Fleming, 88-date (wildlife)
Jaime Collazo, 88-date (wildlife)
Melvin T. Huish, 88-89 (fisheries)
Joseph E. Hightower, 91-date (fisheries)

Ohio Wildlife 1936 **(Ohio State U.)**

- Lawrence E. Hicks, 36-45
- Laurence H. Snyder,* (acting) 45
- Daniel L. Leedy, 45-49
- Charles A. Dambach,* (acting) 49
- Eugene Dustman, 49-59
- Tony J. Peterle, 59-63, (acting) 64
- Theodore A. Bookhout, 64-86

Charles P. Stone, 66-70
Richard D. Curnow, 71-74
Gerald A. Grau, 74-78
Jonathan R. Bart, 79-86

Ohio Fish 1965 **(Ohio State U.)**

- Gerald J. Lauer, 66-67
- Richard A. Tubb, 67-74
- Bernard L. Griswold, 76-79
- Robert F. Carline, 79-84
- F. Joseph Margraf, (acting) 84-87

Stephen H. Taub, 66-72
Bernard L. Griswold, 73-76
Robert F. Carline, 76-79
F. Joseph Margraf, 80-84

Ohio Combined 1986 **(Ohio State U.)**

- Theodore A. Bookhout, 86—date (wildlife)

Jonathan R. Bart, 86—date (wildlife)
Bruce C. Vondracek, 88-91 (fisheries)
Susan Earnst, 92—date (wildlife)

Oklahoma Wildlife 1948 **(Oklahoma State U.)**

- Walter P. Taylor, 48-51
- Adolph M. Stebler, 51-67
- John A. Morrison, 67-75
- Paul A. Vohs, Jr., 76-79
- Frank Schitoskey, Jr., 80-83
- O. Eugene Maughan, (acting) 83-87

Fred M. Baumgartner,* 48-65
George A. Moore,* 53-65 (fisheries)

Robert I Smith,* 65-67
James C. Lewis, 67-77
John A. Bissonette, 77-81

Oklahoma Fish (1965) (Oklahoma State U.)

- Robert C. Summerfelt, 66-76
- O. Eugene Maughan, 77-84

Bradford E. Brown, 65-70
Austin K. Andrews, 70-75
Michael D. Clady, 76-81

Oklahoma Combined (1984) (Oklahoma State U.)

- O. Eugene Maughan, 84-87 (fisheries)
- Philip Zwank, 87-89 (wildlife)
- David (Chip) M. Leslie, Jr., 89—date (wildlife)

David (Chip) M. Leslie, Jr., 85-89 (wildlife)
Alexander V. Zale, 85-94 (fisheries)
William L. Fisher, 91—date (fisheries)

Oregon Wildlife (1935) (Oregon State U.) (deactivated in 1959) (reactivated in 1971)

- Arthur S. Einarsen, 35-59
- Howard M. Wight, 71-75
- E. Charles Meslow, (acting) 75,76-94
- Robert G. Anthony, (acting) 94—date

E. Charles Meslow, 71-75
Robert G. Anthony, 77-94

Oregon Fish (1966) (Oregon State U.)

- Raymond C. Simon, 66-73
- John D. McIntyre, 73-77
- Carl B. Schreck, (acting) 77,78—date

Richard S. Wydoski, 69-70
John D. McIntyre, 70-72
Carl B. Schreck, 75-77
Hiram W. Li, 78—date

Pennsylvania Wildlife 1938 **(Pennsylvania State U.)**

- Logan J. Bennett, 38-43,45-47
- Pennoyer F. English,* (acting) 43-45
- Ward M. Sharp, 48-62
- James S. Lindzey, 62-80
- e Gerald L. Storm, (acting) 80-82

Pennoyer F. English,* 38-58
H. Norton Cope,* 58-59
John L. George, 63-69
Charles T. Cushwa, 69-71
Gerald L. Storm, 72-80

Pennsylvania Fish 1964 **(Pennsylvania State U.)**

- Robert L. Butler, 63-80
- Dean E. Arnold, (acting) 80-82

Anthony Bodola, 64-67
Donald C. Hales, 67-69
Robert F. Raleigh, 70-72
Dean E. Arnold, 73-80

Pennsylvania Combined 1982 **(Pennsylvania State U.)**

- e Gerald L. Storm/Dean. E. Arnold (acting Co-leaders) 82-84
- o Robert F. Carline, 84-date (fisheries)

Gerald L. Storm, 84-date (wildlife)
Dean E. Arnold, 84-date (fisheries)

South Carolina Fish and Wildlife 1988 **(Clemson U.)**

- o Robert E. Trost, 88-90
- David L. Otis, 91-date

Susan M. Haig, 89-94
John J. Isley, 92-date

South Dakota Wildlife 1963 **(South Dakota State U.)**

- Paul F. Springer, 63-67
- Raymond L. Linder 67-84

Robert B. Dahlgren, 67-73
Frank Schitoskey, Jr., 74-80
W. Alan Wentz, 80-81

South Dakota Fish (1965) (South Dakota State U.)

- Alfred C. Fox, 65-68
- Richard L. Applegate, (acting) 68-70
- Donald C. Hales, 70-77
- Richard L. Applegate, 77-83

Richard A. Tubb, 66-67
Richard L. Applegate, 67-77
Robert S. Benda, 78-81

South Dakota Combined (1984) (South Dakota State U.)

- Raymond L. Linder, 84-85 (wildlife)

o Charles R. Berry, Jr., 85—date (fisheries)

Kenneth F. Higgins, 85—date (wildlife)
Walter G. Duffy, 88—date (fisheries)

Tennessee Fish (1972) (Tennessee Tech. U.)

o R. Don Estes, 72—date

C. Phillip Goodyear, 74-75
John N. Rinne, 76
Michael J. Van Den Avyle, 77-81
James B. Layzer, 85—date

Texas Wildlife (1935) (Texas A & M U.) (deactivated in 1954)

- Walter P, Taylor, 35-48

o W. B. Davis, (acting) 48
o George A. Petrides, 48-50

Texas Fish and Wildlife (Texas Tech. U.) (1988)

e Nicholas C. Parker, 88—date (fisheries)

Reynaldo Patino, 89—date (fisheries)
Nancy E. Mathews, 90—date (wildlife)

Utah Wildlife (1935) (Utah State U.)

- Daniel I. Rasmussen, 35-45
- Jessop B. Low, 45-74
- J. Juan Spillett, (acting) 74-75
- David R. Anderson, 75-84

J. Juan Spillett, 67-76
Frederick G. Lindzey, 77-84

Utah Fish (1962) (Utah State U.)

- Donald R. Franklin, 62-66
- * Robert H. Kramer, 66-74
- * Richard S. Wydoski, 74-77
- * Charles R. Berry, Jr., (acting) 77-78
- Ross V. Bulkley, 78-85

Robert H. Kramer, 65-66
Clair B. Stalnaker, 66-75
Charles R. Berry, Jr., 75-77,78-85

Utah Combined (1984) (Utah State U.)

- John A. Bissonette, 85—date (wildlife)

Timothy C. Modde, 86-91 (fisheries)
Thomas C. Edwards, Jr., 88—date (wildlife)

Vermont Fish and Wildlife (1989) (U. of Vermont)

- B. Kenneth Williams, 90—date (wildlife)

Donna Parrish, 91—date (fisheries)
Mary C. Watzin, 90-94 (wildlife)

Virginia Wildlife (1935) (Virginia Polytech. and State U.)

- C. O. Handley, 35-47
- * Henry S. Mosby, (acting) 47-48,48-55
- James S. Lindzey, 55-58
- Burd S. McGinnes, 58-82
- Michael R. Vaughan, (acting) 82-85

Cecil F. DeLaBarre,* 35-49
James B. Whelan, 68-80
Michael R. Vaughan, 80-82

Virginia Fish (1965) (Virginia Polytech. and State U.)

- Kenneth B. Cummings, 66-71
- Robert F. Raleigh, 72-75
- * Garland B. Pardue, 76-83
- Richard J. Neves, (acting) 83-84

R. Don Estes, 66-72
O. Eugene Maughan, 72-77
Richard J. Neves, 78-83

Virginia Combined (1985) (Virginia Polytech. and State U.)

