The Cooperative Fish and Wildlife Research Unit Program

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The Cooperative Fish and Wildlife Research Units Program

By

W. Reid Goforth

Retired,
Former Chief of the Cooperative Fish and Wildlife Research Unit Program

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)

Dedication

This work is dedicated to those who are or have been associated with the unit program. Included are federal 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

Special thanks go to Jim Fleming, Deputy Director of the Cooperative Fish and Wildlife Research Unit Program and his staff, for production help with this revision of the original work, and to my wife Prudence for her editorial help and other support. Most of all, my continuing thanks and admiration are extended to the former and present personnel of the Cooperative Research Units for their persistent dedication to the natural resources on which their research is based and for their endless efforts on behalf of the many students.

Contents

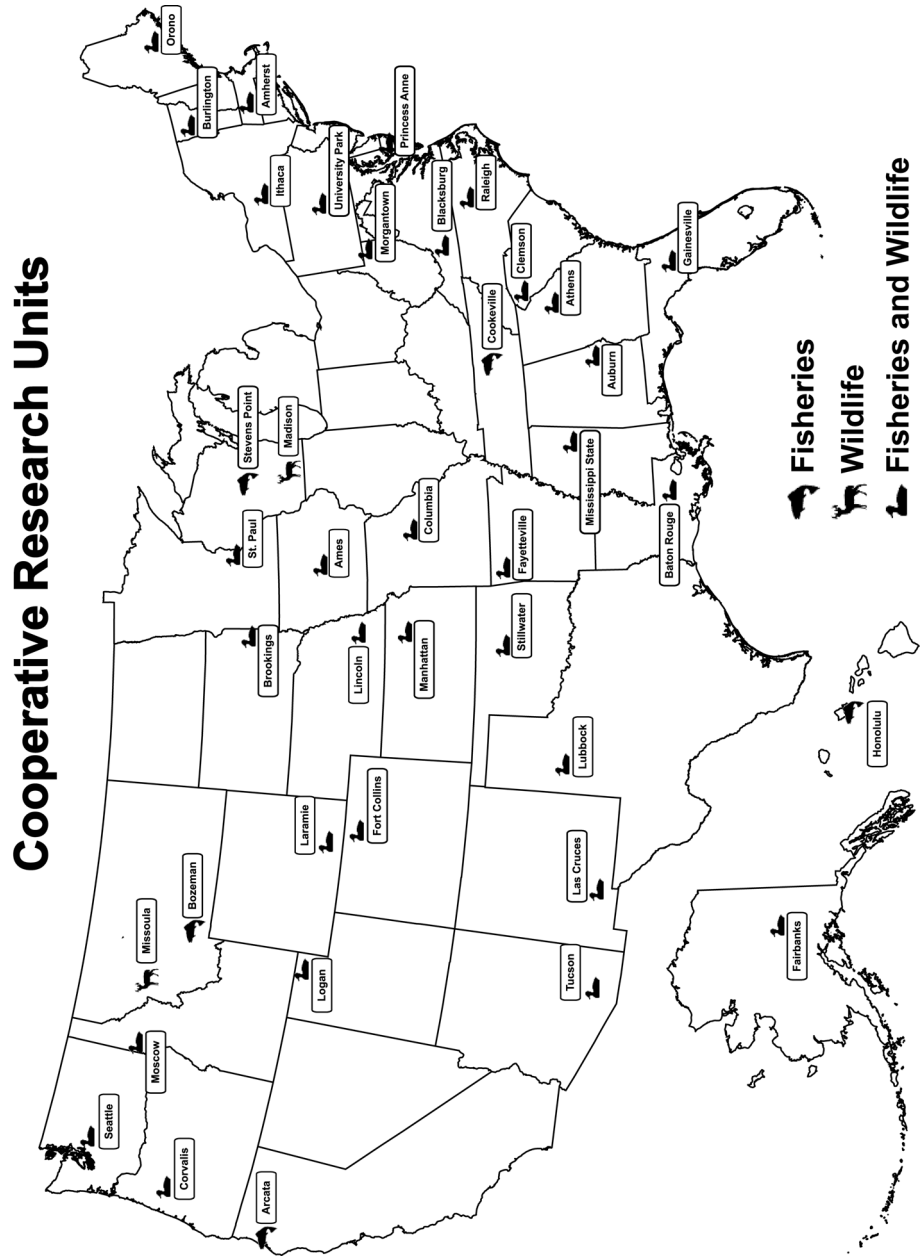
Prologue

This book is about the Cooperative Fish and Wildlife Research Units Program; how it operates, how it originated and how it has evolved through the years. The importance of Unit Program contributions rests with the people that have staffed the Units, the information they have developed for the management of living natural resources, and their students that will influence the future of living natural resources of the United States and the world. The demand for new information to use in managing our living natural resources will continue to accelerate as human populations grow and have increasing needs for those resources while at the same time decreasing the natural habitats available for their production.

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 scarcity of citations in the text.

The Cooperative Research Units originated in the U.S. Department of Agriculture in the mid 1930s and were designated an early component of the Fish and Wildlife Service when that agency was formed as part of the U.S. Department of the Interior in 1940. The Unit program was administered in the Fish and Wildlife Service until 1993. When the Clinton Administration came into being in 1993, Bruce Babbitt was named Secretary of the Interior. Secretary Babbitt announced, very early in his first year of tenure, that he planned to amalgamate all living natural resource research efforts of the Interior into a single research agency. The Cooperative Research Units were then relocated to the new Interior research agency. Several problems, beyond the scope of this book, developed during the formative years of the new research agency, which resulted in Congress moving the new agency to the U.S. Geological Survey as a new Division of Biological Research within that agency. It was at that juncture that the original edition of this book was published. The writing effort for the first edition of this book had been under way for some time and culminated just as the Units were being moved to the Geological Survey.

This second edition includes updates to the Cooperative Research Units' budget history, personnel roster, and research activities. The rest of the document remains unchanged.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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 39 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.

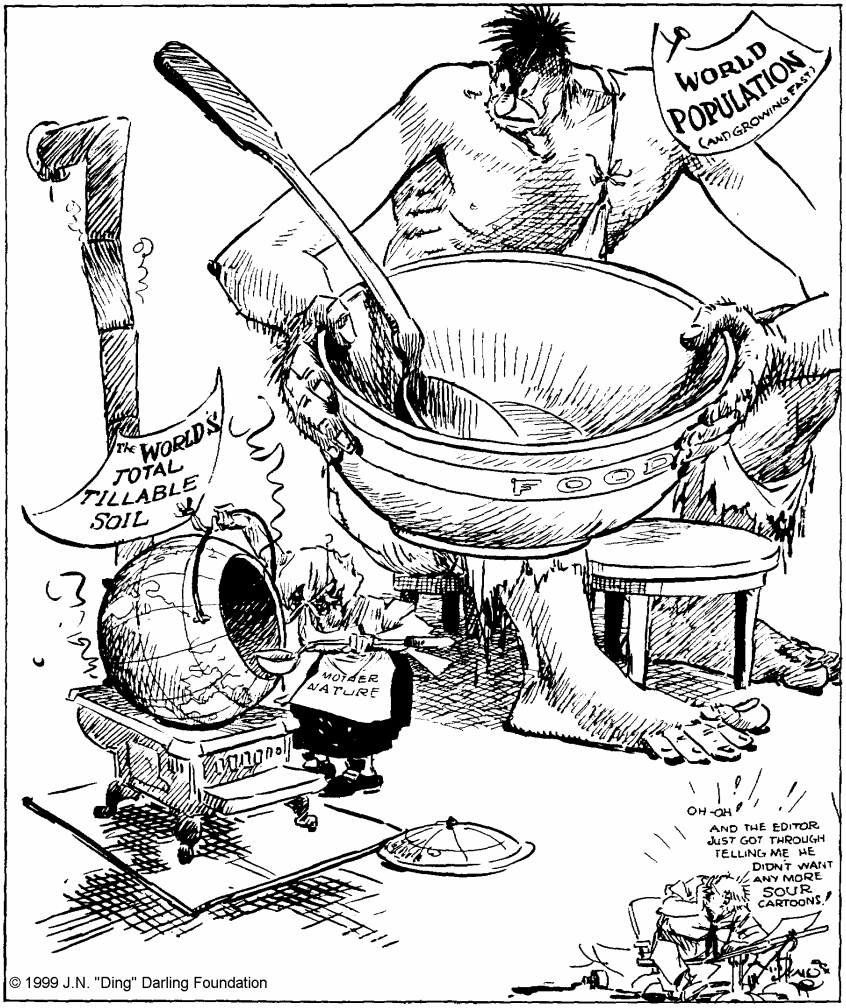
In the New World

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 committed the additional $81,000 to

Iowa Pioneers

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--*Cooperative 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, Covrallis
2. Northern section of Pacific coast region
3. With problems distinctly different from the southern Pacific coast zone and typical of Oregon, Washington and northern 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.

---

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.

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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. Since the inception of the program Units in Connecticut (1937), Texas (1954), Oregon (1959), and Ohio (1991) were closed; Units were reestablished in Oregon (1971) and in Texas (1988).

Cooperative Units Act

In 1960, the Congress passed the Cooperative Units Act (P.L. 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 cooperativewildlife 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 Staffing 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.

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

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 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 2005, 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, Nebraska, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wyoming. Wildlife research units are located in Montana and Wisconsin. Fishery research units are in California, Hawaii, Montana, Tennessee, and Wisconsin. Most states that do not have units have inquired about the possibility of forming one.

In The Service of "The People"

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. Geological Survey director. Requests are often made, but the Survey takes minimal action. Money to pay salaries for new units would be taken from another Survey program for each unit established. In the past, the FWS 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 requested 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 with no added appropriation to cover the cost. Consequently, the program budget may 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 Survey, and the Wildlife Management Institute. The U.S. Geological Survey 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 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 Survey, the host university, the state agency(s), 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 Survey's working representative to the coordinating committee is a unit supervisor from headquarters in Reston, Virginia. 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 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 administrators 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--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 communiqué indicates which cooperator will chair the meeting. Requests for 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, Survey 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.

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 investigations. 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 federal (or combination of federal and state[1]) employees in an office on a university campus perform the range of

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

tasks of any federal 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 federal 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 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 federal 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 relationship 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 federal 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 $l,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,

administrators, 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. This meeting serves 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 provides the only forum for orations by cooperators and unit personnel, collectively.

The Federal Government

Some of the benefits for the federal government 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 federal government and assures the government 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. 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 federal 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 under-graduate 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

Salaries for federal scientist positions, such as those of Unit scientists, vary widely from time to time and from location to location with regard to their comparability to salaries of regular university professors. 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. The locality variance between regular university professor salaries and those of Unit employees continues and is influenced by general economic conditions and the chosen academic filed of specialization.

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. Government agencies that use Units regularly for research investigations are generally interested in applied research efforts that address more immediate 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 Scientists

Recruiting and hiring leaders and assistant leaders for staffing cooperative research units is a unique process because of the cooperative nature of the unit program. Advertisements for recruiting unit leaders are generally restricted to the issuance of vacancy announcements designed to recruit from within the ranks of the federal government. Previous experience as a leader of another unit or as an assistant unit leader is highly preferred for leader candidates. If candidates with unit experience cannot be found then candidates having experience working at other federal research installations are sought. Federal research experience provides the candidate with knowledge needed for meeting the administrative demands of the federal system but provides no guidance for operating within the state and university administrative systems that are a part of the unit.

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 units 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. Recruitments for Assistant Leader positions are aimed at highly qualified applicants with recently completed PhDs., and are advertised at the GS-12 level.

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 Reston, Virginia, (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 federal government 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 federal government, 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 unit headquarters. 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 not well informed about the type of research activities the primary cooperators expect may present some problems because of the objectives of the university system and that of the agency cooperators. Universities prefer individuals with the highest possible level of scientific expertise and experience while the federal government views these positions as entry level for a new Ph. D. A second issue may arise over the difference in emphasis each cooperator places on the hiring of minority candidates for these positions.

