

Cooperative Fish and Wildlife Research Units Program—

**2015** Year in Review



Circular 1420







# Cooperative Fish and Wildlife Research Units—2015 Year In Review

By John Organ, John Thompson, Don Dennerline, and Dawn Childs

Circular 1420

U.S. Department of the Interior  
U.S. Geological Survey





**U.S. Department of the Interior**  
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U.S. Geological Survey, Reston, Virginia: 2016

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## Chief's Message

The Cooperative Fish and Wildlife Research Unit (CRU) Program had its 80th anniversary in 2015. We did not have a party, but those of us who work directly for the Unit program on a daily basis celebrate the privilege we feel in being part of one of the greatest conservation institutions in history. Our mission is our hallmark: meeting the actionable science needs of our cooperators, providing them technical guidance and assistance in interpreting and applying new advances in science, and developing the future workforce through graduate education and mentoring. Our success in accomplishing our mission is due principally to the caliber of the scientists and students they recruit, and the tremendous support from our cooperators.

The National Cooperators Coalition has been active in fostering support and I am very excited about their energy. A Special Session at the 2015 North American Wildlife and Natural Resources Conference was dedicated to the Unit program, and a vision for our future was presented at this most prestigious conservation policy forum. We compiled a directory of expertise within the Unit program organized within thematic science areas as identified by our cooperators. We intend for this directory to facilitate our transboundary initiatives where two or more Units in collaboration will be the catalyst that binds agencies and organizations together on landscape scale conservation science. We are co-sponsoring a workshop at the 2016 North American conference, along with the Association of Fish and Wildlife Agencies, the American Fisheries Society, and The Wildlife Society to jump-start a dialogue on and identify issues associated with the widening gap between science and management. The CRU is viewed by our cooperators as being the standard for delivering actionable science in conservation, and the exception to the emerging trend. This is testament to the legacy of the Unit Program and the foundation it is built upon.

In this Year in Review report, you will find details on staffing, vacancies, research funding, and other pertinent information. You will also see snapshots of Unit projects with information on how results have been or are being applied by cooperators. That is the essence of what we do: science that matters.





## Background

From its inception in Iowa by Ding Darling and the original 9 CRUs, the CRU Program has grown to 40 Units in 38 States with a global presence assigned a mission to (1) deliver actionable science to cooperating agencies and organizations, (2) develop the workforce of the future through applied graduate education, and (3) fulfill the training and technical assistance needs of cooperators.

Images clockwise from upper right: Ding Darling, cartoons by Ding Darling, and 1935 Duck Stamp.



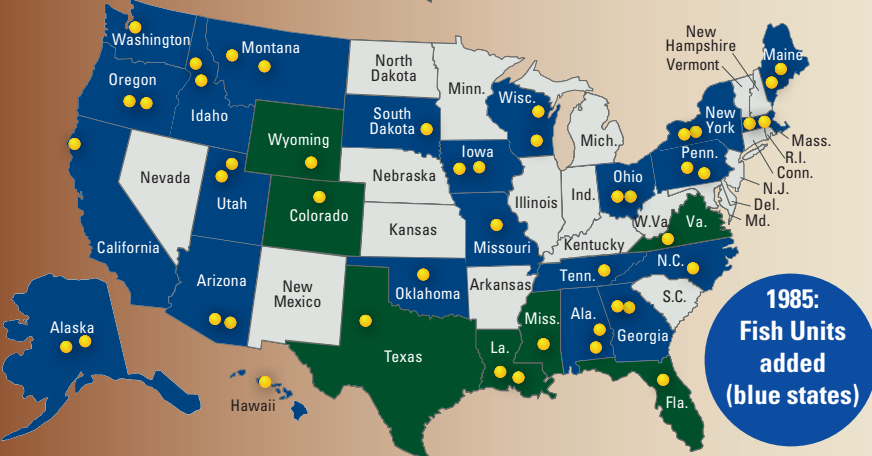
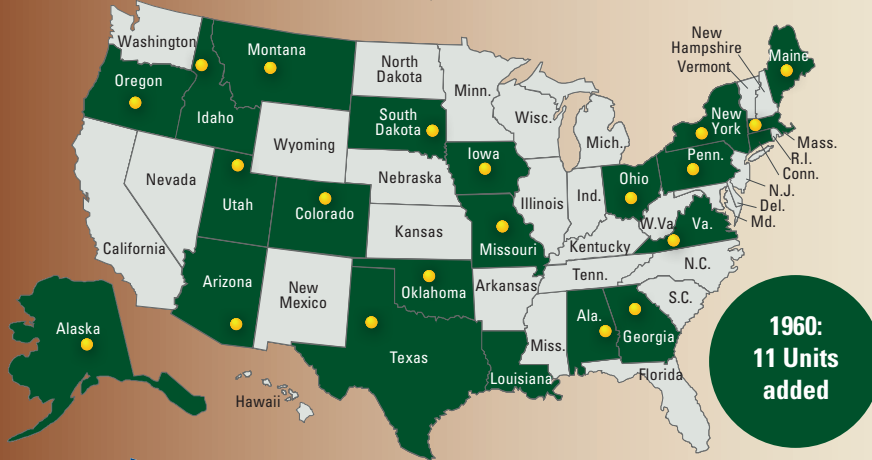
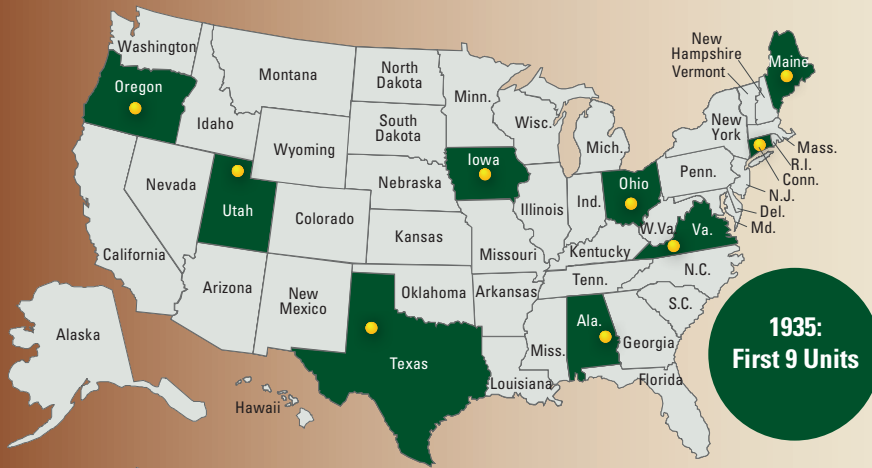
CRU all-hands meeting,  
Leetown, West Virginia,  
1983-84.