- Richard J. Neves, 85—date (fisheries)

Michael R. Vaughan, 85—date (wildlife)
Paul L. Angermeier, 88—date (fisheries)

Washington Fish 1967 **(U. of Washington)**

- Richard R.Whitney, 67-83
- Gilbert B. Pauley, acting 83-87

Ed Marvich, 68-70
Richard S. Wydoski, 70-74
Gilbert B. Pauley, 74-83

Washington Fish and Wildlife 1988 **(U. of Washington)**

- Christian E. Grue, 89—date wildlife
- Gilbert B. Pauley, acting 88 fisheries

Gilbert B. Pauley, 89—date fisheries
Glenn Van Blaricom, 93—date wildlife

West Virginia Fish and Wildlife 1986 **(West Virginia U.)**

- F. Joseph Margraf, 87—date fisheries

Sue A. Perry, 87—date fisheries
Patrick W. Brown, 87-90 wildlife
Petra Bohall-Wood, 92—date wildlife

Wisconsin Wildlife 1971 **(U. of Wisconsin-Madison)**

- Robert L. Ruff,* 72-73
- Donald H. Rusch, 73—date

Wisconsin Fish 1971 **(U. of Wisconsin-Stevens Point)**

- Daniel W. Coble, 71—date

Henry E. Booke, 73-80

Wyoming Fish and Wildlife 1980 **(U. of Wyoming)**

- Stanley H. Anderson, 80—date wildlife

Wayne A. Hubert, 82—date fisheries
Frederick G. Lindzey, 84—date wildlife

'Salaried by state fish and wildlife cooperator

From the beginning, the wildlife units have been part of the National Fish and Wildlife Research Program, administered from the headquarters in Washington, D.C. Since 1973, the fishery units have also been part of this national level program. The various organizational placements of the cooperative unit program have resulted in different patterns of coordination or administration and different types of headquarters positions. The following are individuals who have had formal headquarters assignments involving administrative responsibility for the Cooperative Research Unit Program.

I. T. Bode, 35-37
Hartley H. T. Jackson, 37-39
Leo P. Couch, 39-44
Gustav A. Swanson, 44-46
Lee E. Yeager, 46-47,63-67
Logan J. Bennett, 48-49
Daniel L. Leedy, 49-57
John L. Buckley, 57-58
Eugene H. Dustman, 58-63
Willis King, 60-73
Edward Kinney, 67-73
Thomas S. Baskett, 68-73
Nicholas R. Holler, 68-73
Stephen H. Taub, 72-76
Richard J. Graham, 73-78
Robert G. Streeter, 73-76
Rollin D. Sparrowe, 76-83
Rebecca Field, 79-81
Bernard L. Griswold, 79-83
Paul A. Vohs, Jr., 80-83
W. Reid Goforth, 83—date
Carol A. Lemm, 83-86
John G. Rogers, Jr., 83-86
Jon G. Stanley, 83-85
Terry T. Terrell, 86-88
Edward T. LaRoe, 87-93
Bettina Sparrowe, 88-90
Denise Wilson, 88-90
Mark Shaffer, 88-91
Connie Walker 90—date
Gwen Williams, 91-93
Lynn Haines, 91—date

Other individuals have served the cooperative units headquarters in important temporary assignments, and an array of much appreciated individuals has served the headquarters in capacities both as permanent and temporary support staff.

Appendix I. Employment of Unit Students.

Most units have accurate records of the students who have been granted graduate degrees as advisees of unit personnel. A few units lack complete records of student placement. The following is summarized from the best information available.

As of June 1992, units reported that 4,631 students had successfully completed graduate degrees as advisees of unit biologists. This figure is derived from the most conservative definition of unit students. Many others have completed degrees in conjunction with unit projects or with projects supported through units using cooperating university faculty as advisors.

The best data available on placement (first professional position) after completion of their graduate degree are presented below. Information about placement was unavailable for two units; the numbers of graduates from these units were added to the employment categories based on the overall ratio for student employment as reported by the other units. A few units were uncertain about the total number of students receiving graduate degrees. Where unit records were incomplete, the information used was conservative.

Unit graduates have held responsible positions in practically every conservation organization in the United States and in many foreign countries. The influence of this cadre of individuals is impossible to describe accurately, but without question they have had more influence on fish and wildlife resource management than any other group of people in the world.

Table. Employment of unit graduates by category of employment for first professional position held.

Federal	State fish and wildlife agency	University (includes work toward second degree before first job)	Other (secondary teaching and unknowns)
1,204	1,806	741	880

Appendb0. Turning Points in the Unit Program.

Following the initial formation of the units in 1935, four major turning points markedly changed the program course. In chronological order, the events were:

1. The 1960 Cooperative Unit Act provided a legal basis for the program and provided for the formation of fishery units,
2. The 1973, Service reorganization brought the fishery units together with the wildlife research units under the same National Cooperative Research Unit Program,
3. The 1978 amendment to the 1960 Cooperative Unit Act (Fish and Wildlife Improvement Act of 1978) resulted in the Research Work Order process, and
4. The Cooperative Research Unit Program was deleted from the administration budgets for the Service as presented to the Congress in 1982, 1983, and 1984.

The 1960 Act

Prior to 1960, the unit program was a loose collection of U.S. Fish and Wildlife Service wildlife research biologists called unit leaders and stationed at several universities. Some unit leaders reached out to university researchers and stimulated additional wildlife and, on occasion, fishery research.

Each unit was an ad hoc field station of the U.S. Fish and Wildlife Service working under a cooperative agreement signed by the Service, a state conservation agency, and a university to support research and education efforts. The Service supplied one biologist per unit; the state agency provided minimal funding, loan of field equipment, and other in-kind services; and the university supplied space, office help, and other university services. Some state agencies depended totally on units for their research and development activities. Others developed research capability within their own ranks at the same time the unit was getting established, and the two worked in tandem to meet the research needs of the state agency.

All cooperators recognized the value of the unit in training wildlife biologists, and all supported the process. An example of the value of a unit occurred in Missouri where the first official item of business for the newly formed Missouri Conservation Commission, in its first meeting on 2 July 1937, was to authorize participation in a cooperative wildlife research unit at the University of Missouri.

The units began in 1935, but the activity continued under administrative sanction without benefit of organic legislation. Units were not identified as a line item in the budget and were subject to closure by the Service. Each year, the request for funding for units went to the Congress as part of the Service research budget. The budget received annual scrutiny and approvals through the appropriations process in the same manner as any other portion of the Service activities. The units were dependent on annual decision cycles within the research sub-organization of the Service.

In 1960, the 86th Congress passed Public Law 86-686

> To facilitate cooperation between the Federal Government, colleges and universities, the States, and private organizations for cooperative unit programs of research and education relating to fish and wildlife, and for other purposes.

This act provided statutory authority for the cooperative unit program. A line item was created in the Service budget for the unit program. Specific authority was provided for payment of federal-employee salaries and minimal federal operational expenses (but nothing more), and for the formation of cooperative fishery units in addition to cooperative wildlife research units. The Service decided that the newly forming fishery units would be administered in the regional office structure and not as part of the Service research organization. The Service viewed the major responsibility of cooperative fishery units to be the extension of information within the regions where located. Fishery units were responsible to a regional director, and research was not used in the unit's tide. Fishery unit employees did not have to be appointed to a graduate faculty, and the Ph.D. degree was not a requirement. Some Service employees assigned to the fishery units did not have doctoral degrees.

The Service also decided to staff fishery units with a unit leader and an assistant unit leader. The Division of Wildlife Research immediately requested approval to place assistant leaders in the wildlife research units, and permission was eventually granted.

Results of the 1960 Cooperative Units Act were that two units came to exist at universities where only wildlife research units had previously existed and each of the two units was authorized two employees. Thus the Unit Program (actually two different programs now operating side by side and reporting as separate entities to separate divisions within the Service) went quickly from having a single Service employee stationed at participating universities to four Service employees at those same universities.

These changes heightened interest in units at several universities—each university could gain as many as four staff members by providing only secretarial services, office space, and other in-kind services. In addition, there were some universities that wanted a fishery unit that had never had a wildlife

unit (Montana, 1963; Hawaii, 1966; and California, 1967). In Wisconsin, the fishery unit was formed the same year as the wildlife unit (1971) but at a different university. At three universities (Maine, 1962; Alabama, 1966; Alaska, 1978), fishery units were co-located at the same university with a wildlife research unit but in different department or college of the university. The establishment of fishery units by a separate Service entity was later to cause serious problems related to reorganization of the unit program.

Fishery units differed among themselves based on the backgrounds of unit personnel and desires of the various regional administrations. Some units accomplished research projects, and some individuals taught university courses and served as major professors to graduate students following the pattern established by the wildlife research units.

The results of the variation were mixed. Some fishery unit staff did high quality research and published regularly in peer-reviewed publications while others mostly did extension work, acted as field assistants to research projects, and wrote reports for the files but no articles for publication. More similarities than differences were present, however, in the operational modes of the two sets of units. The 1960 act had increased both the numbers of units and of personnel.

The 1973 Reorganization

A task force was appointed by the Service director in 1972 to examine the operational mode of both sets of units and to make recommendations for the future. The director and others obviously questioned why the two sets of units were being operated from different levels and from different perspectives when they were functioning in a similar mode. The task force representatives were evenly divided among employees from fishery units and wildlife units. No changes in organizational structure were recommended forthrightly by the task force.

The task force report to the director, however, provided the following statement about making the collective administration of the units more effective:

> The consensus of the committee (task force) is that both the fish and wildlife unit programs could be enhanced by placing them within a consolidated Division of Cooperative Units under one of the assistant directors. The opinion of the committee is that this basic structuring would result in a more uniform program with increased communication and coordination for the total Unit Program as well as with all other Divisions and programs of the Bureau.*

At that time, the U.S. Fish and Wildlife Service was the Bureau of Sport Fisheries and Wildlife.