The government 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. Government budget constraints make the difference in cooperator objectives a real problem and often limit 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.

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 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 federal government aware of the special nature of the cooperative unit program. The employees of the units are on the federal payroll, and the federal government must provide central administrative support for the program and insure that federal employees follow federal regulations. The headquarters program belongs entirely to the federal government and must function in all capacities that are expected from any federal 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 federal government 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).

Funding Determines the Research Direction

The initiation of the Research Work Order process allowed the federal government greater use of units for research. From some units, the federal government requested numerous research projects, and most research of some units was for federal work. The shift toward the federal government 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 federal government in cooperative research, several federal 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.

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.

Research Funding, 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 Fish and Wildlife 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 federal government 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 federal attention was focused on the unit program. The RWO process provided the federal government with a select corps of highly qualified researchers in the units and cooperating organizations for research of interest. The Cooperative Unit Program provides the federal government the opportunity to cooperatively direct unit research and to influence the research direction of faculties at 41 major universities.

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:

> 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 federal research facilities and federal 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).

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Why Call Them Sportsmen?

Appendix A. The Cooperative Units Act as Amended. Facsimile of Act Establishing Cooperative Units[1].

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.

Although the Unit Program is commonly thought of as including both the headquarters operation, which is strictly a federal function, and the units themselves, a closer look reveals that the two are entirely different in purpose and function. 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 federal 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 direction and services to unit employees and gathers information needed by the federal system related to use of federal funds. The unit headquarters staff oversees the federal appropriation process for the budget line-item labeled the Unit Program and the distribution of funds to the individual units. 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 federal input to individual units. A unit supervisor serves as the official federal representative on the Coordinating Committee. Federal input is made in concert with the other cooperators during the annual meeting. Some federal 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 federal 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 the original basis for the formation of research centers. This is in contrast to the cooperative research units which follow the direction of the cooperators into widely diverse study areas.

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 mini-center supported by a skeleton crew in Reston that provides primary services for the federal responsibilities. The broader concept of program is more applicable to the units.

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 for this major activity, nor is any consideration given to relieve the burden of other performance 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 federal government. 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. Federal administrators must be ever vigilant to protect units from over-control by the federal government. The cooperative nature of the units must be maintained to maximize their individual effectiveness.

The Research Work Order (RWO) process adds a major dimension to unit administration and does not exist in any other government entity. It yields a large measure of flexibility in working with 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, and one or more representatives of the U.S Geological Survey.

Reading of the minutes from the 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[1]

- Overview of past year's budget exercise.
- Budget for the year ahead.
- Outstanding budget needs.

Equipment[1]

- 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.

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

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

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

UNITED STATES GEOLOGICAL SURVEY, DEPARTMENT OF INTERIOR

and the

UNIVERSITY

and the

STATE DEPARTMENT OF FISH AND WILDLIFE

and the

WILDLIFE MANAGEMENT INSTITUTE

and the

US FISH AND WILDLIFE SERVICE

This agreement, effective on the date signed by all parties, is entered into by the Unit Cooperators: the United States Geological Survey, hereinafter referred to as the "Survey", the _____University, hereinafter referred to as the "University", the _____ Department of Fish and Wildlife, hereinafter referred to as the "Department", the Wildlife Management Institute, hereinafter referred to as the "Institute" and the US Fish and Wildlife Service, hereinafter referred to as the "Service".

I. Authorization:

The Survey is authorized under Public Law 86-686 (as amended November 8, 1978), to enter into cooperative agreements with colleges and universities and State fish and wildlife departments relating to Cooperative Research units for the purpose of developing adequate, coordinated, cooperative unit programs of research and education relating to fish and wildlife.

The University is authorized by the laws of the State of _____ 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 _____ to enter into agreements and investigate questions relating to fish and wildlife and related resources, 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 these 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 Wildlife Research Units.

II. Purpose:

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

III. Objectives:

1. To conduct research into the ecology, biology and management of fish, wildlife, and other renewable natural resources and to investigate the production, utilization, management, protection, and restoration of such resources. This research will be relevant to the needs of the State, the geographical region and the Nation.
2. To provide technical and professional education on the graduate and professional levels, in the fields of renewable natural resource sciences.
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.
5. To help address the information needs of the Cooperators. This objective will include the careful linking of the Department information needs with those of the Survey and Service so the many overlapping interests are properly served.

IV. The Survey Agrees To:

1. Designate three or more full-time employees of the Survey to staff the Cooperative Research Unit. One of these employees shall serve as Unit Leader others shall serve as others shall serve as Assistant Unit Leaders for their respective disciplines. All Unit staff appointments shall be made with the concurrence of the University and the Department. All Survey employees shall meet the qualifications for graduate faculty status within the University.
2. Pay the salaries of Survey personnel assigned to the Unit, and to provide incidental expense funds for these personnel as provided for in PL86-686.
3. Make available such services, and facilities, including equipment, buildings, and land under control of the Survey, 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. Recognize the responsibilities of Unit scientists as educators, consistent with and supportive of the Unit mission identified in PL86-686. These include appropriate performance evaluation and

professional development. Permit the Survey's 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 graduate level 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. Provide funds through this Cooperative Agreement to support specific research, Unit operations or educational projects of primary interest to the Cooperators, including mutually agreed upon university administrative and support services, which meet the terms of the Cooperative Units Act as amended. 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. In support of Unit base operations, 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, as are regularly made available to other University faculty; publication channels; museum facilities; library; equipment; utilities, including both local and long distance telephone services, in locations where Federal Telecommunications Services are not available; indirect cost waivers on Survey funded research as defined in V.4, account services for Cooperator contributions to the Unit 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 regular members of the University faculty, those research scientists of the Survey who are assigned to the Unit. These personnel shall have full faculty rights and privileges and be given professional rank appropriate to their qualifications. Survey personnel shall be given graduate faculty appointments, providing such personnel meet the standards and requirements of the University. Survey personnel shall be eligible for promotion in University 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 university accrue to those individuals by virtue of their being students of the university.
4. Make available the means for the Unit to establish revolving accounts (accounts with no fiscal year limitations) 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 and Survey (as defined in section VI.3). Indirect costs at a rate of ____% will be charged on all research contracts funded by the Survey. The difference between the ___% rate and the University s regular indirect cost rate on contracts will be considered as part of the University contribution to the Unit. Survey research contracts (Research Work Orders) issued under this agreement will be administered under OMB Circular A21.
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 accounts, a minimum of $_____ to be used for basic operational expenses of the Unit (i.e. equipment and supply purchases, maintenance, travel of Unit personnel and students, student stipends, etc). This amount may be supplemented by additional funds or in-kind contributions of services or utilities for the conduct of research projects requested by the Department and mutually agreed upon by the Cooperators. The Department and the Survey will periodically reexamine the amount of their annual basic contributions 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. They will participate in annual coordinating committee meetings.

VIII. The Service Agrees To:

1. Cooperate in the planning and development of research, education, and in-service training and demonstration programs.
2. Make its information needs known to Unit cooperators.
3. Use available resources, as may be mutually agreed upon, for support of the Units' approved programs of research and education.
4. Actively participate in Coordinating Committee Meetings as a non-voting member.

IX. It is Mutually Agreed That:

1. The Unit shall be administered through a Coordinating Committee, consisting of a designated representative of the Survey, the University, the Department, the Service, and the Institute.
   The Coordinating Committee, consisting of signature parties to the Cooperative Agreement, will meet annually in General Session, or as otherwise mutually agreed. To maintain a balance between State, University, Federal, and WMI interests in the program, the Service participates as a non-voting member of the Coordinating Committee, but otherwise is a full participant in all activities and discussions of the Committee.

   At the annual meeting, the Coordinating 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 research 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. Budget statements and reports will be prepared by the Program Leaders and provided to each member of the Coordinating 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 educational programs of the unit with the research and educational programs of the Cooperators, and with the general land and water use programs of the State and Nation.
e. Exchange information so that Cooperators and interested agencies will be informed of the plans, programs, progress, needs, and probable future trends and patterns of development of the research and educational programs of the Unit.
f. A closed Executive Session of the Coordinating Committee, may be held following the General Session, upon request of any Coordinating Committee member, for dealing with issues or matters of operational policy that should not be part of the open forum meeting. The Executive Session shall be attended only by signatory party representatives to the Unit Cooperative Agreement.

2. Participation of the Federal Government in this project is not intended to place it in a position of liability for claims that arise as a result of Unit activities. Each party hereto shall have 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 Survey and 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 programs of the Unit as approved by the Unit Cooperators through the Unit 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 designate for 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 supporters of 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 Cooperators 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 there from.

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.

XII. 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 five days after such conviction;
5. Notifying the Survey 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 by -
    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. It is the intent of Cooperators to review the terms of the agreement every 5 years. The agreement may be terminated through mutual agreement following a written notice to the other cooperators 90 days in advance if a proposed termination date.

Approvals:

_____
State Fish and Game Agency

_____
University

_____
Cooperative Research Units, USGS

_____
Wildlife Management Institute

_____
US Fish and Wildlife Service

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 federal government 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 federal government. 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 Research Work Order (RWO) process carries 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 USGS 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 federal installations (i.e., secretaries for field stations, laboratory technicians at research centers, etc).

The 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 federal 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 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 USGS 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. 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. Administrators from the Units.

Several individuals have left their positions at a local cooperative research unit to serve as administrators at research centers, laboratories and national offices within the U.S. Fish and Wildlife Service (FWS), National Biological Service (NBS) and/or U.S. Geological Survey (USGS). The following list tracks the career advancements of those individuals.

Thomas S. Baskett	*Chief,* Division of Wildlife Research (FWS)
Henry E. Booke	*Scientific Director,* Northeast Anadromous Fish Research Laboratory (FWS)
James P. Clugston	*Director,* Gainesville Fisheries Research Laboratory (FWS)
Eugene H. Dustman	*Director,* Patuxent Wildlife Research Center (FWS)
James Fleming	*Deputy Chief,* Cooperative Research Units (FWS, NBS, USGS)
Alfred C. Fox	*Director,* National Fisheries Research Center, Seattle (FWS)
W. Reid Goforth	*Chief*, Fish and Wildlife Service Office of Research Coordination (FWS) *Assistant Director*, Northern Prairie Wildlife Research Center (FWS) *Director,* Northern Prairie Wildlife Research Center (FWS) *Supervisor,* Cooperative Research Units (FWS) *Chief,* Cooperative Research Units (FWS, NBS, USGS)
Gerald A. Grau	*Assistant Director,* Northern Prairie Wildlife Research Center (FWS) *Assistant Director,* National Wetlands Research Center (FWS)

Richard J. Graham	*Supervisor,* Cooperative Wildlife Research Units (FWS) *Assistant Director,* National Fisheries Contaminant Research Center, Columbia (FWS)
Richard W. Gregory	*Chief,* Office of Information Transfer (FWS)
Bernard L. Griswold	*Supervisor,* Cooperative Fishery Research Units (FWS) *Director,* National Fisheries Research Center, Great Lakes (FWS)
Jack R. Gross	*Branch Chief,* Western Energy and Land Use Team (FWS)
F. Eugene Hester	*Chief*, Division of Fishery Research (FWS) *Associate Director*, Research (FWS) *Deputy Director* (FWS, NBS)
Daniel L. Leedy	*Head,* Cooperative Wildlife Research Units (FWS)
Charles M. Loveless	*Assistant Director,* Denver Wildlife Research Center (FWS) *Assistant Director*, Research (FWS) *Regional Director,* Region 6 (FWS) *Director,* Denver Wildlife Research Center (FWS)
James A. McCann	*Chief,* Division of Population Ecology Research (FWS) *Director,* National Fisheries Research Center, Gainesville (FWS)
John D. McIntyre	*Assistant Director,* National Fisheries Research Center, Seattle (FWS)
A. William Palmisano	*Director,* Alaska Fish and Wildlife Research Center (FWS) *Director*, Leetown National Fisheries Research Center (NBS, USGS)