CRU all-hands meeting,  
Raleigh, North Carolina,  
1990.



CRU all-hands meeting,  
1993-94.







## CRU Mission and Facts

### Mission

- Graduate education to develop the workforce
- Actionable research to meet cooperator science needs
- Technical assistance to cooperators on application and integration of new science

### CRU scientists:

- are embedded in the graduate faculty of State land grant universities
- receive graduate faculty appointments
- are assigned office and lab space, and
- receive administrative support from the universities

### Partnerships

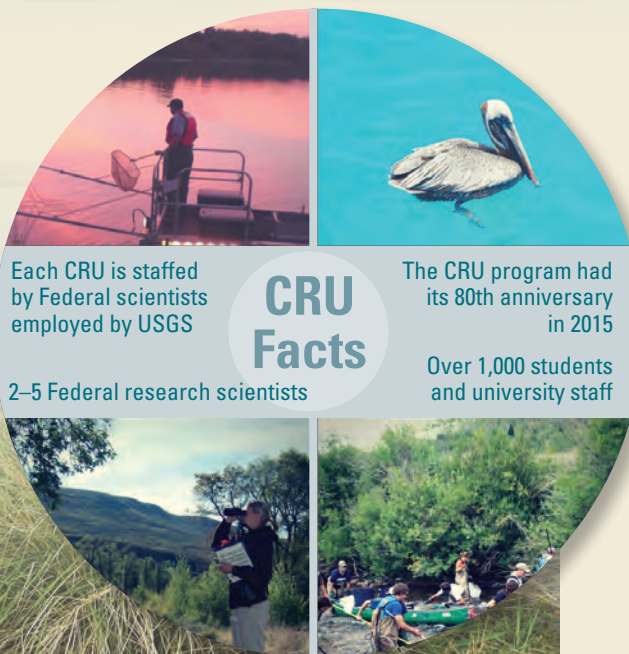
## 40 units in 38 States

Units receive support from and work closely with their respective State fish and wildlife agency



## Research Agenda

Approved by the CRU Coordinating Committee including the Department of the Interior, the State fish and wildlife agency, the land grant university, and the Wildlife Management Institute



Each CRU is staffed by Federal scientists employed by USGS

### CRU Facts

The CRU program had its 80th anniversary in 2015

2–5 Federal research scientists

Over 1,000 students and university staff

### Partners



U.S. Geological Survey



Land Grant Universities



State Fish and Wildlife Agencies



Wildlife Management Institute



U.S. Fish and Wildlife Service





# Training the Conservation Workforce

Each year, nearly 600 graduate students participate in natural resources education and training through the CRU program. Research directed by CRU scientists assists the next generation of professionals to emerge from our programs uniquely prepared to be effective members of the natural resource workforce. The cooperative nature of the CRU program provides this new workforce with a familiarity with the needs and policies of State and Federal science and management agencies. The success of this approach is evident in that Unit students have gone on to hold important leadership positions in nearly every State and Federal conservation agency.

The CRU continued participation in minority education through two programs that focus on groups under-represented in the conservation workforce. In collaboration with the National Wildlife Refuge System of the USFWS, a pilot program is being initiated where graduate and undergraduate students will be conducting research on topics of importance to the Refuge System as a means to develop and recruit Federal scientists and natural resource managers. Five units (North Carolina, New York, Arizona, Florida, and Idaho) partner with the Doris Duke Foundation's Conservation Scholars Program. Through this program undergraduate students attend leadership training programs, work with scientists and graduate students on selected research projects, and are mentored by CRU supported graduate students and research scientists. These "Duke Scholars" also complete paid internships with local, State, Federal, and tribal agencies or nongovernmental organizations.