Initially, the directorate was unwilling to establish an additional division within research to accommodate a collective units program. Just 1 year later, however, the fishery units were moved from their regional administrative affiliations and the wildlife research units were moved from their location in the Wildlife Research Division into the new Division of Cooperative Research. The reorganization resulted in immediate administration of the total program at the national level of administration and institutionalized research as a main thrust for both sets of units. It provided fishery unit personnel with additional insight to Service research needs and necessitated some expansion of staff support for the units in the headquarters.

Perhaps the most profound, yet subtle, effect was on the few employees of the fishery research units who did not hold the Ph.D. degree. Suddenly these individuals were thrust into research positions without having a research degree and without qualifications for graduate faculty status. The latter was mandatory for serving as the major professor for graduate students and for serving on graduate student examining committees. Several means were used to allow adjustment to the changed status. Some of the individuals were admitted to graduate faculty status based on the their recognized stature in the scientific community or on evaluation by a committee of their superior records of research productivity. Others were allowed to continue their own educational pursuits and to earn the Ph.D. degree from the university where stationed. Some were reassigned within the Service to posts that could best take advantage of their expertise in either extension or management. A few continued on with little change in their duties but were unable to become involved in graduate student educational programs. The last assistant unit leader for fisheries whose highest earned degree was a Masters degree retired in 1989.

The Fish and *Wildlife* Improvement Act

The amendment to the 1960 Cooperative Unit Act, through the Fish and Wildlife Improvement Act, that led to the Research Work Order (RWO) process was passed in 1978. The 1978 amendment reads:

> to the provision of assistance (including reasonable financial compensation) for the work of researchers on fish and wildlife ecology and resource management projects funded under this subsection....

The 1978 amendment brought major changes in many areas of cooperative units program operations. An unpredicted change was the increase in supervisory influence of the Service on the activities of the units. A new level of Service concern and involvement meant that a more highly developed organization was needed to meet the increased activities and

involvement at the Washington level. New activities required negotiation of project funding and development of funding mechanisms and working relations with Contracting and General Services to handle the newly created RWO process. The unit program needed assistance on the legal requirements for handling the increased federal funds flowing to the units.

New headquarters control mechanisms were placed on unit activities. Reporting requirements ballooned, financial tracking controls were developed, and accountability documents became more important. The units had entered the mainline in meeting Service needs for research information. As greater control, funding, and involvement in unit activities came from Washington, the state influence on some units lessened. In part, this was because some unit leaders turned more attention toward the more lucrative Federal sources of funding for their research programs. Most unit leaders, however, worked toward finding ways to meet State cooperator desires through portions of projects funded by RWOs while also meeting needs of the federal research sponsor. While activities of the unit leaders increased, little if any change in support or influence was felt by the States—either conceptually or monetarily.

Deletion of the Units From the Executive Branch Budget Submission

The Cooperative Unit Program and its accompanying request for funding were deleted from the administration's budget submitted to the Congress in 1982. As part of the programs of the newly-elected administration of President Reagan to "get the federal government off the backs of the states and allow the states to run their own affairs," the unit program was cut from the Service budget. Funding for the unit program was completely removed from the administration's budget presented to Congress for fiscal 1982. The administration, thinking the unit program was a grants program to states, was unaware that there were federal research biologists stationed at the cooperative research units.

When the decision was made to cease funding the Cooperative Unit Program, there was quick reaction from the state agency and university cooperators. This voice, raised to state congressional delegations, and that of the Wildlife Management Institute and other conservation organizations, caused the Congress to restore funding for the units in the FY 1982 budget. This same scenario was repeated in fiscal years 1983 and 1984.

Trauma Related to Removal From the Budget

Traumatic things happened to the unit program during these years. Unit employees and their families felt as if they were living on a day-to-day

basis. Unit employees began to question their career choices. Some left the program in disgust, from the feeling that they were not appreciated, or to reduce the trauma on families of not knowing whether their jobs with the units were secure. Approximately one-third of the unit positions were vacant at the end of the 3 years of being excluded from the administration's budget. Because the program was not part of the president's budget, filling of vacancies was not allowed.

Service Response

Following the lead of the Interior Department to support the Reagan Administration, the Service director, on 23 February 1983, sent a letter to all unit cooperators indicating that even if the Congress appropriated funds for the unit program in fiscal 1984, the Service intended to terminate the unit program and remove all federal employees. The appropriated funds would then be passed to cooperators via a new type of cooperative agreement so states could continue their own programs. Key phrases from that letter were, ...our position is that the units have served their purpose, and we have not provided for them in the *1984* budget. ...it is our intention to terminate the existing program by September *30, 1983.* The Service directorate was unwilling to fight the new administration for the unit program.

Ironically, the instability occurred at the time the Research Work Order process was being developed. The Service was not yet aware of the potential for increased value of the units that would be related to this change in funding authority. One additional complicating factor was the emergence of the Gramm-Rudman-Hollings Balanced Budget Bill that instituted mandatory budgetary constraints for all phases of the federal budget at the time when the Service was ordered by the Congress to restore funding for the unit program to the Service budget request. It was FY 1985 before the units were restored to the president's budget request to the Congress.

Consequences of the Budget Wars

The budget wars brought some dire consequences to the units. In each of the 3 years that the Congress restored the unit program budget in its appropriation for the Service, funding was provided at the level of the previous year. There were no provisions for inflation or for the salary increases earned by unit employees during those years. After level-funding for 3 consecutive years, the unit budget had shrunk markedly when compared to real dollar values and program needs. By FY 1985, the funding for the unit program was 35% less than would have been expected had it been continually included in the president's budget request.

The funding level in FY 1985 was barely adequate to cover the salaries of the remaining scientists—yet the units were 40% understaffed. There was no money to fill the vacancies and to maintain the commitment of the Service as expressed in the cooperative agreements.

Reinstatement

Cooperator, private organization, and congressional efforts finally convinced the administration that the unit program was a highly-integrated cooperative program that could not be replaced by grant funding. Federal austerity programs dictated that the newly reinstated unit program present a plan to reduce the overall program costs. The idea of combined-discipline units had recently surfaced—the concept was presented to meet the requirement and was accepted. A Service decision to combine existing units, where both fishery and wildlife units existed in the same state, became the operational mode. The new units were named Cooperative Fish and Wildlife Research Units.

The combination units were planned to have a federal staff of a unit leader (administrator/researcher), and two assistant leaders, (one fisheries biologist and one wildlife biologist). The discipline specialty of the leader would tip the balance of the research effort of the unit in the direction the local cooperators wished it to go. The resulting 3-person units would provide a 25% decrease in personnel for the unit program, theoretically accompanied by a 25% reduction in cost.

Because 90% of the appropriated budget for the program is used for salaries, the 25% decrease in number of unit personnel was expected to reduce budgetary need by almost the same percentage. However, the 40% reduction in staffing during the budget war exceeded the planned 25% savings and the program was in the red. The current budget level was insufficient to hire additional staff to bring the program to the new full-staffing level (now 75% of the original staff).

Mandated Program Expansion

At this writing, the program has undergone expansion from congressional mandates to form several new units. The addition of several new units over the recent past seems a direct result of increased visibility of the unit program in the Congress because of the effort to reduce the Program in the early 1980's. The efforts of cooperators to work with their congressional delegations to maintain the program significantly raised the congressional level of awareness of the program. Several states succeeded in having units authorized for their state through appropriations committee language. As a

result, new units were formed in West Virginia (1986); Minnesota (1987); Arkansas, New Mexico, South Carolina, and Texas (1988); Vermont (1989); and Kansas (1991).

In addition, units in North Carolina and Washington, originally single discipline fishery units, were expanded to combined unit status via congressional action. Two of the new units were added by the Congress without additional funding. These two units added six new positions to fund from an already deficient budget. The program operation continued by maintaining six additional vacancies. This resulted in the program falling further and further behind in its ability to meet its cooperative commitments.

Even though the program received one budget increase from the Congress that was designed to fill personnel vacancies in the original program, the overall funding level (as of FY 1993 required 15% of the agreed-upon positions to remain vacant. Several other states are now seeking new units.

Appendix K. Unit Research Highlights.

The research accomplished at units by unit employees and by closely cooperating university faculty is diverse. An important strength of the unit program has been its capability to do basic research in association with the university research community. Equally important is the ability of units to accomplish short term, applied research. The nature of traditional graduate student studies—one to four field seasons and a thesis to satisfy the appropriate degree requirements—lends itself to short-term and applied research. The combination of basic and applied research is important to cooperators and to resource subjects, either because of an information breakthrough that provides factors needed to advance a particular discipline or concept, or because an answer is found to a particularly elusive problem that opens the door for better resource management.

Even the most concise summary of the massive volume of unit research efforts is beyond the scope of this book. Descriptions of some major current efforts and some significant work from earlier times are presented as examples of important research thrusts of the units.

Topics highlighted here were selected from those submitted by personnel serving in units at the time of this writing. These are presented to provide a glimpse of the scope and importance of research conducted in association with units.