Garland B. Pardue	*Scientific Director,* National Fisheries Research and Development Laboratory (FWS)
H. Randolph Perry, Jr.	*Chief,* Branch of Endangered Species Research, Patuxent Wildlife Research Center (FWS, NBS, USGS)
John G. Rogers	*Deputy Director* (FWS)
Thomas G. Scott	*Director,* Denver Wildlife Research Center (FWS)
William K. Seitz	*Assistant Director*, Alaska Fish and Wildlife Research Center (FWS) *Director,* Alaska Fish and Wildlife Research Center (NBS, USGS)
Raymond C. Simon	*Director,* Fish Genetics Laboratory (FWS)
Robert I. Smith	*Chief,* Migratory Bird and Habitat Research Laboratory (FWS) *Chief,* Branch of Surveys, Office of Migratory Bird Management (FWS)
Rollin D. Sparrowe	*Chief,* Division of Cooperative Research (FWS) *Chief,* Office of Cooperative Research Units (FWS) *Chief,* Division of Wildlife Research (FWS) *Chief,* Office of Migratory Bird Management (FWS) *Deputy Assistant Director*, Wildlife Resources (FWS)
Paul F. Springer	*Assistant Director,* Northern Prairie Wildlife Research Center (FWS)
Clair B. Stalnaker	*Chief,* Aquatic Branch, National Ecology Research Center (FWS)
Robert E. Stevens	*Chief,* Division of Fisheries Research (FWS) *Chief,* Office of Research Support (FWS)

Robert G. Streeter	*Head,* Cooperative Wildlife Research Units (FWS) *Chief,* Office of Information Transfer (FWS) *Deputy Director,* North American Waterfowl Management Plan (FWS) *Assistant Director*, Wildlife Resources (FWS)
Jon G. Stanley	*Supervisor,* Cooperative Research Units (FWS) *Director,* National Fisheries Research Center, Great Lakes (FWS)
Stephen H. Taub	*Head,* Cooperative Fishery Research Units (FWS)
Terry T. Terrell	*Chief,* Office of Research Support (FWS) *Deputy Director,* Region 6 (FWS)
Michael J. Van Den Avyle	*Supervisor,* Cooperative Research Units (FWS, USGS)
Paul A. Vohs, Jr.	*Supervisor,* Cooperative Wildlife Research Units (FWS) *Director,* Denver Wildlife Research Center (FWS)
Byron Ken Williams	*Chief,* Cooperative Research Units (USGS)
Lee E. Yeager	*Head,* Cooperative Wildlife Research Units (FWS)

Appendix H. Unit Formation Dates and Tenure of Employees.

Unit Name (year established) (university)

- Leaders, tenure (specialty)
  - Assistant Leaders, tenure (specialty)

Alabama Wildlife (1935) (Alabama Polytech. Inst. now Auburn U.)

- Harold S. Peters, 1935-37
- Allen M. Pearson, 1937-49
- Arnold O. Haugen, 1949-57
- Maurice F. Baker, 1958-67
- Dan W. Speake, 1967-84
  - Frank W. Fitch, Jr. *, 1949-55
  - Dan W. Speake*, 1955-67
  - Edward P. Hill, 1967-80

Alabama Fishery (1966) (Auburn U.)

- John S. Ramsey, 1967-84
  - James M. Barkuloo, 1969-70
  - William L. Shelton, 1971-82

Alabama Combined (1984) (Auburn U.)

- Nicholas R. Holler, 1985-98 (wildlife)
- James B. Grand, 1998-date (wildlife)
  - Dan W. Speake, 1984-95 (wildlife)
  - John S. Ramsey, 1984-86 (fisheries)
  - Mark B. Bain, 1986-91 (fisheries)
  - Elise Irwin, 1995-date (fisheries)
  - Michael S. Mitchell, 1999-2005 (wildlife)

Alaska Wildlife (1950) (U. of Alaska Fairbanks)

- Neil W. Hosley, 1950-51
- John L. Buckley, 1951-58
- Robert F. Scott, 1958-61
- James S. Lindzey, 1961 (acting)
- Frederick C. Dean, 1962 (acting)
- David R. Klein, 1962-91
  - Peter C. Lent, 1968-76
  - Philip S. Gipson, 1976-84

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*Salaried by state fish and wildlife cooperator

Alaska Fisheries (1978) (U. of Alaska Fairbanks)

- James B. Reynolds, 1978-91
  Stephen L. Tack*, 1978-81
  Jacqueline D. La Perriere, 1980-91
  Robert H. Armstrong*, 1981-84

Alaska Combined (1991) (U. of Alaska Fairbanks)

- James B. Reynolds, 1991-99 (fisheries)
- F. Joseph Margraf, 1999-date (fisheries)
  Jacqueline D. LaPerriere, 1991-99 (fisheries)
  David R. Klein, 1991-97 (Senior Scientist)
  Daniel D. Roby, 1992-95 (wildlife)
  Anthony D. McGuire, 1995-date (ecology)
  Brad Griffith, 1996-date (wildlife)
  Abby N. Powell, 2000-date (wildlife)
  Mark Wipfli, 2003-date (fisheries)

Arizona Wildlife (1950) (U. of Arizona)

- Lyle K. Sowls, 1950-62, and 1963-86
- Charles R. Hungerford*, 1962-63 (acting)
  Norman S. Smith, 1968-87

Arizona Fish (1964) (U. of Arizona)

- William J. McConnell, 1964-71
- Jerry C. Tash, 1971-86
  Charles D. Ziebell, 1966-86

Arizona Combined (1986) (U. of Arizona)

- O. Eugene Maughan, 1987-2000 (fisheries)
- Scott A. Bonar, 2000 (acting), 2001-date (fisheries)
  Norman S. Smith, 1987-92 (wildlife)
  Charles D. Ziebell, 1986-89 (fisheries)
  Carol C. McIvor, 1993-99 (fisheries)
  Stephen DeStefano, 1994-99 (wildlife)
  Scott A. Bonar, 2000-01 (fisheries)
  Courtney J. Conway, 2000-date (wildlife)
  Melanie Culver, 2002-date (fisheries)

Arkansas Fish and Wildlife (1988) (U. of Arkansas-Fayetteville)

- ❖ James Johnson, 1988-98 (fisheries)
- ❖ David G. Krementz, 1999-date (wildlife)
  - Cynthia A. Annett, 1989-92 (fisheries)
  - Thomas E. Martin, 1989-93 (wildlife)
  - Thomas J. Kwak, 1994-99 (fisheries)
  - Brad Griffith, 1995-96 (wildlife)
  - Daniel D. Magoulick, 2000-date (fisheries)
  - William L. Thompson, 2000-04 (wildlife)

California Fish (1967) (Humboldt State U.)

- ❖ Roger A. Barnhart, 1967-95
- ❖ Walter G. Duffy, 1997-date
  - C. Frederick Bryan, 1967-71
  - Thomas J. Hassler, 1972-97
  - Margaret A. Wilzbach, 1999-date

Colorado Wildlife (1947) (Colorado State U.)

- ❖ Lee E. Yeager, 1947-63
- ❖ Charles M. Loveless, 1963 (acting)
- ❖ Vincent H. Reid, 1963 (acting)
- ❖ Fred A. Glover, 1964-72
- ❖ Jack R. Gross, 1972-74 (acting)
- ❖ Kenneth R. Russell, 1974-80
- ❖ William K. Seitz, 1980-81 (acting)
- ❖ Fred B. Samson, 1981-84
  - Charles M. Loveless, 1961-62
  - Jack R. Gross, 1967-72
  - Robert G. Streeter, 1972-73
  - William W. Mautz, 1975-76
  - William K. Seitz, 1976-80, 1981-83

Colorado Fish (1949) (Colorado State U.)

- ❖ William C. Beckman, 1949-53
- ❖ Howard A. Tanner, 1953-63
- ❖ Robert E. Vincent, 1964-71
- ❖ William J. McConnell, 1971-82
- ❖ Eric P. Bergerson, 1974-82 (acting)
  - Howard A. Tanner, 1952-53
  - George Post, 1964-66
  - Robert J. Behnke, 1966-73
  - Eric P. Bergersen, 1973-82

Colorado Combined (1984) (Colorado State U.)

- Fred B. Samson, 1984 (acting; wildlife)
- David R. Anderson, 1984-03 (wildlife)
- Dana Winkleman, 2003-date (fisheries)

Eric P. Bergerson, 1984-2003 (fisheries)
Fred B. Samson, 1985 (wildlife)
Kenneth P. Burnham, 1988-date (wildlife)

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

- Paul D. Dalke, 1935-37

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

- Richard W. Gregory, 1979-85 (fisheries)
- Wiley M. Kitchens, 1985-97 (fisheries)
- H. Franklin Percival, 1998-date (wildlife)

H. Franklin Percival, 1981-98 (wildlife)
Carol C. McIvor, 1988-93 (fisheries)
Raymond R. Carthy, 1996-date (wildlife)
Wiley M. Kitchens, 1997-date (ecology)

Georgia Fish (1962) (U. of Georgia)

- Roger A. Barnhart, 1964-66
- Melvin T. Huish, 1966-68 (acting)
- Alfred C. Fox, 1968-75
- James P. Clugston, 1975 (acting)
- Robert E. Reinhert, 1975-79
- Ronnie J. Gilbert, 1979-81 (acting)
- Michael J. Van Den Avyle, 1981-84

Melvin T. Huish, 1963-66
James P. Clugston, 1968-75
Ronnie J. Gilbert, 1978-79, 1981-84

Georgia Wildlife (1979) (U. of Georgia)

- James C. Lewis, 1982-84

Georgia Combined (1984) (U. of Georgia)

- Michael J. Van Den Avyle, 1984-96 (fisheries)
- Michael J. Conroy/Cecil A. Jennings, 1996-97 (acting Co-leaders)
- Cecil A. Jennings, 1997-date (fisheries)

Vickie S. Blazer, 1984-92 (fisheries)
Michael J. Conroy, 1986-date (wildlife)
Cecil A. Jennings, 1994-97 (fisheries)
James T. Peterson, 1999-date (fisheries)

Hawaii Fish (1966) (U. of Hawaii)

- John A. Maciolek, 1966-77
- James D. Parrish, 1977-date
  - Leighton R. Taylor, Jr., 1972-75
  - Charles E. Birkeland, 2000-date

Idaho Wildlife (1947) (U. of Idaho)

- Paul D. Dalke, 1947-67
- Maurice G. Hornocker, 1968-85
  - Elwood G. Bizeau, 1967-85

Idaho Fish (1963) (U. of Idaho)

- Donald W. Chapman, 1964-73
- Theodore C. Bjornn, 1973-85
  - Robert N. Thompson, 1964-66
  - Theodore C. Bjornn, 1966-73
  - Robert G. White, 1974-80
  - James L. Congleton, 1980-85

Idaho Combined (1985) (U. of Idaho)

- Theodore C. Bjornn, 1985 (acting; fisheries)
- James Michael Scott, 1986-date (wildlife)
  - James L. Congleton, 1985-date (fisheries)
  - Theodore C. Bjornn, 1986-01 (fisheries)
  - R. Gerald Wright Jr., 1995-2004 (biology)
  - Christine Moffitt, 2002-date (fisheries)

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

- Logan J. Bennett, 1935-38
- Thomas G. Scott, 1938-42, 1945-48
- Carl J. Drake*, 1942-45 (acting)
- Edward J. Kozicky, 1948-56
- Arnold O. Haugen, 1957-73
- Robert B. Dahlgren, 1973-85
  - Kenneth R. Russell, 1969-74 (special appointment)
  - Erwin E. Klaas, 1975-85

Iowa Fish (1965) (Iowa State U.)