**600**

Graduate students in the CRU program



**19**

PhD degrees awarded

**60**

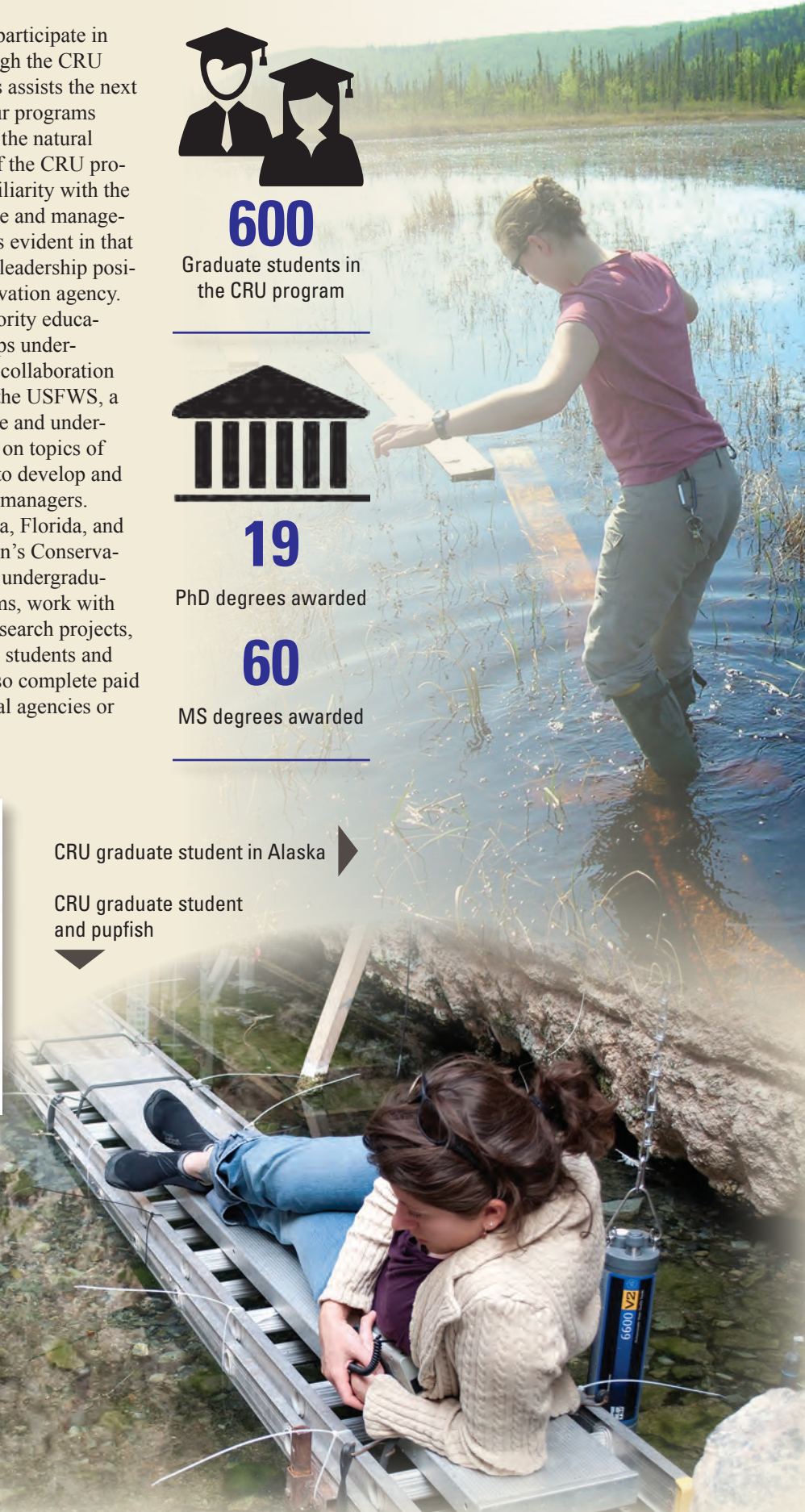
MS degrees awarded



Doris Duke conservation scholars

CRU graduate student in Alaska

CRU graduate student and pupfish





## Leveraging Resources

The unique cooperative model of the CRU program allows each cooperator to receive much more from their individual contribution than could be achieved alone. Program wide, the 2–5 Federal research scientists stationed at host universities collectively garner about \$25M in State and Federal research funding each year. Non-Federal cooperative faculty annually bring in an additional \$6M in Federal funds through CRU Research Work Orders. Combined research funds at the CRUs support an average of about 1,100 students and university staff annually. Coupled with this, being located on some of the finest land grant colleges and universities provides CRU researchers access to world class research and library facilities. Unit scientists and affiliated university faculty link the research mission of all cooperators with student training thereby providing students with the opportunity to address the information needed by State and Federal decision-makers and managers.