Fisheries Research

Arctic Grayling Ecology and Management

Grayling are ecologically and economically important throughout interior and arctic Alaska and much of Canada. A series of studies was conducted to augment the valuable body of knowledge on grayling life history collected by the Alaska Department of Fish and Game during the 1950-70's. Overfishing was identified as a problem for graylings in the Chena River. Methods were developed to assess satisfaction and expectations of anglers fishing this complex. Other contributions included a description of the lengthy and complicated grayling migration patterns, of the critical nature of Alaska water clarity standards, of differences in life histories for western Alaska populations and interior populations, and of the critical nature of timing in the spawning runs.

Research findings on mining impacts and grayling allowed state standards for water clarity to remain in effect. The migration component

was important in making recommendations concerning oilfield development. The Alaska Department of Transportation approved new culvert designs to minimize delays to spawning migrations. Results of grayling behavior studies were important in developing enhancement plans for the Chena River.

Steelhead and Chinook Salmon Biology

Researchers defined the interrelations and importance of the half-pounder steelhead to adult steelhead runs of Klamath-Trinity River basin. As a result, the California Department of Fish and Game and the Oregon Department of Fish and Wildlife adopted angling regulations designed to protect the half-pounder from over-exploitation. Both agencies now require the protection of intermittent streams during logging operations and other land use activities. Intermittent streams were important as spawning and short-time nursery habitat for steelhead. Estuaries, even very small ones, were found to be important as rearing areas for steelhead.

Three different life history patterns were discovered for the freshwater phase of Klamath-Trinity River chinook salmon. The importance of coastal lagoons as rearing areas for juvenile chinook was documented. Data on chinook salmon biology in the Klamath-Trinity River system were used by the U.S. Forest Service to designate wild spring chinook salmon as a "sensitive" species. Findings about the role of coastal lagoons and small estuaries in salmon life cycles are being applied by salmon support groups in timing their fish releases to achieve optimum survival and by the Bureau of Land Management in habitat enhancement of estuaries.

Fishery Operations Planning System

Several studies focused on the development of a Fisheries Operations Planning System (FOPS). Development of this system was prompted by an expressed need by managers in the west for a system that provided a planned approach to fish management consistent with growing angler demands and the ability of the resource to provide recreational fishing. A 5-year research effort produced an operations plan for management of cold water lakes. The data base included about 3,000 lakes scattered throughout five state management regions. These studies had immediate benefits to ongoing management programs and problems as well as providing for the foundations of FOPS.

Researchers and managers, in consultation, developed a second-generation version of FOPS called STEAD (System To Evaluate Angler Days). With this process has come a change in the way fisheries are managed in some western states, resulting in a more holistic approach to management and one that can be defended when questions are raised by critics and lawmakers.

Limnology of Streams on High Tropical Islands

Unit researchers conducted the first series of rigorous limnological investigations of streams in Hawaii. The effort included physical inventory, survey, and classification of streams; assessment of the status of modifications; inventory of fishes and other macrofauna; studies of life histories of individual species; and overall assessment of ecological quality and management needs of streams.

Studies have focused on life history characteristics of some of the (few) freshwater fishes and large mollusks and crustaceans of the Pacific islands. First estimates were made of the distribution and habitat requirements in Hawaii for several of these aquatic species. These studies demonstrated the effects of human activities (particularly channelization and dewatering) on little-known species in tropical streams. The results concerning amphidromy, distribution, habitat use and requirements, and environmental

tolerances have indicated the vulnerabilities of the native fauna and suggested the necessary steps to be taken in habitat management (especially protection of natural habitat) in order to preserve native populations.

Nearshore Marine Fishery Resource Ecology

Researchers have identified nearshore marine fish community resources of Pacific islands and have described the interactions with the habitats upon which they depend. Emphasis was on structure of fish communities, including relative abundance of species and especially trophic structure, life history and biology of some key resource species, and effects of small-scale fisheries. Studies have improved the understanding of the composition and structure of shallow-water marine fish communities. The trophic structure of complete nearshore demersal fish communities in such natural condition was described and quantified for the first time. This result provided a basis for understanding energy flow at high levels in these ecosystems, for estimating predation pressure on prey groups, and for recognizing the trophic base required to support these fish populations in the tropics.

Anadromous Fish

Intensive studies on the life history and habitat needs of chinook, coho, and sockeye salmon and of steelhead in the upper Columbia River Basin and Alaska contributed to understanding the population dynamics of wild stocks, effects of sedimentation, migration problems encountered by smolts and adults, and factors involved in improving the quality of hatchery fish. Current efforts include studies of how to control bacterial kidney disease, to improve passage of adults migrating past dams, to determine the parameters to use for assessing the quality of hatchery fish to best supplement wild stocks, and to assist the endangered species reviews for Snake River stocks.

Studies related to restoration of Atlantic salmon initially focused on early life history stages, then on territoriality and behavior of juveniles in streams and movements of downstream-migrating smolts and, most recently, the upstream passage of adult salmon. Studies of intragravel stages of salmon provided some of the first data on survival of eggs and alevins of wild salmon. The information was used in models developed by the U.S. Fish and Wildlife Service for predicting restoration probabilities for Atlantic salmon in New England. Data from studies of salmon fry survival were used by state biologists in adjusting fry stocking densities. Study results on salmon smolt survival and behavior led to recommendations on the timing of stocking and to the discovery that significant numbers of smolts were non-migratory.

Extensive research was conducted into problems associated with restoration programs for anadromous fish populations in the Connecticut River. Studies on the effect of low-head hydropower turbines on anadromous fish recruitment were conducted to provide management guidance on effects of turbine operations and flow regimes of the Connecticut River.

Fish Health

A long-term research emphasis focused on bacterial kidney disease (BKD) and infectious hematopoietic necrosis (IHN)—the two diseases of greatest concern for artificial production of chinook salmon and steelhead in the Pacific Northwest. Studies investigated the transmission of IHN virus, the use of chemotherapeutics to treat BKD, and the importance of nonspecific host defenses against both pathogens.

Wild Trout Management

In cooperation with state fish and wildlife departments, special angling regulations were designed and tested for restoration of wild trout populations. Regulation modifications recommended from this study resulted in a several-fold increase of wild trout, and the regulations (mostly catch and release) were accepted by anglers as the best way to maintain healthy trout populations in many of the rivers in western states.

Large-Impoundment Recreational Fisheries Management

Findings that larger young-of-the-year largemouth bass survived better overwinter, and that smaller bass were lost to predation rather than to starvation, resulted in increased awareness of the need for habitat management. Identification of factors to enhance recruitment of young largemouth bass prompted increased protection for large adults. Studies showed that larger adults spawn earlier, resulting in populations of young that have a size advantage over those produced by smaller, later-spawning adults.

New methods were developed for sampling and assessing crappie populations. Results provided increased opportunities for the state to manage crappie fisheries. Unit-developed computer programs are considered essential to standardized fishery assessment programs of several state agencies.

Pond Fisheries

Studies on management of sportfishes in reservoirs and ponds were prominent in early fisheries research efforts. Pioneering studies laid the groundwork for acceptance of minimum- and slot-length limits for large-

mouth bass to reduce overharvest and to maintain quality fishing throughout the Midwest. This research led to development of "indices" of Proportional Stock Density (PSD), and Relative Weight (Wr), that gave fisheries managers a simple, rapid method of stock assessment.

A major effort was in the examination of the ecological basis of fish production and management of Ozark streams. This research affected several areas of fisheries management including providing sound data for use in accomplishing stream restoration and for instituting unique harvest regulations for smallmouth and rock bass.

Trout Habitat

Research by unit personnel in the 1960's was among the first to show how stream habitat modifications influenced trout populations. A 1966 study on stream morphology and trout populations in relation to floodplain use documented that stream-side livestock grazing resulted in deleterious changes in channel morphology, particularly width and depth, with accompanying decreases in trout size and abundance. Other studies examined physical habitat needs of trout and related these to changes associated with channelization and reduced stream flow. A study conducted to examine the potential problems caused by angler wading found the effect to be directly related to wading frequency and stage of trout embryo development. Twice-daily wading throughout development resulted in deaths of eggs and pre-emergent fry as great as 96%, whereas a single wading just before hatching resulted in mortality as high as 43%. This was the first time detrimental effects of angler wading had been demonstrated. Results received nation-wide attention.

Fish Hybridization Studies

Investigations into phylogenetic relations between major groups of fishes have yielded new concepts about their genetic relationships and about which species might more readily hybridize. Artificial-hybridization studies provided basic information for understanding growth of bluegill and channel catfish. Studies focused on growth and survival of various crosses in several culture systems. Research was directed toward genetic manipulation of hybrid striped bass in efforts to improve their growth and production. The most promising work was in triploid production. Results clearly demonstrate that high-value, marketable triploid fish can be produced in 14 to 18 months and that they are desired by commercial markets.

Fisheries Resources

Recent ecological and physiological research was conducted on landlocked, but reproductive, populations of the normally anadromous striped bass. These efforts helped state fish and wildlife authorities to better understand and to better manage these populations.

Stress Management to Enhance Fish Survival

This research program was dedicated to determining how environmental conditions and management practices affected the capacity of fish to perform necessary life functions by learning how fishes respond physiologically to stressful situations. This information was used to modify or alter management strategies or practices to enhance the overall fitness of the fish.