- Robert J. Muncy, 1965-79
- Wayne A. Hubert, 1979 (acting)
- John G. Nickum, 1980-85
  - Ross V. Bulkley, 1967-78
  - Wayne A Hubert, 1979-82

Iowa Combined (1985) (Iowa State U.)

- Robert B. Dahlgren, 1985-87 (wildlife)
- Paul A. Vohs, Jr., 1987-92 (wildlife)
- Erwin E. Klaas, 1992-99 (wildlife)
- David L. Otis, 2001-date (wildlife)

Erwin E. Klaas, 1985-92 (wildlife)
John S. Ramsey, 1986-90 (fisheries)
Clay Pierce, 1993-date (fisheries)
Rolf R. Koford, 1994-date (wildlife)

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

- Timothy C. Modde, 1991-92 (fisheries)
- Philip S. Gipson, 1993-date (wildlife)

Jack F. Cully, Jr., 1994-date (wildlife)
Christopher S. Guy, 1994-02 (fisheries)
Craig Paukert, 2003-date (fisheries)

Louisiana Wildlife (1962) (Louisiana State U.)

- John D. Newsom, 1962-81
- Phillip J. Zwank, 1981-85 (acting)

Robert H. Chabreck, 1967-72
A. William Palmisano, Jr., 1972-74
H. Randolph Perry, Jr., 1975-79
Phillip J. Zwank, 1980-81

Louisiana Fish (1963) (Louisiana State U.)

- William H. Herke, 1963-64, 1967, 1971 (acting)
- R. O'Neil Smitherman, 1964-67
- Jerry C. Tash, 1967-71
- C. Fred Bryan, 1971-85

William H. Herke, 1963-85

Louisiana Combined (1985) (Louisiana State U.)

- C. Frederick Bryan, 1985-03 (fisheries)
- Sammy King, 2003-date (wildlife)

William H. Herke, 1985-94 (fisheries)
Alan D. Afton, 1988-date (wildlife)
Richard M. Pace III, 1989-99 (wildlife)
Megan K. G. La Peyre, 2000-date (fisheries)
C. Fredrick Bryan, 2003 (fisheries)

Maine Wildlife (1935) (U. of Maine)

- Clarence M. Aldous, 1935-40
- John Pearce, 1940-42
- Howard L. Mendall, 1942-78
- James A. Sherburne, 1978-83
- John A. Bissonette, 1983-85 (acting)

Gustav A. Swanson*, 1936-37
Howard L. Mendall*, 1937-42
Charles Brown, 1942-44
Jay S. Gashwiler*, 1944-48
Malcolm W. Coulter*, 1948-68
Voit B. Richens, 1968-79
John A. Bissonette, 1981-83

Maine Fish (1962) (U. of Maine)

- Richard W. Hatch, 1962-77
- Jon G. Stanley, 1977-83
- John R. Moring, 1983-85 (acting)

Paul A. Haefner, Jr., 1963-69
Richard W. Gregory, 1969-74
Jon G. Stanley, 1975-77
John R. Moring, 1979-83

Maine Combined (1985) (U. of Maine)

- William B. Krohn, 1985-date (wildlife)

John R. Moring, 1985-2002 (fisheries)
Dennis B. Griffith, 1988-90 (wildlife)
Cynthia S. Loftin, 1999-date (wildlife)
Joe Zydlewski, 2003-date (fisheries)

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

- F. Joseph Margraf, 1995 (acting), 1996-99 (fisheries)
- James W. Wiley, 2001-2006 (wildlife)

Dixie L. Birch, 1996-2003 (wildlife)
Steven G. Hughes, 1995-2004 (fisheries)
Eric May*, 1998-2000

Massachusetts Wildlife (1948) (U. of Massachusetts)

- ❖ William G. Sheldon, 1948-72
- ❖ Wendell E. Dodge, 1972-87
- ❖ Mark Sayre*, 1988 (acting)
- ❖ Rebecca Field, 1988-90
  - Joseph S. Larson, 1967-69
  - Wendell E. Dodge, 1970-72
  - James J. Kennelly, 1973-79
  - Douglas S. Miller, 1981

Massachusetts Fish (1963) (U. of Massachusetts)

- ❖ James A. McCann, 1963-72
- ❖ Roger J. Reed, 1972-79
- ❖ Boyd E. Kynard, 1979-80 (acting)
- ❖ Henry E. Booke, 1980-88
  - Roger J. Reed, 1963-72
  - James D. Parrish, 1975-77
  - Boyd E. Kynard, 1978-79, 1980-89

Massachusetts Combined (1990) (U. of Massachusetts)

- ❖ Rebecca Field, 1990-96 (wildlife)
- ❖ Jay B. Hestbeck, 1996-97 (wildlife)
- ❖ Mark B. Bain, 1998 (acting; fisheries)
- ❖ Stephen DeStefano, 1999-date (wildlife)
  - Rebecca Field, 1988-90 (fisheries)
  - Martha E. Mather, 1991-date (fisheries)
  - Jay B. Hestbeck, 1989-96 (wildlife)
  - Rebecca Field, 1996-99 (wildlife)
  - Paul R. Sievert, 2000-date (wildlife)

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

- ❖ Mary G. Henry, 1988-94 (fisheries)
- ❖ David E. Andersen, 1994-95 (acting), 1995-date (wildlife)
  - David E. Andersen, 1989-94 (wildlife)
  - Bruce C. Vondracek, 1991-date (fisheries)
  - David C. Fulton, 1998-date (wildlife)

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

- Robert J. Muncy, 1979-89 (fisheries)
- Edward P. Hill, 1989 (acting), 1990-92 (wildlife)
- L. Esteban Miranda, 1992-93 (acting; fisheries)
- Harold L. Schramm, Jr., 1993-date (fisheries)
  Edward P. Hill, 1980-89 (wildlife)
  L. Esteban Miranda, 1986-92, 93-date (fisheries)
  Francisco Vilella, 1995-date (wildlife)

Missouri Wildlife (1937) (U. of Missouri)

- Paul D. Dalke, 1937-47
- Rudolf Bennitt*, 1947-48 (acting)
- Thomas S. Baskett, 1948-68, 1973-84
- W. Reid Goforth, 1968 (acting), 69-73
  Rollin D. Sparrowe, 1969-76
  Fred B. Samson, 1976-81

Missouri Fish (1962) (U. of Missouri)

- David I. Foster, 1963 (acting)
- Richard O. Anderson, 1963-84
- Charles F. Rabeni, 1984 (acting)
  David I. Foster, 1963-66
  Daniel W. Coble, 1967-71
  James B. Reynolds, 1972-78
  Charles F. Rabeni, 1979-84

Missouri Combined (1985) (U. of Missouri)

- Charles F. Rabeni, 1985-date (fisheries)
  Ronald D. Drobney, 1986-2003 (wildlife)
  David L. Galat, 1988-date (fisheries)

Montana Wildlife (1950) (U. of Montana)

- E.L. Cheatum, 1950-52
- Philip L. Wright*, 1952 (acting)
- Melvis S. Morris*, 1952 (acting)
- John J. Craighead, 1952-77
- Bart W. O'Gara, 1978-92
- I. Joseph Ball, 1993-2004
- Michael S. Mitchell, 2005-date
  Bart W. O'Gara, 1968-78
  I. Joseph Ball, 1979-93
  Thomas E. Martin, 1993-date

Montana Fish (1963) (Montana State U.)

- ❖ Richard J. Graham, 1963-73
- ❖ Richard W. Gregory, 1974-79
- ❖ William R. Gould, 1979-80 (acting)
- ❖ Robert G. White, 1980-02
- ❖ Alexander V. Zale, 2002-date

  William R. Gould, 1963-91
  Alexander V. Zale, 1994-02
  Christopher S. Guy, 2002-date

Nebraska Fish and Wildlife (2003) (U. of Nebraska-Lincoln)

- ❖ Craig R. Allen, 2004-date

  Kevin L. Pope, 2005-date (fisheries)

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

- ❖ Phillip J. Zwank, 1989-97 (wildlife)
- ❖ Bruce C. Thompson, 1997-98 (acting), 1998-2003 (wildlife)
- ❖ Louis C. Bender, 2003-2004 (acting)
- ❖ Colleen A. Caldwell, 2004-date (acting)

  Bruce C. Thompson, 1989-97 (wildlife)
  Colleen A. Caldwell, 1994-date (fisheries)
  Louis C. Bender, 2000-date (wildlife)

New York Wildlife (1961) (Cornell U.)

- ❖ Daniel Q. Thompson, 1961-75
- ❖ Milo E. Richmond, 1975-77 (acting), 1977-84

  Milo E. Richmond, 1968-75
  Richard A. Malecki, 1978-84

New York Fish (1963) (Cornell U.)

- ❖ Alfred W. Eipper, 1963-75
- ❖ John G. Nickum, 1975-76 (acting), 1977-80
- ❖ Steven P. Gloss, 1980-84

  Henry A. Regier, 1964-66
  Clarence A. Carlson, Jr., 1966-72
  John G. Nickum, 1973-75
  Steven P. Gloss, 1978-80

New York Combined (1984) (Cornell U.)

- ❖ Milo E. Richmond, 1984-date (wildlife)

  Steven P. Gloss, 1984-87 (fisheries)
  Richard A. Malecki, 1984-date (wildlife)
  Mark B. Bain, 1991-2003 (fisheries)

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

- F. Eugene Hester, 1963-71
- Melvin T. Huish, 1972-88
  - Robert E. Stevens, 1966-70
  - Garland B. Pardue, 1971-74
  - J. Howard Kerby, 1975-88

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

- W. James Fleming, 1988-95 (wildlife)
- Jaime Collazo/Joseph E. Hightower, 1996-99 (acting Co-leaders)
- Thomas J. Kwak, 1999-date (fisheries)
  - Melvin T. Huish, 1988-89 (fisheries)
  - Jaime Collazo, 1989-date (wildlife)
  - Joseph E. Hightower, 1991-date (fisheries)
  - Theodore R. Simons, 1996-date (ecology)

Ohio Wildlife (1936) (Ohio State U.)

- Lawrence E. Hicks, 1936-45
- Laurence H. Snyder*, 1945 (acting)
- Daniel L. Leedy, 1945-49
- Charles A. Dambach*, 1949
- Eugene Dustman, 1949-59
- Tony J. Peterle, 1959-63, 1964 (acting)
- Theodore A. Bookhout, 1964-86
  - Charles P. Stone, 1966-70
  - Richard D. Curnow, 1971-74
  - Gerald A. Grau, 1974-78
  - Jonathan R. Bart, 1979-86

Ohio Fish (1965) (Ohio State U.)

- Gerald J. Lauer, 1966-67
- Richard A. Tubb, 1967-74
- Bernard L. Griswold, 1976-79
- Robert F. Carline, 1979-84
- F. Joseph Margraf, 1984-86 (acting)
  - Stephen H. Taub, 1966-72
  - Bernard L. Griswold, 1973-76
  - Robert F. Carline, 1976-79
  - F. Joseph Margraf, 1980-84

Ohio Combined (1986) (Ohio State U.) (closed in 1998)

- Theodore A. Bookhout, 1986-96 (wildlife)
- Deanna J. Stouder, 1996-98 (fisheries)

Johnathan R. Bart, 1986-98 (wildlife)
F. Joseph Margraf, 1986-87 (fisheries)
Bruce C. Vondracek, 1988-91 (fisheries)
Susan Earnst, 1992-98 (wildlife)
Martin A. Stapanian, 1997-98 (wildlife)

Oklahoma Wildlife (1948) (Oklahoma State U.)

- Walter P. Taylor, 1948-51
- Adolph M. Stebler, 1951-67
- John A. Morrison, 1967-75
- Paul A. Vohs, Jr., 1976-79
- Frank Schitoskey, Jr., 1980-83
- O. Eugene Maughan, 1983-87 (acting)

Fred M. Baumgartner*, 1948-65
George A. Moore*, 1953-65 (fisheries)
Robert I. Smith*, 1965-67
James C. Lewis, 1967-77
John A. Bissonette, 1977-81

Oklahoma Fish (1965) (Oklahoma State U.)