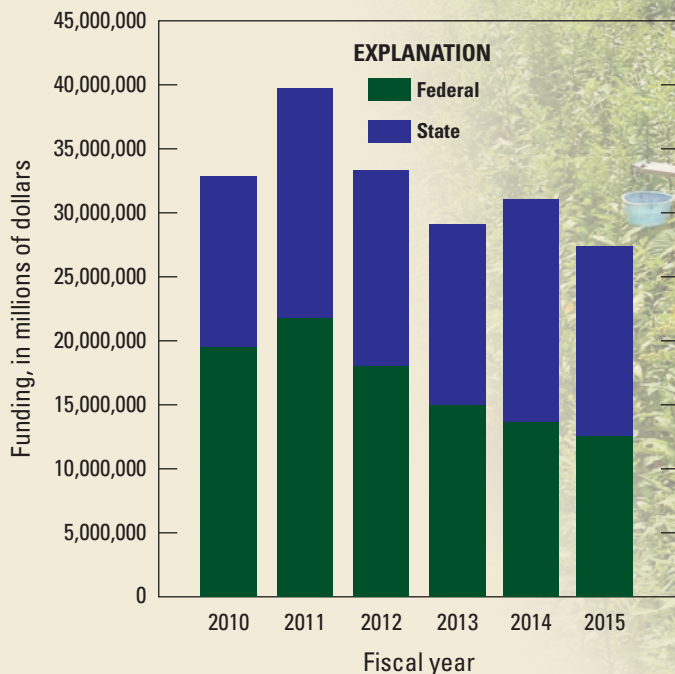
Funding from the State agencies is leveraged by the other cooperators to ensure State agencies have local access to state of the art research capabilities and facilities to help meet their contemporary research needs and have a continuous output of highly qualified graduate students for subsequent employment.

# \$30M

in State and Federal  
research funding per year

# 2–5

Federal research  
scientists per CRU





## Outreach and Training

Unit scientists remained actively engaged in our technical assistance mission by delivering 26 workshops and short courses to our State and Federal partners through designated, instructor-led courses, and special symposia at the National Conservation Training Center in Shepherdstown, West Virginia. Courses and workshops covered a variety of subjects, but recurrent topics included structured decision-making, R programming and graphics, and Bayesian modeling approaches. Scientists recognized for their expertise in specific areas also presented 43 invited seminars in FY 2015.

Unit scientists routinely develop programs and applications to be used by State and Federal natural resource managers to conduct data analyses to inform decision-making. During 2015, the Vermont Unit has been working on a new R package (AMHarvest) that will provide some tools for simulating harvest data, analyzing harvest data, and evaluating how well different models and estimators perform. The AMHarvest package could be available for download through the Comprehensive R Archive Network (CRAN) in early 2016. The Unit is also working on a proposal to build a friendly, web-based application that will allow users to take advantage of the AMHarvest package and existing R packages without having to write code. The proposed application will facilitate adaptive harvest management by storing inputs and outputs, assessing support for different models, and using outputs as inputs in subsequent analyses.

### The CRU Partnership

Units work with the State and Federal agencies and other organizations to assist them with the following:



- actionable science,
- training, and
- development of the future workforce through graduate education and mentoring.



The USGS Ecosystems Mission Area also includes 17 major research science centers, many with satellite field stations networked across the Nation.



# 358

Scientific publications



# 68

Courses taught



# 901

Presentations



# 43

Invited seminars

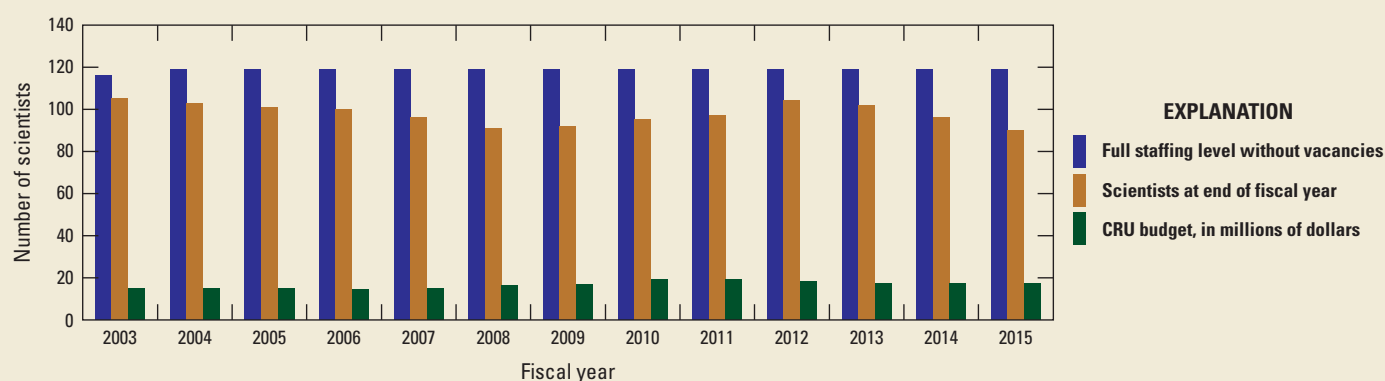
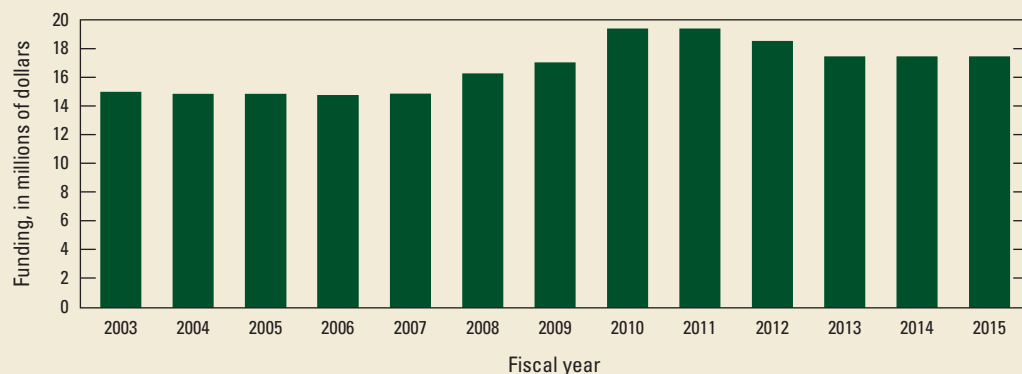