Stress response seems adaptive for the immediate threat but maladaptive for all other functions. Stress response leads to impaired ability of fish to resist diseases by suppressing their immune system. Stress also affects behavior, impairs learning, and retards development.

Crowded anadromous fish populations have depressed development that retards optimal timing of seaward migration. The information is used to optimize rearing density and flow requirements for anadromous salmonids in hatcheries.

Application of the stress theory allowed identification of stressful aspects of fish handling, transportation, and collection procedures. The loading and unloading of transported fish are the bottlenecks to fish health and performance. Techniques were developed to alleviate some recognized problems. The response of salmonids to stressful situations has a genetic basis, and different stocks may have different physiological responses to the same stressor.

Brown Trout Ecology and Management

The distribution and density of juvenile and adult brown trout are largely determined by availability of adequate spawning sites. Other habitat features seem relatively unimportant. Regulatory agencies now more closely scrutinize proposed construction activities in stream corridors to ensure adequate spawning sites.

Discharges from wastewater treatment plants altered the thermal regime of streams for several miles downstream of plant outfalls and contributed to prolonged periods of fish stock stress during summer. Temperatures limits for discharges are now imposed in permit standards.

Recreational Research

Aerial survey techniques developed by the unit for determining recreational use by anglers on the Missouri River are used extensively by the South Dakota Department of Game Fish and Parks. Studies linking wetland drainage with stream flooding problems caused a cessation of activities under PL 566.

Sauger Recruitment

Recent studies of sauger revealed the annual exploitation rate in some reservoirs to be at least three times higher (> 25%) than previously reported. The information was used by the Tennessee Wildlife Resources Agency to justify size limits for sauger, the first time for such regulations in Tennessee.

Trout Habitat Requirements

Unit research led the way in investigations of the winter habitat needs of rainbow and cutthroat trout in the tailwaters of Flaming Gorge Dam. When the Bureau of Reclamation was scheduled to upgrade the turbines of the dam, unit studies evaluated the effects of increased and variable flows on both the native and sport-fish species. Following the termination of research studies, unit employees served on the technical advisory group that was formed to recommend discharge rates beneficial to trout.

Effects of Angling on Warmwater Fish Populations

Studies have documented significant effects of angling on fish populations, including bluegills thought to be hardly affected by angling. Angling pressures influence fish populations. These data contributed to many recent changes in fish management strategies.

Lake Whitefish

A decade-long study of lake whitefish in northern Lake Michigan, the most important commercial fish in the upper Great Lakes, produced data useful in population dynamics models. Application of output from the models has greatly influenced management of lake whitefish by both Wisconsin and Michigan resource agencies.

Sediment Effects on Trout Production in Mountain Streams

Field sampling techniques and statistical procedures were developed for both research and monitoring on effects of sediment on spawning. Both laboratory and field studies were used to develop predictive models that

relate the amount of sediment in spawning gravels to the survival-to-emergence of young trout. The models were incorporated into a manual for monitoring and assessing the effects of sediment to be used by fish and wildlife agencies and the U.S. Forest Service.

Wildlife Research

Big Game Population Evaluation

Modification and development of line-transect sampling methods to estimate numbers of pronghorns from fixed-wing aircraft were recommended following study. Line-transect sampling incorporating the recommended changes is used widely in western states to estimate pronghorn numbers.

Probability sampling was used to estimate mountain lion numbers. This approach uses information gained (snow tracks) from sampling an area with randomly selected transects to estimate probability of missing animals. Those animals probably missed are added to those detected for the population estimate. This approach is the only reliable method available known to estimate mountain lion numbers over large areas.

Canada Goose Population Dynamics

Major research using large-scale marking was conducted on the interrelation of movements, survival, behavior, and management of subspecies of Canada geese in the Mississippi Flyway. Research objectives included the calculation of precise and unbiased seasonal survival rates, correlation of unconfounded estimates of survival and harvest rates, spatio-temporal distribution of Canada geese of various subspecies throughout the Mississippi Flyway, estimates of population sizes, and subspecific and population derivation of the Canada goose harvest in various regions of North America.

Canada goose populations are heavily exploited throughout their range. Delays in the arrival of spring or overharvest cause poor reproduction or recruitment. In a year of poor reproduction or recruitment, harvest regulations tend to be too liberal, subsequent harvests too high, and adult survival depressed. The research provided better information about how to predict fall-flight harvest levels, influenced the regulation-setting process to increase the stability of goose populations, and provided means to optimize recreational harvests.

Ruffed Grouse Limiting Factors

The ruffed grouse is an important game bird in northern Great Lakes states as well as neighboring provinces of Canada. Under the assumption that hunting has no significant effect on ruffed grouse population levels, managers have allowed numbers of hunters, length of seasons, and number of birds harvested to more than quadruple in the past 50 years. Unit studies demonstrated that grouse harvest rates were 50–100% in fragmented, accessible habitats on public lands. The interaction of exploitation rates with forest fragmentation, hunter access and, ironically, habitat preservation through public ownership, has led to the extirpation of grouse in some areas and drastically reduced population levels in still others. This information is altering ruffed grouse harvest regulations in Great Lakes states.

Black Bear Studies

Long-term studies found that Shenandoah National Park had one of the most dense black bear populations in North America. The massive defoliation of oaks by gypsy moths in Shenandoah National Park causes extensive acorn crop failures. Acorn crop failures eliminated the bears' primary food source, but had little short-term demographic effect on the bear population. Carrying capacity for bears might be reduced by several consecutive years of defoliation. Embryo-implantation schedules and other unique aspects of bear reproductive physiology were determined and information was provided for the development and implementation of management plans for bears in the national park and on other public lands.

Desert Bighorn Sheep

Unit research projects were responsible for basic information on abundance and distribution of habitat of the desert bighorn sheep. Studies found a population surplus in the breaks and wild canyons along the Colorado River in southern Utah. This herd was reduced by hunting and transplantation programs. Management recommendations included removal of cattle from critical sheep ranges, water development and maintenance, continued ewe-lamb surveys, and continued hunting of trophy animals. Similar research on the Green River in northeastern Utah has led to better management of the California bighorn sheep.

Upland Game Management

Unit studies found habitat deterioration, through conversion to farming, to be the most significant factor in the decline of pheasant populations in the early 1970's. Recommendations included increased soil

bank and related agricultural practices and programs to improve habitat for pheasants.

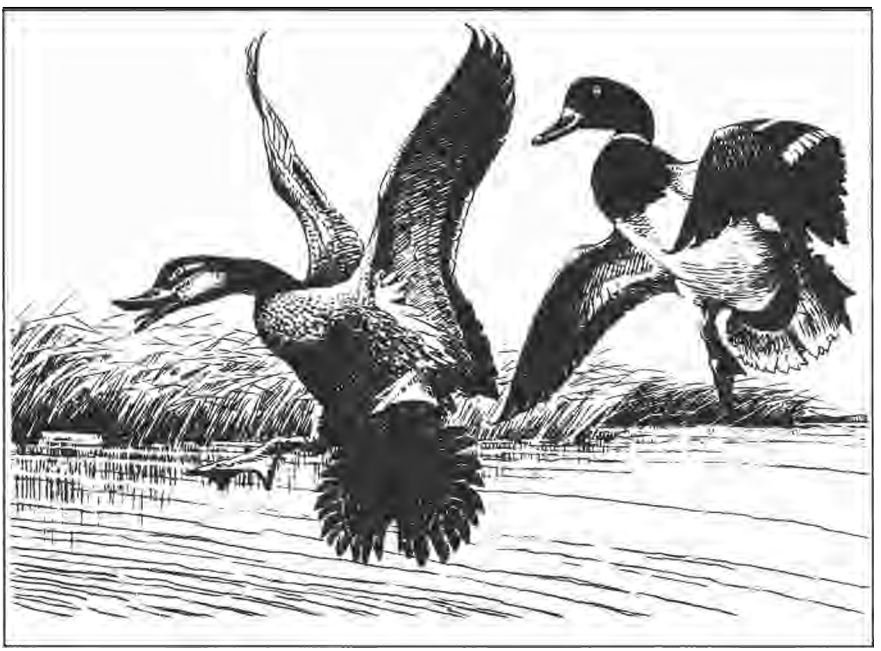
Waterbirds and Limiting Factors

Studies of effects of livestock grazing found the practice as currently conducted to be almost uniformly detrimental to waterfowl production on federal refuges and state wildlife management areas. This finding resulted in alteration of the extent and duration of grazing regimes on public lands where waterfowl production was an important priority.

Researchers found Gunnison Island in Great Salt Lake to be critically important to the production of young pelicans and thus to maintenance of the population. This information was instrumental in causing major parts of the island to be purchased or leased for a pelican sanctuary.

Waterfowl Research

Determination of foods eaten by young ducklings (gadwalls, pintails, widgeons, and lesser scaups) documented the importance of Potamogeton pusillus, Cladophoracea or Lemna minor, chironomidae larvae, gastropoda,



or cladocera, and provided information for productive marsh management. Impoundments on spring-fed silt marshes that were drained on a rotational basis and allowed to remain dry through one summer increased in importance for waterfowl production.