- Robert C. Summerfelt, 1966-76
- O. Eugene Maughan, 1977-84

Bradford E. Brown, 1965-70
Austin K. Andrews, 1970-75
Michael D. Clady, 1976-81

Oklahoma Combined (1984) (Oklahoma State U.)

- O. Eugene Maughan, 1984-87 (fisheries)
- Philip Zwank, 1987-89 (wildlife)
- David (Chip) M. Leslie, Jr., 1989-date (wildlife)

David (Chip) M. Leslie, Jr., 1985-89 (wildlife)
Alexander V. Zale, 1985-93 (fisheries)
William L. Fisher, 1991-date (ecology)
Dana L. Winkelman, 1998-2003 (fisheries)

Oregon Wildlife (1935) (Oregon State U.) (closed in 1959; reformed in 1971)

- Arthur S. Einarsen, 1935-59
- Howard M. Wight, 1971-75
- E. Charles Meslow, (acting) 1975, 1976-94
- Robert G. Anthony, (acting) 1994-95, 1995-98

  E. Charles Meslow, 1971-75
  Robert G. Anthony, 1977-94
  Daniel D. Roby, 1995-98

Oregon Fish (1966) (Oregon State U.)

- Raymond C. Simon, 1966-73
- John D. McIntyre, 1973-77
- Carl B. Schreck, 1977 (acting), 1978-98

  Richard S. Wydoski, 1969-70
  John D. McIntyre, 1970-72
  Carl B. Schreck, 1975-77
  Hiram W. Li, 1978-98

Oregon Combined (1998) (Oregon State U.)

- Robert G. Anthony, 1998-date (wildlife)
- Carl B. Schreck, 1998-date (fisheries)

  Hiram W. Li, 1998-date (fisheries)
  Daniel D. Roby, 1998-date (wildlife)

Pennsylvania Wildlife (1938) (Pennsylvania State U.)

- Logan J. Bennett, 1938-43, 1945-47
- Pennoyer F. English*, 1943-45 (acting)
- Ward M. Sharp, 1948-62
- James S. Lindzey, 1962-80
- Gerald L. Storm, 1980-82 (acting)

  Pennoyer F. English*, 1938-58
  H. Norton Cope*, 1958-59
  John L. George, 1963-69
  Charles T. Cushwa, 1969-71
  Gerald L. Storm, 1972-80

Pennsylvania Fish (1964) (Pennsylvania State U.)

- Robert I. Butler, 1963-80
- Dean E. Arnold, 1980-82 (acting)

  Anthony Bodola, 1964-67
  Donald C. Hales, 1967-69
  Robert F. Raleigh, 1970-72
  Dean E. Arnold, 1973-80

Pennsylvania Combined (1982) (Pennsylvania State U.)

- Gerald L. Storm/Dean E. Arnold 1982-84 (acting Co-leaders)
- Robert F. Carline, 1984-date (fisheries)
  - Dean E. Arnold, 1984-99 (fisheries)
  - Gerald L. Storm, 1984-97 (wildlife)
  - Duane R. Diefenbach, 1999-date (wildlife)
  - Erin M. Snyder, 2001-03 (fisheries)

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

- Robert E. Trost, 1988-90 (wildlife)
- David L. Otis, 1991-2001 (wildlife
- Craig R. Allen, 2002-04 (wildlife)
- J. Jeffery Isely/Patrick G.R. Jodice, 2004-date (acting Co-leaders)
  - Susan M. Haig, 1989-94 (wildlife)
  - J. Jeffery Isely, 1992-date (fisheries)
  - Craig R. Allen, 1998-2002 (wildlife)
  - Patrick G. R. Jodice, 2002-date (wildlife)

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

- Paul F. Springer, 1963-67
- Raymond L. Linder, 1967-84
  - Robert B. Dahlgren, 1967-73
  - Frank Schitoskey, Jr., 1974-80
  - W. Alan Wentz, 1980-81

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

- Alfred C. Fox, 1965-68
- Richard L. Applegate, 1968-70 (acting)
- Donald C. Hales, 1970-77
- Richard L. Applegate, 1977-83
  - Richard A. Tubb, 1966-67
  - Richard L. Applegate, 1967-77
  - Robert S. Benda, 1978-81

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

- Raymond L. Linder, 1984-85 (wildlife)
- Charles R. Berry, Jr., 1985-date (fisheries)
  - Kenneth F. Higgins, 1985-date (wildlife)
  - Walter G. Duffy, 1988-97 (fisheries)
  - Steven R. Chipps, 1999-date (fisheries)

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

- ❖ R. Don Estes, 1972-95
- ❖ James B. Layzer, 1995-98 (acting), 1998-date

  C. Phillip Goodyear, 1974-75
  John N. Rinne, 1976
  Michael J. Van Den Avyle, 1977-81
  James B. Layzer, 1985-98
  Phillip William Bettoli, 2000-date

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

- ❖ Walter P. Taylor, 1935-48
- ❖ W. B. Davis, 1948 (acting)
- ❖ George A. Petrides, 1948-50

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

- ❖ Nick C. Parker, 1988-2003 (fisheries)
- ❖ Clint W. Boal, 2003 (acting)
- ❖ Reynaldo Patino, 2004-date (acting)

  Reynaldo Patino, 1989-date (fisheries)
  Nancy E. Mathews, 1990-95 (wildlife)
  Clint W. Boal, 2000-date (wildlife)

Utah Wildlife (1935) (Utah State U.)

- ❖ Daniel I. Rasmussen, 1935-45
- ❖ Jessop B. Low, 1945-74
- ❖ J. Juan Spillett, 1974-75 (acting)
- ❖ David R. Anderson, 1975-84

  J. Juan Spillett, 1967-76
  Frederick G. Lindzey, 1977-84

Utah Fish (1962) (Utah State U.)

- ❖ Donald R. Franklin, 1962-66
- ❖ Robert H. Kramer, 1966-74
- ❖ Richard S. Wydoski, 1974-77
- ❖ Charles R. Berry, Jr., 1977-78 (acting)
- ❖ Ross V. Bulkley, 1978-85

  Robert H. Kramer, 1965-66
  Clair B. Stalnaker, 1966-75
  Charles R. Berry, Jr., 1975-77, 1978-85

Utah Combined (1984) (Utah State U.)

- John A. Bissonette, 1985-date (wildlife)
  Timothy C. Modde, 1986-91 (fisheries)
  David A. Beauchamp, 1994-99 (fisheries)
  Thomas C. Edwards, Jr., 1988-date (wildlife)
  Phaedra E. Budy, 2000-date (fisheries)

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

- Byron K. Williams, 1990-95 (wildlife)
- Donna L. Parrish, 1995-97 (acting), 1997-date (fisheries)
  Mary C. Watzin, 1990-94 (wildlife)
  Donna L. Parrish, 1991-95 (fisheries)
  Therese M. Donovan, 2000-date (wildlife)

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

- C. O. Handley, 1935-47
- Henry S. Mosby, 1947-48 (acting), 1948-55
- James S. Lindzey, 1955-58
- Burd S. McGinnes, 1958-82
- Michael R. Vaughan, 1982-85 (acting)
  Cecil F. DeLaBarre*, 1935-49
  James B. Whelan, 1968-80
  Michael R. Vaughan, 1980-82

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

- Kenneth B. Cummings, 1966-71
- Robert F. Raleigh, 1972-75
- Garland B. Pardue, 1976-83
- Richard J. Neves, 1983-84 (acting)
  R. Don Estes, 1966-72
  O. Eugene Maughan, 1972-77
  Richard J. Neves, 1978-83

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

- Richard J. Neves, 1985-date (fisheries)
  Michael R. Vaughan, 1985-date (wildlife)
  Paul L. Angermeier, 1988-date (fisheries)

Washington Fish (1967) (U. of Washington)

- Richard R. Whitney, 1967-83
- Gilbert B. Pauley, 1983-87 (acting)
  - Ed Marvich, 1968-70
  - Richard S. Wydoski, 1970-74
  - Gilbert B. Pauley, 1974-83

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

- Gilbert B. Pauley, 1988 (acting; fisheries)
- Christian E. Grue, 1989-date (wildlife)
  - Gilbert B. Pauley, 1989-97 (fisheries)
  - Glenn VanBlaricom, 1993-date (wildlife)
  - David A. Beauchamp, 1999-date (fisheries)

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

- F. Joseph Margraf, 1987-96 (fisheries)
- Patricia M. Mazik, 1998-date (fisheries)
  - Patrick W. Brown, 1987-90 (wildlife)
  - Sue A. Perry, 1987-96 (fisheries)
  - Petra Bohall-Wood, 1992-date (wildlife)
  - Stuart A. Welsh, 2000-date (fisheries)

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

- Robert L. Ruff*, 1972-73
- Donald H. Rusch, 1973-99
- Christine A. Ribic, 1999 (acting), 2000-date
  - Christine A. Ribic, 1994-99
  - Michael Samuels, 2003-date

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

- Daniel W. Coble, 1971-97
- Michael A. Bozek, 1997-99 (acting), 1999-date
  - Henry E. Booke, 1973-80
  - Michael A. Bozek, 1994-97
  - Brian L. Sloss, 2002-date

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

- Stanley H. Anderson, 1980-2005 (wildlife)
- Wayne A. Hubert, 2005-date
  - Wayne A. Hubert, 1982-2005 (fisheries)
  - Frederick G. Lindzey, 1984-2004 (wildlife)

From the beginning, the wildlife units have been part of the National Fish and Wildlife Research Program. 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, 1935-37
Hartley H. T. Jackson, 1937-39
Leo P. Couch, 1939-44
Gustav A. Swanson, 1944-46
Lee E. Yeager, 1946-47, 1963-67
Logan J. Bennett, 1948-49
Daniel L. Leedy, 1949-57
John L. Buckley, 1957-58
Eugene H. Dustman, 1958-63
Willis King, 1960-73
Edward Kinney, 1967-73
Nicholas R. Holler, 1968-73
Stephen H. Taub, 1972-76
Richard J. Graham, 1973-78
Robert G. Streeter, 1973-76
Rollin D. Sparrowe, 1976-83
Rebecca Field, 1979-81
Bernard L. Griswold, 1979-83
Paul A. Vohs, Jr., 1980-83
W. Reid Goforth, 1983-99
Carol A. Lemm, 1983-86
John G. Rogers, Jr., 1983-86
Jon G. Stanley, 1983-85
Terry T. Terrell, 1986-88
Edward T. LaRoe, 1987-93
Bettina Sparrowe, 1988-90
Denise Wilson, 1988-90
Mark Shaffer, 1988-91
Connie Walker, 1990-97
Gwen Williams, 1991-93
Lynn Haines, 1991-2004
Linda A. Gaumer, 1993-97
W. James Fleming, 1995-date
Michael W. Tome, 1994-date
Michael J.Van Den Avyle,1996-date
Byron K. Williams, 1997-date
Janice Jo Lacy, 1998-2000
Shari Weant, 2001-date
Bern Shanks, 2005-date

Many other individuals have served the cooperative units headquarters in important assignments; an array of much appreciated individuals has served the headquarters in support 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 2005, units reported that 7,185 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 Agency	State Fish and Wildlife Agency	University[1]	Other[2]
1,866	2,362	1,546	1,444

[1] Includes students pursing another degree before receiving first job.
[2] Refers to non-government and private industry positions and unknowns.

Appendix J. 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.
5. In 1993 the Cooperative Research Unit Program was transferred, along with the research centers of the Fish and Wildlife Service, to the newly formed National Biological Survey. From that stand-alone organization in the Interior Department, the entire Interior Biological Research Organization was later transferred, by action of Congress, to become a fourth division in the U.S. Geological Survey.