# 26

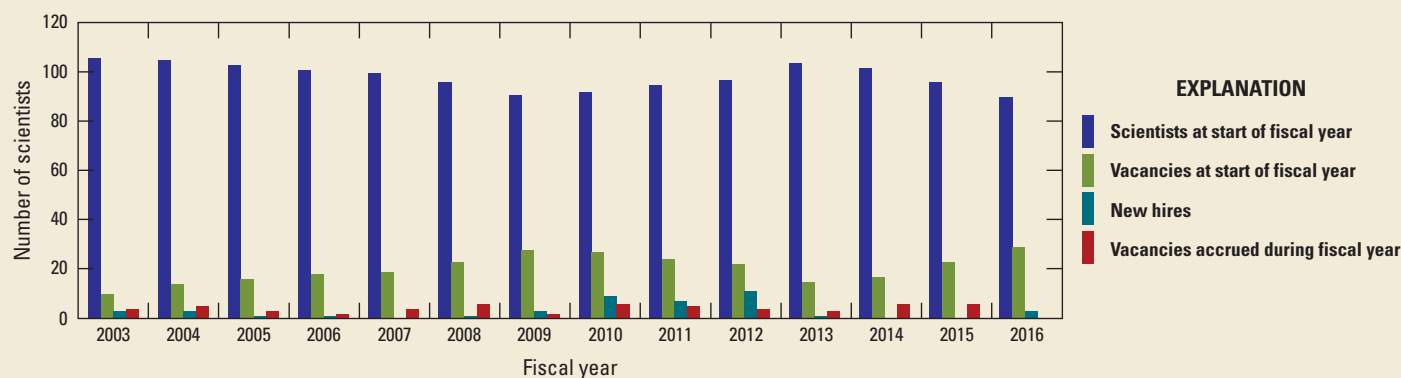
Workshops



## Budget and Staffing



## New Hires and Staffing Changes



### Current (2016) vacancies.

[CF&WRU, Cooperative Fish and Wildlife Research Unit; CFRU, Cooperative Fish Research Unit]

Unit	Vacancies	Unit	Vacancies	Unit	Vacancies
Alaska CF&WRU	1	Iowa CF&WRU	1	New York CF&WRU	1
Arizona CF&WRU	1	Kansas CF&WRU	1	North Carolina CF&WRU	1
Arkansas CF&WRU	1	Louisiana CF&WRU	2	South Carolina CF&WRU	2
California CF&WRU	1	Maine CF&WRU	1	Utah CF&WRU	1
Florida CF&WRU	1	Maryland CF&WRU	3	Vermont CF&WRU	1
Hawaii CFRU	2	Massachusetts CF&WRU	1	Virginia CF&WRU	1
Idaho CF&WRU	1	Minnesota CF&WRU	1	Washington CF&WRU	1
				<b>Total</b>	<b>26</b>







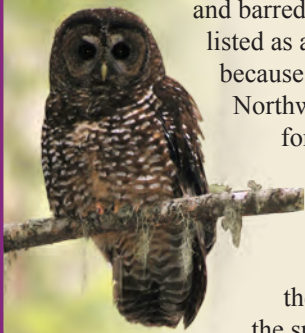
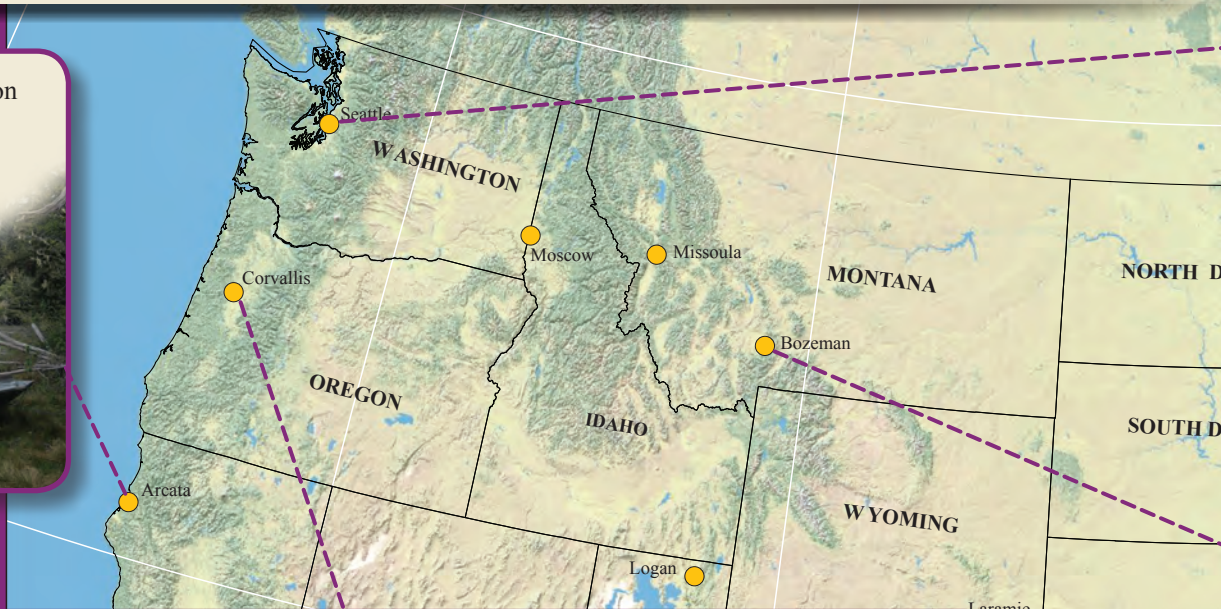
## Endangered Species Act