Salinity levels above 9,000 ppm sodium chloride (NaC1) reduced vegetative growth and seed production of sago pondweed. A NaC1 concentration of 3,000 ppm stimulated the production and growth of tubers. Salinities above 9,000 ppm stopped the growth of 1-week-old plants. Plants 4-8 weeks of age could produce new growth in NaC1 concentrations of 12,000 ppm, but a concentration of 15,000 ppm caused death of the plant. Seed germination was reduced by 50% at NaC1 levels above 3,000 ppm.

The historic research emphasis on Great Salt Lake wetlands and associated waterfowl was expanded to include shorebirds and other nongame species. Although Great Salt Lake basin was recognized as an important stopover site for migratory waterfowl, its importance as a staging area for migratory shorebirds was only recently recognized. Current research efforts are documenting the shorebird use of Great Salt Lake for staging and nesting.

Wetlands Valuation and Waterfowl Ecology

Nesting requirements and productivity of the giant Canada goose were addressed through several research projects. The data were used in the restoration of this subspecies—which has been one of the true waterfowl management success stories.

Forest Management for Ruffed Grouse

Prescribed rotation of 1-ha clearcuts in aspen-scrub oak and mixed oak cover types resulted in doubling the numbers of drumming grouse on the areas. The clearcutting had a marked effect on the distribution of drumming grouse. Clearcuts were interspersed in a mature forest type with similar species mixture. Few drumming males were located in clearcut areas during the first eight growing seasons. During the 9-11 years post-cutting, however, over 80% of the area drumming sites were located in the prescription clearcuts. Wildlife managers and private landowners can apply the silvicultural techniques used in this study on relatively small-area forests and expect to have a positive influence on the abundance of ruffed grouse.

Animal Damage Control

Information from investigations into vole reproductive behavior and population dynamics has led to new theory for studies of population growth.

Studies into management of voles in fruit orchards documented severe damage. An array of effective solutions to damage problems has been developed including recommendations for closer and more frequent mowings, correct placement of bait stations, and the inclusion of a herbicide-controlled barren strip between tree rows.

Biotelemetry and Grizzly Bears

Advances in biotelemetry in conjunction with a long-term study of grizzly bears resulted in a landmark research effort that is still the reference point for population studies of grizzlies in the Yellowstone ecosystem. Recent grizzly bear research has been instrumental in bringing reality focus to claims and counter claims by livestock producers of predation on domestic animals.

Coyote Research

Predation by coyotes on white-tail deer fawns in the south reduced deer hunting success in some areas. Investigators found coyote home ranges were small and alerted managers that coyote population densities were high. This information allowed state agencies to institute new regulations for coyote population management.

Mourning Doves

Long-term research was conducted into mourning dove behavior, reproductive biology, population census techniques, and preferred habitats. These studies affected management of this most popular game species and culminated in a comprehensive book on mourning dove ecology and management. The book was edited and partially authored by former Unit Leader Thomas Baskett.

Caribou—reindeer Range Relations

This research focused on the interrelations of caribou with their food resources and stressed nutritional relations, forage selection, plant responses to grazing, animal populations, and individual responses to variations in forage quality and seasonal energetics. Island introductions provided natural laboratories to follow population increase and decline in relation to food resources. Major contributions included development of concepts of forage selection on the basis of quality and summer movement patterns, establishment of the relations between seasonal forage availability and population responses and the relations between forage quality and individual body size, and clarification of the relations between caribou and lichens as a principal component of their

winter forage. The information was employed to establish carrying capacity levels for introduced caribou in the Aleutian Islands as well as for assessing herd and range relations on the basis of body size and condition in Alaska, Norway, and West Greenland. Results were incorporated into the fire management policy for interior and Arctic Alaska by the U.S. Bureau of Land Management. The data provided a basis for management decisions in Alaska regarding allocation of rangelands for caribou versus reindeer and for managers to assess possible conflicts between reindeer grazing and other wildlife. The study delineated the characteristics of caribou calving grounds and insect-relief habitat and showed that those areas needed protection as critical habitat components.

Deer Habitat Selection and Use

Initial research focused on ecology of deer range, but recent emphasis was on the importance of old-growth forests as winter habitat for deer. Old-growth forests provided critical deer habitats that are not replaced in second-growth stands. Forest management agencies incorporated results from this research into their long-range management plans.

Muskoxen Habitat and Population Research

Projects that delineated unique habitats for muskoxen provided a basis for recommendations governing oil and gas exploration in Alaska and Greenland. Muskoxen tissue investigations determined that no apparent loss of genetic diversity occurred as a consequence of introductions using small numbers of animals. The original Greenland muskoxen, from which the Alaskan stock was derived, have low genetic diversity.

Effect of Northern Development on *Wildlife*

Several research projects evaluated the consequences of developmental activities on wildlife. Both the adaptability and limitations of caribou, muskoxen, mountain sheep, bears, foxes, and to a lesser extent birds and other wildlife were examined to learn how wildlife reacted when confronted with the effects of large scale development projects (oil and gas exploration, oil field and pipeline development, road construction, etc.). Oil field development could affect access of caribou to insect-relief areas and reduced access could negatively affect successful reproduction.

Importance of Arctic Riparian Shrub Communities to Large Herbivores

Riparian shrub communities in the Arctic are an important ecosystem component because they receive heavy use by large herbivores. Studies focused on seasonal use patterns, foraging behavior, selectivity of herbivores in riparian communities, and the ecology of shrubs (primarily willows) affected by browsing.

Javelina Ecology

Research on javelina spanned more than 30 years and resulted in data on javelina life history and ecology that provided a firm base for virtually all of the current research and management practices for this species.

Sea Otter Ecology

Early over-harvest in Alaskan waters set the stage for natural experiments among islands with and without traditional sea otter populations and on islands with recently re-established populations. The relations of sea otter density, sea urchins, and kelp communities were investigated. In the absence of predation by sea otters, sea urchin populations destroyed kelp communities and, in turn, the various fish and invertebrates associated with the kelp communities. Findings from this research answered controversial questions about sea otter ecology and were important in guiding the reintroduction and management of sea otters along the Pacific Coast.

Population Estimation

Capture-Recapture/Banding-Recovery Analysis Theory

Eight closed models were formulated from research, estimation issues were addressed in a largely likelihood framework, tests between models were derived, literature was synthesized, and model selection methods were developed. Removal surveys are common in fisheries and wildlife population estimation, and these estimators are linked to models allowing capture probabilities to depend on capture history. A comprehensive computer program, CAPTURE, was written and made available for model selection, parameter estimation, and testing.

Visibility Bias in Aerial Surveys

The validity of winter surveys of mallards in the Mississippi Valley was largely dependent on water conditions. Mallards favored either bottomland hardwood habitats (where visibility by observers is poor) or flooded agricul-

tural fields (where visibility by observers is good). Because of this, aerial counts are biased, and the bias may not be consistent from year to year—survey results are questionable even as trend indicators. Research was undertaken to evaluate visibility bias in winter surveys of mallards, investigate sources of visibility bias, and measure the effects of bias on overall survey bias and precision. Visibility in open habitats was about 70%, contrasted with 30% in forested habitats. Current efforts are directed toward evaluating adaptive sampling methods for waterfowl surveys to eliminate the effects of relative visibility in varying habitat types.

Distance Sampling: Theory and Application

Results of earlier work on line-transect sampling and analysis theory laid the foundations for research into parametric and nonparametric theory for the analysis of grouped and ungrouped data, either truncated or untruncated, and led to an explosion of research on this general topic.

Line and Point Transect Sampling

The application of this sampling theory has been extensive, including surveys of pronghorns, feral pigs, fruit bats, mice, several species of deer, rabbits and hares, primates, and African ungulates. Marine mammal surveys include several species of dolphins, porpoises, seals, and whales. Distance sampling provided the only information about abundance of marine mammals, and population management decisions for these species, made at the Congressional level, were based on the survey results.

In 1988, 3 years of intense research began on capture-recapture models and inference theory for open populations. The research focused on the analysis theory for multiple data sets, model selection methods, and various ways to model survival and capture probabilities as a function of external variables. Two international workshops were held to explain the theory to biologists and biometricians. Many workshops were presented on the various results of these efforts, with emphasis on application. Important applications include work on population dynamics of mallards, northern spotted owls, and several marine mammal species.

A large software package (TRANSECT) was developed as part of the research and was made available to biologists. Biologists in 50 countries have used TRANSECT.

Waterfowl and Wetlands

Early research included pioneering wood duck studies that focused on Mississippi River tributaries, roosting habitats, and population dynamics. Examples of important waterfowl research efforts include use of potholes

by waterfowl, adaptations to nesting, survival, management of nesting habitat, nest parasitism, value of habitat diversity, productivity related to habitats, interface with the agroecosystem surrounding wetlands, modeling and energetics of geese, development of a refuging species model for management applications, and physiology and energetics of several duck species.