The 1960 Act

Prior to 1960, the unit program was a loose collection of U.S. Fish and Wildlife Service (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 title. 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.*

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 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, which is part of the Fish and Wildlife Improvement Act, established the Research Work Order (RWO) process and 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…

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

The 1978 amendment brought major changes in many areas of regarding operations for the Cooperative Research Units Program. 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 –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 for the Cooperative Research Units Program, there was quick reaction from state agency and university cooperators. These cooperators, along with the Wildlife Management Institute and other conservation organizations, voiced their concerns to state congressional delegations, causing the U.S. 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

Several new units were added in the latter part of the 1980s, probably because of increased program visibility that resulted from the program being eliminated from the administrations' budget for three years. The resulting concern and actions by cooperators regained budget status for the Program in 1984. 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.

One small budget increase was realized in the early 1990s but it was far from enough to make the program whole. In fact, through the early and mid 1990s it was necessary to refrain from filling vacancies so that the saved salary funds could be used to keep up with increases in salaries for the positions that remained filled. This cannibalization of positions continued well into the late 1990s, until 1998 when Congress started appropriating budget increases for the Cooperative Research Units Program. In 2001, Congress fully funded the program but appropriated stagnant budgets in subsequent years. Once again, the program was forced to offset rising personnel costs by resuming its cannibalization of vacated positions. By 2006, 16 percent of the program's authorized positions were vacant and unfunded.

While budgets remained stagnant and unit science vacancies increased between 2001 and 2005, the U.S. Senate asked the Cooperative Research Units Program to draft a strategic plan for expansion. At the time of the request, several states were seeking the establishment of a local unit while other states that already had units were seeking personnel increases. In response to this observed need, program leaders developed and the Senate approved in 2005 a strategic plan that explained how proposals for Cooperative Research Unit expansion would be evaluated. By the time this book was reprinted in February 2006, however, the program had not yet received additional funds to enact any program expansion requests, let alone fill current commitments to program cooperators.

In 2004, program cooperators and other interested parties, excluding federal agencies, formed the National Cooperator's Coalition. This Coalition was established to improve cooperator input into the operation of the national program and to consolidate support for cooperator interests in the Cooperative Fish and Wildlife Research Units. In 2005, bylaws were adopted and a steering committee was established. The Coalition now meets annually to review program activities and priorities at the national level, to strategize on building support for the program, and to exchange information with federal program managers.

Amalgamation of Interior Agency Research Programs

The 1993 proposal of Secretary Babbitt to merge all living resource research efforts of the Interior agencies into a single research organization was traumatic to the U.S. Fish and Wildlife Service. The research arm of the Service

was the largest and most organized of any of the Interior's agency based research programs, focusing entirely on the information needs of Service managers. Negotiations between the Secretary and Congress regarding this reorganization proposal did not go well, and at one point Congress raised the possibility of eliminating all funds for the Department of the Interior's living research programs. Further negotiations resulted in the proposed amalgamated living research program being fused with the Interior's well established U.S. Geological Survey research arm and being designated as a specific discipline within the agency. While formerly part of the research program of the Service, the Cooperative Research Units now reside within the Survey and are administered by that agency.

Appendix K. Unit Research Highlights.

A unique and important value of the Cooperative Research Units Program is its capability to address very specific, short-term information needs of the cooperators while also conducting long-term, basic research on the biology and ecology of fish and wildlife. This programmatic capability exists for two reasons. First, unit scientists rely on graduate students to address the applied management questions of unit cooperators. This approach allows the federal personnel to investigate the more complex, longer-term questions surrounding fish and wildlife conservation; although unit scientists may sometimes have graduate students research separate portions of a larger information need. Second, the Cooperative Research Units Program is affiliated with 40 different universities, each campus providing unit scientists with access to may discipline experts. Consequently, the program can address almost any applied or basic research topic concerning living resources.

What follows is a look at the ways in which the Cooperative Research Units Program meets the ever-growing needs of its state and federal cooperators. Some of the project descriptions are new whereas others provide updates on research projects featured in the book's first edition. All descriptions, however, demonstrate how unit scientists play a vital role in the development of sound scientific research that guides fish and wildlife management efforts throughout the country.

Habitat Studies

Fish and wildlife habitat is shrinking, in both size and quality, on almost every piece of land in the world due to commercial and residential development, road building, agricultural production, timber harvesting and numerous other activities. To counter the ecological effects of these development projects on fish and wildlife, natural resource managers must have a thorough understanding of how ecosystems function as well as what quality habitat means for a variety of fish and wildlife species. Unit scientists therefore focus a large part of their research efforts on identifying and evaluating specific habitat parameters of different animals.

Landscape Analysis of Moose Distribution Relative to Fire History in Interior Alaska

Moose (Alces alces) are a critical component of ecosystems in interior Alaska, as well as being an important resource for subsistence and sport harvests. And because fire is the dominant form of disturbance for this region, it plays an essential role in forage production for moose. The managers for interior

Alaska's national wildlife refuges are responsible for developing refuge fire management plans and responding to federal subsistence proposals, many of which concern moose. Yet to carryout these administrative tasks, the refuge managers need a thorough understanding of how fires shape interior Alaska's ecosystems.

Recent research on large herbivores indicates that the characteristics of a given landscape, such as patch size, shape and configuration, play a major role in determining the spatial distribution of animals. What is not known, however, is how the age and juxtaposition of wildland fires affect the density of moose populations. To further wildlife managers' understanding of how large-scale habitat disturbances impact moose, unit scientists are analyzing the distribution of moose in interior Alaska in relation to spatial data on vegetation and other topographic features, including the age and configuration of wildfire. These analyses will provide important insights for managing wildland fires and moose, thereby promoting a better understanding of the role of fire on ecosystems in interior Alaska.

Cougar Ecology and Management

Recent increases in cougar populations (Felis concolor) and cougar-human interactions throughout western North America present new challenges for wildlife managers. Therefore, a team of unit researchers completed an integrative analysis of cougar distribution and abundance for the entire state of Montana using variables pertaining to habitat, prey, land use, and proximity to humans. They also looked at the attitudes of wildlife stakeholders (ranchers, hunters, suburbanites, etc.) toward cougars. Collectively, these research objectives led to the development of measures for evaluating the population performance of cougars, estimating the cat's population size, and identifying genetic characteristics of local and regional cougar populations.

This work culminated in a 3-day workshop on adaptive harvest management of mountain lions in the Rocky Mountain west that was attended by biologists and administrators from New Mexico, Utah, Colorado, Wyoming, Idaho, Montana, U.S. Fish and Wildlife Service (FWS), and the Bureau of Indian Affairs. Wildlife agencies in Colorado, Idaho and Montana, as well as the FWS, have embraced the management model and approach presented by the unit scientists, and other states have recognized the merit of understanding both biological carrying capacity and stakeholder acceptance capacity when formulating management plans for cougars. Indeed, the combined data on biological carrying capacity and stakeholder acceptance capacity provide a basis for formulating cougar management plans at broad geographical scales and offers a holistic approach to sharing the landscape with a large carnivore.

Factors Affecting Overwinter Survival of Stocked Trout in Tailwaters

Researchers developed a comprehensive understanding of factors affecting the overwinter survival of trout in Wyoming tailwaters. Several integrated graduate student projects provided insight on the relative and cumulative effects of water temperature, ice processes, starvation, water level fluctuation, and fish stocking practices on the overwinter survival of juvenile trout among tailwaters. Strategies were developed to optimize survival of stocked fish through managing winter flows and the size and timing of stocking.

Missouri River Benthic Fishes Study

This multi-year research project is one of the largest basin-wide river fisheries studies ever undertaken by the Cooperative Research Units Program, encompassing 2,300 miles along the mainstem of the Missouri River and involving six units, eight state agencies and multiple federal partners. The research team's goal was to provide population structure and habitat use

information for 26 benthic fish species, many of which are rare, threatened, or of special concern by state or federal agencies. Therefore, at all fish collection sites the team measured the river basin's physical and water quality characteristics, such as depth, velocity, water temperature and substrate, in addition to collecting specimens for all targeted benthic species.

A significant accomplishment of the study included the development and refinement of a stratified random sampling design, standard operating procedures, and fish capture gears. Additionally, the U.S. Fish and Wildlife Service used the study's relative abundance and spatial distribution data when deciding not to list two candidate species in 2001 (sicklefin chub, Macrhybopsis meeki, and sturgeon chub, Macrhybopsis gelida). The U.S. Army Corps of Engineers will use the data to manage the timing and magnitude of reservoir releases throughout the Missouri River Basin.

Burrowing Owl Survival Studies

Burrowing owls are considered endangered in Minnesota, Iowa, Mexico, and Canada, and populations have declined significantly in British Columbia, Alberta, Arizona, California, Colorado, Kansas, Nebraska, Nevada, New Mexico, Utah, and Washington. Consequently, the FWS has listed the western burrowing owl (Athene cunicularia) as a Species at Risk and is currently conducting a range-wide status review. Despite widespread declines and increased concern for burrowing owl populations throughout North America, biologists lack reliable data on underlying causes of the bird's decline. Thus the goal of this research effort is to compare the primary demographic parameters among populations of burrowing owls that display varying levels of migratory behavior.

Unit scientists selected seven research sites, which include two locations at which owls are entirely migratory (central Washington and northeastern Wyoming), one site at which owls are about 50% migratory (southern Washington), and four locations at which owls are year-round residents (southern Arizona and central and southern California). The objectives of the project are as follows: 1) compare annual fecundity and annual territory fidelity among populations; 2) document migratory status of each local population; 3) compare annual survival of adult owls (both males and females) among populations; 4) compare juvenile recruitment among populations; and 5) examine the habitat and landscape features that influence reproductive success, territory fidelity, and annual survival in each local area.

Suburban Ecology

The entire nation is experiencing tremendous growth, particularly along the interface between urban and rural areas. This suburban expansion occurs in the form of housing developments, industrial parks, shopping malls, roadways, and other structures that obliterate, alter, or otherwise impact terrestrial and aquatic habitats and associated wildlife and fish populations. Additionally, some animals that once were viewed as popular game species or important members of an ecological community are now regarded as pests and health threats.

When responding to conservation issues in suburban environments, wildlife managers often design and implement education programs that strive to increase public awareness about the habitat needs and multiple values of wildlife. On other occasions, managers offer landowners some sort of incentive program to compensate them for the damage they incur when native wildlife use their property. In all situations, wildlife managers look towards the efforts of researchers to learn how human activities impact the behavior and survivorship of wildlife and how those activities could be conducted in a way that minimizes disturbance to wildlife.

Migrations and Winter-range Use by Ungulates in Northwestern Wyoming

Changes in land management often occur when property is transferred to a new owner. Some times this results in either the loss of a critical habitat feature or the conversion of contiguous habitats into isolated fragments. Such changes make it more difficult for animals needing large tracts of land to find food, shelter and a breeding mate. And when population segments are isolated geographically for a long period of time, genetic changes may emerge in each population segment. To understand the effects of oil/gas development and increased home building on cervids, unit scientists examined the seasonal movements and winter habitat use patterns of mule deer (Odocoileus hemionus) and pronghorn antelope (Antilocapra americana). The research identified migration corridors for each animal and provided state and federal resource agencies with the opportunity to protect these movement pathways into the future.

Effects of Sediment Toxicity on Endangered Mussel Populations

The upper Tennessee and Cumberland Rivers are home to one of the most diverse assemblages of freshwater mussels in the world. In total, these rivers host 60 species of freshwater mussels, 30 of which are federally protected as either endangered or threatened under the Endangered Species Act. But much of the shoreline for each river also supports coal mining projects that have

drained a variety of toxic compounds into both river systems. Unit scientists, therefore, are determining how the toxic compounds, which have settled into the rivers' sediment streambed, are impacting juvenile mussel recruitment. The research team will present their findings directly to the mining industry, as well as recommendations on how the industry could improve its best management practices guidance for waste material disposal. State authorities also may use the study's results to restructure waste disposal laws.