Unit scientists work with Federal and State cooperators to provide answers to science questions that inform decision-making in implementing the Endangered Species Act.

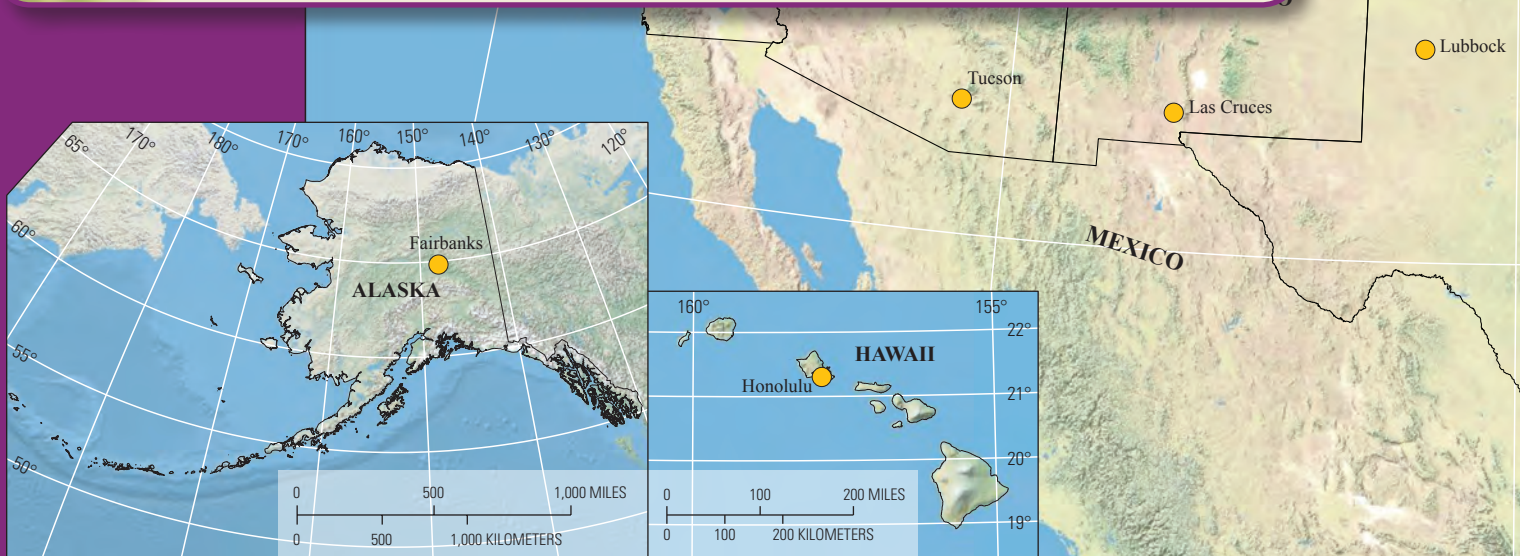
Unit work in California on tidewater goby informed the decision to down list tidewater goby from federally endangered to threatened.



40°



The Oregon CRU northern spotted owl demography study reports on the effects of habitat, climate, and barred owls on long-term demography of northern spotted owls. The northern spotted owl was listed as a federally threatened species by the U.S. Fish and Wildlife Service in 1990 principally because of declines in its old growth forest habitat throughout the Pacific Northwest. In 1994, the Northwest Forest Plan (NWFP) was developed and implemented to conserve late-successional forest resources on Federal lands to aid conservation of the northern spotted owl and other old-growth forest dependent species. At that time, a long-term effectiveness monitoring program was developed to monitor the status of the northern spotted owl and through regular evaluation of the monitoring data, determine whether the NWFP was aiding in the recovery of the species. This research reports on the most recent effort to evaluate the status and trends in northern spotted owl demographic rates on 11 study areas across the species range from 1985 to 2013.



120°

110°

100°



Unit work in Washington on chinook salmon in the Salish Sea contributed to the listing as threatened. Cooperative Fish and Wildlife Research Unit work is critically important in efforts designed to achieve **pre-listing conservation** because we can provide the scientific underpinning, the monitoring protocols, and the decision science that are critical to success.