Unit assessment of bottomland hardwood stands revealed low rates of suitable cavities for nesting wood ducks and the need for enhanced nest box programs. Follow-up studies indicated nest box isolation, density, spacing, and location with respect to cover types were critical to the success of nest box programs. This information influenced management agencies to change their strategy in the management of nest box programs and resulted in significant increases in wood duck populations.

Research into the bioenergetics of breeding wood ducks provided new insight into the nutritional needs of breeding waterfowl. A productivity model for wood ducks, derived from analyses of 20 years of nesting data gathered on this species, was produced in 1991. This model provided a basis for wood duck management and direction for future research. These efforts produced important information about moist soil and green tree reservoir management for optimum waterfowl benefits. Techniques developed for moist soil management are used on refuges throughout the United States.

One of the most comprehensive Canada goose studies ever undertaken was completed in 1991 in the Atlantic Flyway. Findings indicate that Canada geese are no longer migrating as far south as they did traditionally and that they are being seriously overharvested at the currently most popular wintering site, the Chesapeake Bay. The result is a dramatic decline in Atlantic Flyway goose numbers. Management recommendations from this study include varying and manipulating hunting season dates and season limits by areas. Areas with nuisance resident flocks would be more closely cropped while flocks that are part of the declining population would have curtailed seasons and limits to allow for their recovery.

Exploited Population Compensation and Additivity

Much of the work on exploitation involved waterfowl. Biologists suggested that field and experimental approaches offer the best chance of obtaining more refined results and a better understanding of the exploitation process. To this end, a species of frog *(Rana grylio)* with unique reproductive characteristics suited to this type of study is being used to further test the existing premises.

The Ring-necked Duck in the Northeast, a book authored by a former unit leader, won an award from The Wildlife Society in the late 1950's and is still a standard source of information on this species.

Marsh Ecology and Predator–Prey Relations

Paul Errington's early works with muskrat and mink interactions in prairie marshes were unit studies. Many of the early classic theories were derived from Errington's descriptions of ecological interactions within the marsh boundaries. Some of the basic theories on predator-prey interactions were developed as extensions of this early work.

Agroecology

The habitat base for pheasants, a popular introduced upland game bird, has undergone extensive agricultural related changes through the years. Ring-necked pheasants and their relations with the agroecosystem have been intensively studied, and most of current pheasant management practices stem from studies conducted by units in the Midwest.

Furbearers and Predators

Long-term research on large predators in the western states was a deciding factor in changing the status of the cougar from vermin, hunted for bounty, to game animal with managed population levels and an assured place in western ecosystems.

Several studies on large furbearing predators, including black bears, bobcats, coyotes, fishers, red foxes, river otters, and martens, have provided increasingly effective management programs. Topics investigated included habitat use, food habits, range expansion, and effects of regulated harvesting. Inter- and intra-species interactions were given special attention, especially the effects of newly established coyote populations on red foxes.

The fisher has received special emphasis. Fishers were rare at the turn of the century in much of the southern portion of their North American range. With trapping regulation and abandoned farmlands reverting into forests, fishers began a recovery in New England in the 1940's–50's that still continues. Early studies documented preferred habitats, rates of range expansion, and age and sex-specific patterns of growth and reproductive development. Recent studies focused on geographical and seasonal variation in body condition, habitat use, food habits, social organization, population dynamics, and reproductive biology. Researchers found that adult males were spatially separated from other adult males, and that home ranges of adult females were also distinct from other adult females. These findings, combined with meas-

urements of spatial requirements and recruitment, allowed population density and size to be estimated.

Migratory Bird Production

Pioneering studies were completed on the nesting biology of black ducks, eiders, ring-necked ducks, and woodcock. Studies at Moosehorn National Wildlife Refuge led to the development of the woodcock singing-ground survey. The survey was implemented throughout the range of the species and is a main source of data used to monitor woodcock population trends.

The American woodcock biology research program culminated in the seminal work on the species, The Book of the American Woodcock, by the first leader of the Massachusetts Unit. This work vied for recognition as the best pioneering work on any non-waterfowl migratory bird species in wildlife conservation history and set the stage for the early management programs of states fortunate enough to count the woodcock among their huntable species.

Wild Turkey

The relative importance of the various mortality and disturbance factors including predation, disease, accidents, weather, hunting, and poaching under southeastern conditions was assessed, and the findings were applied on both public and private lands managed for wild turkeys. Turkeys were found to only minimally depredate crops and to add to the economic value of farmland in the upper Midwest.

Threatened and Endangered Species

Genetic Diversity

Reintroduction programs conducted as a component of recovery efforts for threatened and endangered species must consider the importance of preservation of genetic diversity in new or supplemented populations. State-of-the-art genetic techniques are being developed by unit researchers and used for constructing pedigrees and for identifying differences and similarities among populations to foster the development of improved management strategies for endangered birds.

Ozark *Big-eared* Bat, Red-cockaded Woodpecker, Neosho Madtom, Leopard Darter, Arkansas River Shiner, Interior Least Tern, Bald Eagle

Recent research on these species in mid-western United States has produced valuable information for state fish and wildlife managers. Findings of population status, habitat requirements, and habitat availability from these research projects have significantly enhanced recovery efforts of some formally listed species (e.g., Ozark big-eared bat and interior least tern).

Black-footed Ferret, Paddlefish, *Piping* Plover, Least Tern, Bald Eagle, Pallid Sturgeon, Sicklefin Chub, *Swift* Fox, Sturgeon Chub, Osprey, and Ferruginous Hawk

These species have been recent research subjects of western units. The ability to understand population levels and to identify limiting factors affecting these species have significantly altered western land management programs.

Red-cockaded Woodpecker

Studies of red-cockaded woodpecker nesting habits showed that placement of opening restrictors on enlarged cavities does not deter red-cockaded woodpeckers from utilizing the cavity, but it does prevent other woodpeckers from enlarging the cavity for their use.

Black-capped Vireos

Research has shown that black-capped vireos do not need open shrubland as originally believed, and that livestock grazing on areas used by vireos is detrimental because the domestic animals attract cowbirds that parasitize vireo nests.

Razorback Sucker

Larvae of razorback suckers were not able to recognize and avoid predators as early as larvae of northern hognose suckers. Razorbacks improved recognition ability over their first 2 months of life, suggesting that fry older than 2 months should be stocked for best survival.

Freshwater Mussels

Studies of distribution and environmental requirements of endangered freshwater mussels, including the ecological effects of silt, coal-mining activities, channel modifications, and toxic spills, provided state and federal

agencies with assessments of probable effects from various development projects. Fish host research has demonstrated the significance of nongame fish assemblages to the health and reproduction of mussel assemblages in rivers within the United States.

Several studies focused on determining the present distribution, habitat requirements, and threats to the continued existence of mussel species. Research on the Caney Fork River drainage in Tennessee found that construction and operation of Center Hill Dam altered the temperature regime of the tailwater, blocked movements of host fishes, and alternately scoured and exposed much of the stream bed during hydroelectric peaking operations. These perturbations eliminated more than 40 mussel species (including several endangered or extinct species) from the first 15 km of tailwater. Hydraulic models were developed that predict suitable and unsuitable sites for mussel reintroductions.

The Black-footed Ferret

Rediscovered in 1981 near Meeteetse, Wyoming, black-footed ferrets became a central focus of a variety of research efforts. The development of survey techniques and evaluation of habitats for reintroduction potential provided important information. Evaluations of techniques for release of young ferrets and the ability of young ferrets to fend for themselves aided in the recovery program. A popular training program was presented annually for several years by unit personnel and students to instruct field personnel of numerous agencies on proper techniques to use in searching for black-footed ferrets.

Whooping Cranes

Sandhill cranes were used as surrogates to determine the effectiveness of placing yellow aviation marker balls on transmission lines to reduce the frequency of whooping crane collisions with these obstacles. Aviation marker balls on transmission lines were effective in causing cranes to change their flight paths and to significantly reduce the frequency of collisions.

Yuma Clapper Rail

Research on this elusive bird produced new information on habitat needs. Telemetry data proved for the first time that the species is nonmigratory. Population numbers of the rail were found to be higher than was previously believed.

Manatees

Manatee studies, completed in the early 1980's, provide the current guide for the placement of marinas and no-wake zones, critical decisions for manatee management. Research to discover the proper census techniques and population modeling laid the groundwork for much of the manatee work still being pursued by the U.S. Fish and Wildlife Service and other agencies.

Gulf Coast Beach Mice

Investigations of population ecology and the life history of endangered Gulf Coast beach mice provided information on beach mouse population dynamics and insight into the functioning of limited populations of the rapidly reproducing, short-lived small mammals. Translocation techniques were investigated and successful translocations of two subspecies was completed. The translocations substantially improved the status of these subspecies. Information from these studies has provided the foundation for biological opinions issued in several Section 7 consultations.

Northern Spotted Owls

Unit research projects provided the backbone of information on northern spotted owls. Managers used the information as evidence for the need for new forest management practices for old-growth forests in the Northwest.

Mexican Spotted Owls

Investigations of this southern segment of spotted owl populations determined their home range size and habitat characteristics, identified common characteristics of roost sites used by the owls, developed an inventory method that can be used concurrently for flammulated owls (a U.S. Forest Service sensitive species) and Mexican spotted owls, identified habitat requirements of Mexican spotted owls and flammulated owls where their ranges overlap, and found sufficient inhabited sites in Mexico to increase the known locations of Mexican spotted owls in that country by 10%.