Playa Lake Areas as Habitat Reserves for Prairie Dogs

Although farms often surround playa lakes in the Great Plains region, they are subject to less intensive agricultural practices in comparison to other farmlands. Resultantly, the lands adjoining playa lakes exist as one of the last sources of native habitat and refuge for wildlife. In the Southern High Plains of Texas, unit scientists have observed black-tailed prairie dogs (Cynomys ludovicianus) living in close association with playa lakes. The scientists also found that some species of small mammals and birds occurred in greater densities when associated with the prairie dog colonies. Results of this research project will be used in education efforts that seek to involve farmers in the protection of playa lakes and associated lands.

Invasive Species

As the world grows constantly smaller through advanced communications and transportation methods, the natural world tends to become more homogeneous. Species are being found daily in new areas of the world where they never previously existed and this problem is growing exponentially, resulting in interspecies competitions for which neither native species or biologists were prepared. Additionally, there is the tendency of humans to move species into new places either for recreational or ornamental purposes. Planned introductions of non-native species results in problems that parallel those observed when an exotic plant or animal enters a new area on its own.

The interactions of invasive species and native plants, fish and wildlife are unpredictable and many times have adverse effects on the invaded community's original inhabitants. In extreme cases, the native species may be forced out of their niche or become endangered because they did not evolve with the invader and, therefore, lack effective mechanisms to combat the invader's higher reproductive output and less specific habitat needs. Research on invasive species is particularly taxing because it must be carried out in the absence of basic information. Every study starts from scratch and must include an investigation of all parameters within the targeted community.

Ecological Impacts of Imported Red Fire Ants

The red imported fire ant (Solenopsis invicta) is native to Brazil and arrived in the southeastern U.S. between 1933 and 1945. Overtime, this ant emerged as an agricultural and urban pest, as well as a source of public health and environmental concerns. For this project, unit scientists are quantifying how the exotic red imported fire ant is impacting native wildlife and ecological processes in the Southeast. Specifically, the scientists are investigating which native species and ecological processes, such as seed dispersal, are vulnerable to fire ant invasions while also determining the severity of the ant's impact on native communities and how those impacts are generated. State and federal conservation entities are using the results to promulgate control measures and to educate landowners and other citizens about the fire ant problem, including how to respond to fire ant invasions.

Northern Pike Introduction in Colorado

A top concern among fishery managers in Colorado is the spread of whirling disease, but a close second is the presence of northern pike (Esox lucius) in trout lakes. The natural distribution of northern pike exists mostly within Canada, Northeast U.S. and northern sections of the Ohio Valley and Great Lakes region. In 1956, the Colorado Division of Wildlife introduced the fish into some trout lakes to enhance Colorado's sportfishing opportunities, but since then northern pike have spread on their own to other lakes, much to the detriment of trout populations. Unit scientists are researching how and why some trout lakes were converted to northern pike lakes and are studying the population dynamics associated with these conversions. Upon completion of this project, the scientists hope to provide fishery managers with possible management options that will eliminate or reduce the spread of northern pike to other trout lakes.

Sampling Vulnerability of Invasive Freshwater Fishes: Snakeheads and Flathead Catfish

Snakeheads (Channa spp.) are native to Africa and southern Asia and have been transported around the world for use in the food and pet trade industries. Flathead catfish (Polydictis olivaris) are native to the Mississippi, Rio Grande and Mobile River drainages, but because they are prized as a sportfish in many areas, they have been introduced widely in the United States. Both types of invasive fish are obligate carnivores and, therefore, detrimental to other fish populations. To control the populations of invasive fish, fishery managers typically use electro-shocking but more research is needed to understand which electric voltage gradients that are the most effective for

detecting and assessing the populations of snakehead and flathead catfish. Thus the purpose of this project is to investigate which electro-shocking parameters are most efficient for immobilizing and capturing snakeheads and flathead catfish.

Eastern Red Cedar Invasion and Effect on Small Mammal Community Structure

Eastern red cedar (Juniperus virginiana), as its name suggests, is native to the United States' eastern region and flourishes in areas with thin, dry soils. Although the plant naturally occurs in prairies and oak barrens, in the absence of fire the tree can become an invasive plant, thereby displacing warm season grasses that are important to grassland dependent wildlife.

For this particular study, Unit scientists examined small mammal communities in areas where eastern red cedar had invaded tallgrass prairie habitats and old fields in Virginia and the Carolinas. During the study, the researchers observed a shift in the location of small mammal communities along the gradient of increasing red cedar trees. In the old field and tallgrass prairie plots, most grassland species (i.e., hispid cotton rats, Sigmodon hispidus, and harvest mice, Reithrodontomys humulis) decreased as the number of cedar trees increased. The white-footed mouse (Peromyscus leucopus) was the only woodland species to demonstrate a population increase.

Population Management

Since the beginning of the fishery and wildlife management profession, biologists have always needed a comprehensive understanding of the factors affecting an animal's life span. Research that focuses on reproduction, mortality, dispersal, juvenile versus adult survivorship and many other population dynamic factors yields valuable insight on how a fish or wildlife population is structured. But the factors influencing population dynamics are complex and are still poorly understood for many species. It is for this reason that population dynamics research remains as one of the key building blocks of any fish and wildlife research project. Without it, fisheries and wildlife managers would lack all of the biological information they need to make scientifically sound, informed decisions on how to restore and sustain a population's existence.

Capture-Recapture/Banding-Recovery Analysis Theory

This project exemplifies the type of sophisticated mathematical studies unit scientists sometimes conduct. It was part of a long-term study in which the researchers developed and tested various mathematical estimation tools, specifically to determine which estimates yield the best fit for differing

population sizes and reproductive characteristics of a given species. Although the mathematical models were developed primarily to refine harvest predictions for waterfowl, they could be used for any species for which biologists have known population dynamic characteristics and that is experiencing population reductions due to changes in habitat, predation, disease and other similar forces.

Development of Population Models for Harvest Management of Mourning Doves

When developing an informed management plan for a game species, wildlife biologists must have access to a set of population models that integrates available knowledge on the animal's life history parameters. Thus this project involves the synthetic analysis and modeling of data collected during previous mourning dove (Zenaida macroura) banding and breeding ecology studies to create a decision-making tool that state and federal agencies, technical committees and flyway councils could use when predicting the population effects of harvest regulations on mourning doves. For the same group of dove managers, unit scientists are generating a list of research and monitoring data priorities; information that will be needed to improve the reliability of population models for mourning doves.

Gene Flow among Populations of Black Bear in Arizona

Black bear (Ursus americanus) habitat in southwest Arizona's "sky island" ecosystem is becoming increasingly fragmented, which in turn may interrupt migrations and gene flow among bear populations. To address this concern and to improve future bear management efforts in the region, unit scientists are using genetic markers obtained from field and museum specimens to estimate gene flow among historical and current bear populations in southwest Arizona. Once those gene flow estimates are identified, the scientists will compare the connectivity level of black bear populations from 100-years ago to the connectivity levels of current bear populations. Results of the study will be used to prepare bear management recommendations for the Arizona Game and Fish Department.

Genetic Diversity

Reintroduction programs conducted as a component of recovery efforts for threatened and endangered species must consider the importance of preserving genetic diversity in new or supplemented populations. It is for this reason that unit researchers are developing state of the art genetic techniques to construct pedigrees of endangered birds and to identify differences and similarities among captive and wild bird populations. Results of this study will

foster the development of improved management strategies for endangered birds among state wildlife agencies and the U.S. Fish and Wildlife Service.

Threatened and Endangered Species

As human activities continue to encroach on the habitats of fish and wildlife and as the predation and harvest rates of animals continue to fluctuate among years, more and more species are becoming threatened with extinction. To counter this trend, scientists are researching methods that fish and wildlife managers could use either to increase the survivorship of at-risk species or to mitigate the impacts of those specific activities that threaten fish and wildlife populations. Due to the complex nature of recovering threatened and endangered species, the results of past conservation efforts represent various degrees of success and failure.

Gulf Coast Beach Mice

The federally endangered beach mouse (Peromyscus polionotus) inhabits the Gulf Coast between Indian Pass, Florida, and the tip of Alabama's Fort Morgan Peninsula. Due to intense development of this coastal front, the populations of beach mice are becoming increasingly isolated. The species' fate is compounded further by its slow recovery to a series of tropical storms that damaged the mouse's remaining habitat in the late 1990's. To aid conservation and recovery efforts of the Fish and Wildlife Service, unit scientists have conducted life-history research on four beach mouse subspecies. Initial data indicated that the animal's preferred habitat was limited to a narrow section of frontal dunes. Recent studies, however, have determined that the presence of interior scrub habitat, which often is removed substantially from dune areas, is crucial for population survival following catastrophic storm events. The Service has used the research results to revise their critical habitat designations and population re-establishment decisions for the beach mouse.

Robust Redhorse

The robust redhorse (Moxostoma robustum) is a member of the redhorse sucker family and is designated as a federal species of concern. It was discovered in 1869 by Edward Cope but subsequently led a mysterious life; so mysterious that the biological community thought the fish was extinct until it was rediscovered in Georgia's Oconee River in 1991. At the time of its rediscovery, virtually nothing was known about the robust redhorse's biology and ecology, and it was believed that the captured individuals came from a remnant, senescent population that was experiencing little or no recruitment.

Since 1991, Unit scientists have been instrumental in generating basic information about the robust redhorse's life-history. This research team has

investigated the fish's spawning cycle to determine where the fish mates and what type of spawning habitat the species requires; to learn how much suitable spawning habitat exists within the Oconee River; to identify the size and distribution of redhorse larval populations; and to determine whether or not the peak flows of hydropower facilities eliminate larval nursery areas. Unit scientists also conducted population dynamics research to estimate the population size, recruitment rate, and survivorship of robust redhorse individuals and obtained preliminary data on the seasonal habitat needs of juvenile redhorses. Collectively, these research projects have provided fisheries biologists with the biological information they need to formulate management strategies for the robust redhorse population in Oconee River and to decide how the fish could be restored to medium and large rivers within its historic range.

Predictive Habitat Modeling for the Endangered Aplomado Falcon in the Northern Chihuahuan Desert

Five years of investigations among federal and private biologists culminated in the formulation of a predictive habitat model for the endangered northern aplomado falcon (Falco femoralis septentrionalis). This model and associated map identifies grassland locations that breeding falcons are most likely to use in western Texas, southern New Mexico, and northern Chihuahua, Mexico. To validate this prediction, unit scientists teamed up with federal agencies and The Peregrine Fund to measure and compare the characteristics of predicted and known breeding sites for the raptor, focusing specifically on habitat conditions, prey base availability and overall landscape features of each grassland site. The U.S. Fish and Wildlife Service and Bureau of Land Management are the primary users of the validated model, often using it to plan conservation and land management efforts for the endangered bird.

Developmental Habitat Use by Juvenile Sea Turtles in the Northern Gulf of Mexico

Habitat use by sea turtles is not well documented or understood. This creates significant challenges for biologists that must respond to natural and anthropogenic events that impact sea turtle populations and habitat, whether it is in the form of tropical storms, cold-stunning events, or coastal development and recreation. To ensure wildlife biologists are prepared for such events, unit scientists investigated how juvenile sea turtles use the coastal habitat of Cape San Blas. These researchers used netting and radio and sonic telemetry to identify (1) the number of sea turtle species, (2) the density and size-class composition of each population, (3) the seasonal variation in species and size-class composition, and (4) the habitat preferences of each sea turtle species. Results of this study will provide wildlife managers at the Florida Fish and Wildlife Commission and FWS with critical information about the sea turtles

that occupy the rapidly developing coastline of Florida's panhandle. The study also will generate new information on how juvenile sea turtles disperse throughout the entire Gulf of Mexico.