Work from the Montana Fisheries Unit on the endangered pallid sturgeon identified the mechanism responsible for the species decline in the Missouri River.



Unit work in Alabama on Rio Grande cutthroat trout and Arctic grayling led to findings that endangered species listing was not warranted.



Unit work in Virginia on the endangered Roanoke logperch is contributing to a coordinated recovery strategy.





## Species of Greatest Conservation Need

State Wildlife Action Plans identify Species of Greatest Conservation Need (SGCN) in their State, and identify information needs and management actions necessary to keep these species common.

The Washington Unit is identifying and diagnosing key factors that influence marine survival of Puget Sound salmon and steelhead, developing improved run forecasting predictions, and informing effective habitat and population restoration programs.



The West Virginia Unit, in collaboration with the Cerulean Warbler Technical Group, National Council for Air and Stream Improvement, National Fish and Wildlife Foundation, Appalachian Mountains Joint Venture, and researchers and managers from universities, State agencies, U.S. Forest Service, USFWS, and private landowners in West Virginia, Ohio, Kentucky, and Tennessee, completed a 6-year study last year with the objective of identifying forest management approaches that are compatible with cerulean warbler conservation.



The Nebraska Unit is studying various aspects of reintroduced river otters in the State, including habitat use, movements, genetics, and impacts of non-native vegetation.





The Pennsylvania Unit is developing river otter spatial capture-recapture models in the open source modeling platform R to see how population estimates might change with better defined models.



The New York Unit has developed a decision tool to help the State identify SGCN.



The Virginia Unit is using acoustic detectors to study bat habitat associations and distributions.



The North Carolina Unit has been studying the effects of a variety of human activities on nesting American oystercatchers at Cape Lookout and Cape Hatteras National Seashores on the Outer Banks of North Carolina since 1997. Using low cost, low power, digital audio and video recording devices, the researchers have been quantifying animal behavior in ways that were not previously possible.





## Harvest and Population Management

The management of fish and wildlife populations for the benefit of current and future generations of all Americans is the foundation of this Nation's conservation heritage. We assist our cooperators in their mission through a variety of actions, from the development and implementation of basic monitoring protocols to complex population modeling. These efforts serve to facilitate the conservation and restoration of rare and declining species, and to sustainably manage harvests of game and furbearer species.

The Idaho Unit is developing angler survey methods for chinook and steelhead and also is studying spawning ecology of kokanee.



The Montana Unit is studying the movements of rainbow and brown trout, very popular sport fish, to better understand the spatial scale populations and harvest needs.



The Montana and Wyoming Units are collaborating with several western States to better understand elk population and harvest dynamics at a geographic scale.





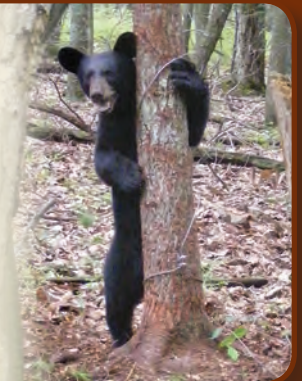
The South Dakota Unit is studying the value of using an Internet-based survey to replace the traditional angler mail surveys sent by South Dakota Game, Fish and Parks.



The Massachusetts Unit is leading research to support the black bear management plan in the State.



The Pennsylvania Unit is leading work on fall harvest guidelines for wild turkey, and on population and harvest management of black bears and white-tailed deer.



The Missouri Unit is leading a research project to examine the effects of the Light Goose Conservation Order regulations on the distribution and behavior on nontarget waterfowl.





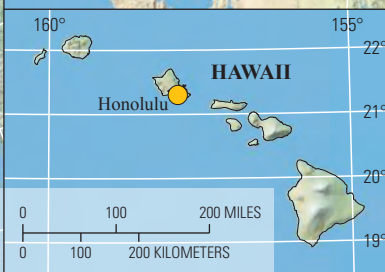
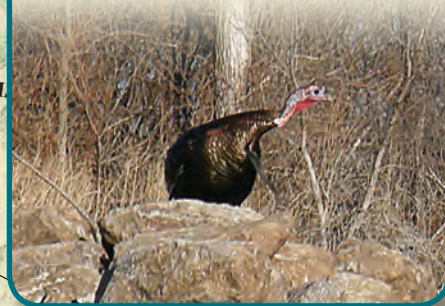
## Adaptive Management/Structured Decision-Making

Decision science is becoming a much needed approach to enable transparent, quantifiable decisions in the face of uncertainty and contention, and allow managers and scientists to learn through management actions.

The Nebraska Unit is exploring how structured decision-making can link resilience, adaptive management, and optimization to generate a cohesive method of implementing management within this emerging social-ecological paradigm. Resilience thinking acknowledges the presence of multiple stable states in nature and considers the extent to which a given system can absorb perturbation before shifting into a different organization of functions and processes. Central to resilience theory is the awareness of the ubiquity of surprise in social-ecological systems. Combining elements of adaptive management and resilience thinking has been suggested as a way to implement the emerging social-ecological management paradigm.



The Alabama Unit is conducting a long-term research project for the Alabama Department of Conservation and Natural Resources to inform adaptive management of Eastern Wild Turkey populations across the State.