Gap Analysis of Biodiversity

A major recent thrust into a proactive approach to protecting biological diversity, this research has used habitats defined by vegetation types and surrogate vertebrate and butterfly species to denote species richness. The work provides focus and direction for efforts to conserve biological diversity. Gap analysis facilitates determination of which components of biodiversity occur

in managed and protected areas and which do not. The process provides a national scorecard to determine how much of our nation's biodiversity is being protected for long-term survival and provides an index of priorities for where additional habitat protection is needed.

Ecology and Habitat Quality

Warmwater Riverine Fish Ecology

Studies were conducted to assess the effects of flow regulation on fish communities and the effects of discontinuous water releases on riverine fisheries and aquatic habitat. Fish populations and stream habitat relations were developed for application to conditions in warmwater streams across the Southeast. High levels of flow regulation on the Tallapoosa River in Alabama were found associated with depressed abundance and diversity of larval and shoreline fish—fish using deep, channel habitats were less affected. Sampling methods were developed and refined for large river research and monitoring. Results directly affected Federal Energy Regulatory Commission regulations relative to flow regimes on the Tallapoosa River.

Navigable Rivers and Reservoirs

Studies have focused on assessment of environmental effects on fish communities. We determined where larval fishes are found with respect to depth and transverse cross-section, and the use of back-water and back-channel habitats as nursery areas. Energetics approaches were used to evaluate effects of increased barge traffic on navigable rivers and effects of reservoir heating and fertilization on fish management strategies.

Effects of Dissolved Oxygen on Fish Populations

Laboratory studies have shown reduced concentrations of dissolved oxygen as harmful to fish. A water-quality criterion for surface waters of a minimum of 5 mg/l of dissolved oxygen was recommended by U.S. Environmental Protection Agency and various states. Expensive waste treatment facilities are required to meet the criterion. This criterion was subject to constant challenge because it lacked field verification. A 3-year field study conducted by a unit verified the laboratory-based conclusions.

Stream Acidification

Cost and pH altering effectiveness of five different types of acid neutralizing devices, either calcite or soda ash dispensers, were evaluated.

All were capable of raising stream pH 1 unit or more at flows up to about 1 m^3/sec. All increased the suitability of living conditions for aquatic organisms. Only one device proved trouble-free and flexible enough to be used for operational systems. The cost of this device was found prohibitive for all but worse-case situations. The devices have been used for treatment of acid mine drainage, still an important problem in Appalachia.

Wetlands

Research projects have focused on developing a better understanding of the functions of coastal, forested, and small palustrine wetland systems and their importance to waterfowl, shorebirds, and other migratory birds, and on improving management and mitigation techniques for their conservation.

Land Use Effects on Salmonid Production in Arid Landscapes

Removal of the riparian vegetation by ungulate browsing or other means had several effects. Stream systems become more simplified, and stream biota were then subject to scour and displacement from summer flash floods after vegetation removal. Production of salmonids was reduced when the canopy was removed from the stream. Elevated water temperatures in desert stream systems often exceeded upper critical lethal limits during the day, and the energy produced from increased photosynthesis was shunted into organisms not eaten by juvenile salmonids. Higher temperatures increased metabolic demand for salmonids by 43%, but the forage base did not increase significantly.

A least-cost strategy for habitat rehabilitation was devised, based upon defining key factors limiting salmonids and applying economic evaluation of population responses to physical gradients. Habitat enhancement programs promoted by land users were evaluated, and many were found to be of no value because they did not address key limiting factors.

Green Tree Reservoir Management

Research leading directly to management application was the creation and study of best management practices for a green timber reservoir at the Montezuma National Wildlife Refuge in central New York. Development of this shallow, seasonally-flooded impoundment was the first major effort in the Northeast to use other than passive water manipulation in order to create nesting and roosting sites for waterfowl and other wetland species while at the same time preserving the live timber stands found on these areas.

Purple Loosestrife

Coordinated studies with scientists in Europe and the United States were conducted to identify and screen insect species that are potentials for controlling this exotic, wetland, plant invader from Europe. Past efforts to eradicate the plant using traditional measures have failed. Three insect species were tested and approved by the U.S. Department of Agriculture for release in the United States and Canada. These insects are expected to reduce this plant pest to acceptable levels and maintain control through a self-sustaining, balanced biological system. Managers look to this program as an answer to reverse wetlands degradation by purple loosestrife that has prevailed through much of the 20th century.

Coastal Plain Wetlands

Studies have focused on detailed examinations of normal and impacted wooded-swamp stream and flood-plain ecosystems. The results have included in-depth descriptions of physical and chemical characteristics of the streams (species, biomass, populations, compositions, movements, and abundance of fish), fish populations as related to stream habitats, swamp stream use by anadromous fish, wildlife resources of the flood plains, and effects of stream channelization. Results were valuable for predicting ecological consequences of modifying stream flows and for land-use planning.

Flow Regimes

Effects, or predicted effects, of river impoundment and associated flow regimes were one focus of research in the early 1980's. A study was conducted to predict how increasing power generating capacity and changing from a relative constant to a fluctuation flow regime at Hauser Dam on the Missouri River would influence trout populations. Results indicated proposed flow regimes would have major negative effects on the trophy trout fishery, and the dam modification was not made.

A study on effects of dissolved gas supersaturation related to operation of Yellowtail Afterbay Dam on the Bighorn River ecosystem is the most comprehensive field study on this topic to date. Field and laboratory studies revealed thresholds above which trout exhibited gas bubble trauma. Various manipulations of flow release from radial and sluice gates in the dam showed that a change in water release pattern would decrease, but not eliminate, gas bubble trauma in trout. Management recommendations were implemented by the U.S. Bureau of Reclamation.

Water Quality-Fish Production Relations

Studies have resulted in practical management solutions to water recycling problems in aquaculture programs, development of an aquatic bioassay facility, and improved understanding of contaminant ecology, including acid precipitation.

Habitat Perturbations

Recent research in this area falls into three categories: 1) assessing the biological effects of contaminants on various natural systems, 2) determining the effects of direct human activities on natural populations, and 3) evaluating the consequences of habitat alteration and management decisions on aquatic and terrestrial resources. Investigation into the effects of certain pesticides on wetland and upland invertebrate communities indicates an indirect effect on the growth of ducklings and upland nesting birds. Another project on invertebrate resources found that exotics, such as the ruffe in the St. Louis Estuary of Lake Superior, may have significant effects on native species because the ruffe competes for the same invertebrate food sources as native fishes.

Prescribed Burning

Extensive studies were conducted by units on the uses of prescribed burning for habitat improvement in the northeastern United States in the 1970's. State fish and wildlife agencies throughout the region now use controlled burning as a regular part of their land management programs.

Fish and *Wildlife* Resources of Western Lake Erie

Two major research thrusts have focused on Lake Erie; wildlife work on the marshes and fisheries work in the lake proper. Significant findings from these studies include how the timing and duration of marsh drawdown affect vegetation response, and the subsequent response of waterfowl populations of the area. This information has enabled development of a set of guidelines for producing and maintaining habitats (vegetational complexes) that are attractive to waterfowl, particularly during the autumn migration. The studies have demonstrated how water levels can be manipulated to increase seed production from plant species that have the highest metabolizable energy values from a range of plant species that occur in the Lake Erie marshes.

These studies have also shown that if the amount of water in shallow marshes is reduced by 50% as soon as icemelt occurs (in early April), macroinvertebrate population densities can be significantly increased to coincide with the timing of the spring waterfowl migration through the Lake

Erie marshes. Implementation of these findings permits maximizing the value of such prime, scarce marshes to migrating waterfowl.

Fishery research in Lake Erie by units has been directed mainly toward the basic biology of walleye and yellow perch. These are the two most important sport fishery species in Lake Erie. Findings have clearly indicated that the populations in the western and central basins of Lake Erie are unique, function differently, and must be managed as separate populations.

Old-Forest Associated *Wildlife*

Much current effort in this area has focused on the northern spotted owl. The seminal research on this species, which discovered the near obligate association of the owl with old-forest in the Northwest, was by a unit student. The listing of the owl as a threatened species drew heavily on unit-generated research; the listing is, and will undoubtedly continue to be, a major influence on forest land-management practices throughout the Northwest.

Recent unit studies lead the inventory and life history research efforts on the marbled murrelet in coastal Oregon. The documentation of the first nest sites in the state and the clear habitat association—old-growth forest stands—has provided the data that prompted the proposal for protection of the murrelet under the Endangered Species Act.

Effects of Agricultural Chemicals

Investigations into the effects of agricultural chemicals (dieldrin, atrazine, PCBs, fertilizers, herbicides) on fish, water quality, and wildlife have provided important information. Examples of use include studies of dieldrin levels found in ring-necked pheasants and studies on the effects of agricultural chemicals and fertilizers in lakes and wetlands. These studies altered use, manufacture, and management practices associated with these compounds.

Ding's Farewell