Protection of Endangered Bats

The Ozark big-eared bat (Plecotus townsendii ingens) is one of the most endangered bat species in the United States. It roosts within the caves of eastern Oklahoma, southern Missouri, and western Arkansas and is quick to flee when disturbed by humans and animals. This low tolerance for human and animal disturbance can lead to starvation during the winter season and the premature death of juvenile bats during the breeding season. In response to this conservation problem, unit researchers evaluated the efficacy of gating off cave-passages as a technique for eliminating human disturbance. Additionally, the scientists documented the bat's genetic structure at maternity colonies and hibernacula in northeastern Oklahoma. Both research objectives respond directly to the Fish and Wildlife Service's conservation priorities for the newly established Ozark Plateau National Wildlife Refuge.

Black-Footed Ferret Monitoring

Black-footed ferrets (Mustela nigripes) were thought to be extinct in the U.S. until biologists found approximately 120 individuals in Wyoming in the mid-1980s. Since then the U.S. Fish and Wildlife Service and multiple state wildlife agencies have administered a captive-breeding program to reintroduce the ferret among 8 prairie dog colonies in the Intermountain West. Every year biologists must monitor the survivorship and reproductive output of each ferret population to evaluate the success of their reintroduction efforts. This is a difficult task, however, because black-footed ferrets are nocturnal and disturbance to the prairie dog colonies must be kept to a minimum. To address this problem, unit scientists evaluated the efficacy of scent detection dogs and visual surveys that use different colored spotlight filters for monitoring ferret populations. The research team found that scent detection dogs were very useful in detecting the presence or absence of ferrets in a prairie dog colony but that biologists must use colored spot light filters when counting and identifying individual ferrets in each colony.

Adaptive Management

Scientists often hypothesize about the ecological relationships between animals and their environments; however, the functional relationships between species and communities are still poorly understood nor well defined. Resultantly, fish and wildlife managers often develop and rely upon single management prescriptions that are based on models incorporating stakeholder

requirements, expert opinion, empirical data, and/or engineering constraints for the conservation issue at hand. Such prescriptions are problematic because they use imprecise (and sometimes inaccurate) knowledge and because natural systems typically are very dynamic. To combat this problem, numerous unit scientists have led the way in developing and applying adaptive management approaches that provide fish and wildlife managers with iterative advances in knowledge and decision-making processes that they can use when addressing a variety of natural resource projects and issues.

Development of an Integrated, Adaptive Management Protocol for American Black Ducks

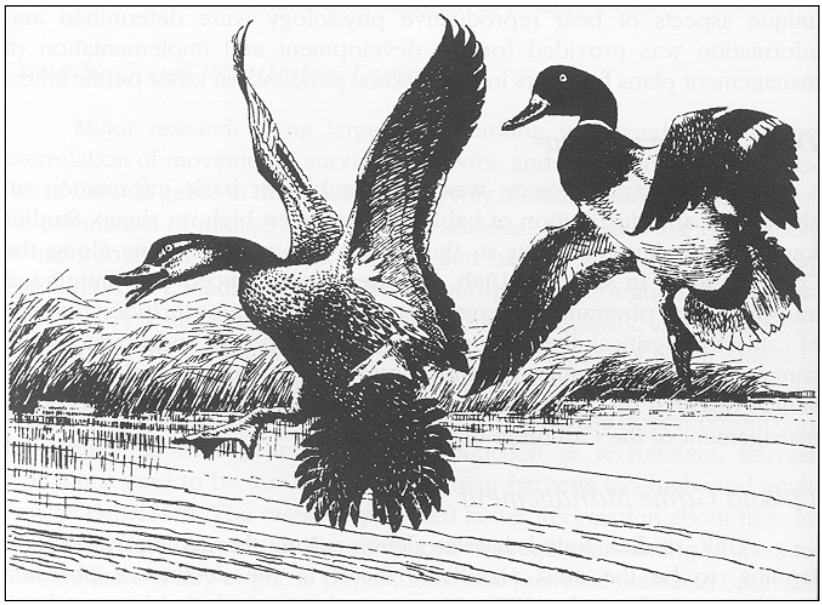
Adaptive harvest management (AHM) is an innovative approach that wildlife biologists are now using to set annual harvest regulations for waterfowl. When developing AHM strategies for a particular species, biologists must collect and analyze population data before they can develop and evaluate a set of population models that describe possible outcomes of different harvest rates and environmental factors (e.g., change in weather or number of ponds that can support breeding ducks and geese).

Unit scientists have played a significant role in the development of AHM strategies for the American black duck (Anas rubripes). The project began with the development and evaluation of single- and multiple-population AHM models for the bird but because the models were created using only data from mid-winter and breeding surveys, unit scientists are now conducting a new statistical analysis of the single-population model that includes the must current plot survey, band recovery, and harvest data from the Canadian Wildlife Service. The U.S. Fish and Wildlife Service and Canadian Wildlife Service will use the AHM protocols to create a joint, international harvest strategy for the American black duck. The potential also exists for this particular set of protocols to serve as the prototype for resolving similar, complex international resource issues in the future.

Parameter Estimation for Adaptive Harvest Management of Atlantic Population Canada Geese

Unit scientists began developing AHM protocols for the Atlantic population of Canada geese (Branta canadensis). To jumpstart the process, the researchers needed to estimate the population's survival rate in the absence of harvest, the population's relative vulnerability to harvest, and the population's maximum achievable harvest rate relative to harvest regulations. All estimates were developed for juveniles, non-breeding adults, and breeding adults. Results of the project indicated that survival rates in the absence of harvest were 87% for adults and 59% for young geese. No differences were found for survival

estimates in the absence of harvest between breeding and non-breeding adult cohorts. Relative vulnerability to harvest was estimated at 1.5 juveniles per adult; however, the researchers did not detect variation in harvest vulnerability between juveniles, non-breeding adults and breeding adults.



Lower Atchafalaya River Basin Project

The Lower Atchafalaya River Basin in southern Louisiana commonly experiences higher levels of sedimentation after each flood event. This accelerated deposition of sediments leads to the creation of spoil banks that preclude both the circulation of water and purge of decaying organic matter, which in turn promotes hypoxia in the floodplain's backwater habitat. To mitigate this recurrent problem, unit scientists partnered with numerous federal and state partners to monitor the basin's water quality and fish community structure. They will use the field data to develop adaptive management protocols that the Army Corps of Engineers can use when dredging the basin to move river water through backwater habitats, to purge the swamp of accrued organics, and to reduce instances of chronic hypoxia/anoxia.

Diseases

Disease has always been a natural source of mortality among fish and wildlife species. With increasing man-made environmental resistance, however, the range, frequency, and severity of disease outbreaks also are increasing. In

other words, the speed at which humans convert natural habitats into artificial or altered systems outpaces the genetic diversification (i.e., evolution) of fish and wildlife. Resultantly, the immune systems of fish and wildlife populations cannot combat new environmental stress factors, thereby sparking a greater incidence of disease outbreaks. As this problem intensifies, more research will be needed to provide fishery and wildlife managers with the knowledge-base they need to control the population impacts of new and existing diseases.

The Ecology of Chronic Wasting Disease in White-Tailed Deer in Wisconsin

Chronic wasting disease (CWD) is a type of transmissible spongiform encephalopathy that attacks the central nervous system of captive and free-ranging cervids. Like mad cow disease, CWD causes emaciation, abnormal behavior and eventually death among its victims. Observed first in the late 1960s at a research facility in Fort Collins, Colorado, CWD now infects wild and captive populations of white-tailed deer (Odocoileus virginianus), mule deer (O. hemionus), and elk (Cervus elaphus) in 10 states and 2 Canadian provinces. One particular outbreak impacts approximately 1.5 million white-tailed deer in southern Wisconsin's "Eradication Zone."

For this project, unit scientists are working with biologists at the Wisconsin Department of Natural Resources (WI-DNR) to learn how the disease spreads among deer and to determine what the long-term effects of CWD may be on the state's deer population. The study's specific objectives are as follows: 1) determine the spatial distribution of CWD in Wisconsin's Eradication Zone; 2) identify the relationship between CWD prevalence and the age, sex and clinical health of deer; 3) assess the vulnerability of CWD infected deer to hunting; and 4) evaluate how and when CWD is transmitted within and among social groups of white-tailed deer. Results of the study will provide WI-DNR biologists with the knowledge-base they need to refine their CWD control efforts.

Whirling Disease

Salmonid whirling disease is perhaps the most challenging management problem facing trout managers in Colorado and other western states. It is attributed to the European parasite Myxobolus cerebralis and claims two hosts during its life-cycle, the aquatic Tubifex tubifex worm and salmonids, especially rainbow trout (Oncorhynchus mykiss). When the parasite attacks the central nervous system of juvenile fish, it prevents the transformation of cartilage into hardened bone; thereby killing the victim. Among older fish, the multiplying parasite places pressure on the fish's organ of equilibrium, which forces the fish to move erratically so it cannot find food or escape predators.

In this study, unit scientists used the packed-bed filtration technique to quantify the temporal and spatial distributions of whirling disease actinospores (the spores that infect fish) in open waters. The researchers found that the rate of infection dropped significantly when fish were exposed to the parasite at least 9-weeks after hatching. (Note: fish of any age can be infected with M. cerebralis without contracting whirling disease.) The scientists also observed a direct correlation between disease intensity and the number of actinospores to which the fish were exposed. Study results indicated that the extent of disease intensity was related directly to the age and size of fish at first exposure. Although an acquired immune response to the parasite was observed, immunization through actinospore exposure unfortunately made the fish susceptible to other diseases.

Fish Passageways

Dam building, road building, and other construction activities manipulate the flow of water through natural systems and disrupt the movements of aquatic life. These activities impact anadromous fishes more than any other organism because migratory movements are an essential part of their life cycle. It is for this reason that the construction of fish passageways has become a critical component of fish management efforts. Consequently, fisheries biologists are investing more time in researching how to construct and manage fish passageways so that populations of anadromous fish continue to thrive.

Migration and Survival of Salmonids in Large and Small River Systems and Estuaries

For this study, unit scientists compared the survivorship rates of Chinook (Oncorhynchus tshawytscha) and Coho salmon (O. kisutch) within different spawning streams of the Columbia River System. Their primary objective was to determine the extent to which water quality and food stress in upper watersheds affects the survival of salmon once they reach the ocean. Using radio-telemetry, the research team collected survivorship and mortality data on both salmon populations as they migrated to their adult foraging ground and back upstream to spawn. Results of the study indicated a higher survivorship among outward migrating fish in long river systems when compared to inward migrants. Once the migrating juveniles reached their estuary or near-shore destination, however, the rate of mortality increased many times due to pressure from avian predators. Not only did the scientists' research help fishery mangers understand which factors affect the survivorship of migrating salmon, it influenced how biologists manage the gull populations that prey on juvenile salmon.

Migration of Anadromous and Resident Fishes after Dam Removal in the Neuse River, North Carolina

In 1952, Carolina Power and Light (now Progress Energy) constructed Quaker Neck Dam on the Neuse River to provide cooling water for a coal-fired electric plant. Although this low-head dam had a fish ladder to support fish migration, most studies revealed minimal use of the ladder by anadromous and resident fish. By 1998, the power company voluntarily agreed to breach the dam, thereby improving access to historical spawning grounds further upstream. To confirm fish are using those spawning beds, unit scientists are documenting the migratory patterns of anadromous and resident fish; investigating how water flow and temperature affects the movement and distribution of each fish group; and estimating the run size for American shad (Alosa sapidissima) and striped bass (Morone saxatilis). Fishery biologists will use the study's results to develop a flow regime that augments spawning conditions for resident and anadromous fish in the Neuse River. And by knowing how fish are using the river's restored mainstem, the biologists will be more prepared to predict the benefits of dam removal in other river systems.

Ding's farewell

Ding Darling entrusted this "last cartoon" to his secretary to be used after his death. It appeared on the front page of the Des Moines Register *Tuesday, February 13, 1962—the morning after the day he died. Family, friends, and readers of a half-century of Darling cartoons recognized the warmth of this last farewell from a man who loved and contributed so much during his lifetime.*

Cooperative Research Units