The Vermont Unit is providing the Bureau of Land Management and its partners with the information needed to understand terrestrial resource location and abundance, condition, and trend, and to provide a basis for effective adaptive management.

The Vermont Unit is developing an R package called AMHarvest that includes a variety of functions for implementing an adaptive management program for harvested species.



The Pennsylvania and New York Units are collaborating in the development of a decision model for fall wild turkey hunting seasons.



The Georgia Unit is developing an adaptive management framework for phragmites management in the Great Lakes Basin at the patch and landscape scale.





## Landscape Ecology

Contemporary conservation challenges require inquiry and management at larger geographic scales. Landscape ecology is the field of science that explores spatial patterns and interrelations of ecological processes across ecosystems at various scales. Landscape ecology emphasizes the interactions of pattern, process, and temporal and spatial scale and their effect on ecological flows. The diversity of expertise and the university connection to multidisciplinary experts positions CRUs to be leaders in this arena.

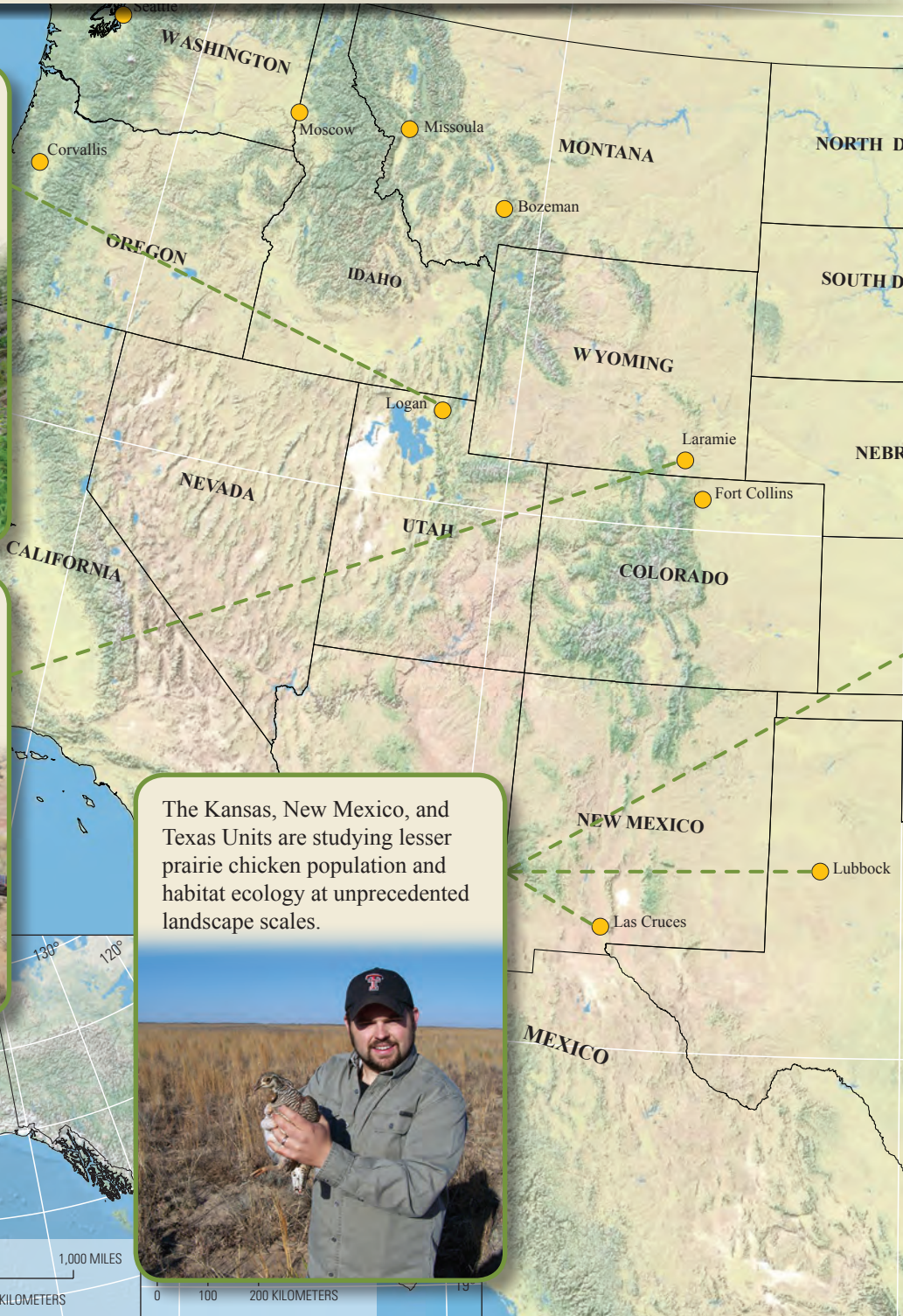
The Utah Unit is involved in a number of projects investigating landscape patterns of vegetation changes resulting from climate and other factors and their effects on wildlife.



The Wyoming Unit is investigating population dynamics and movements of ungulates at the geographic scale, and identifying factors driving migrations and factors inhibiting migrations.



The Kansas, New Mexico, and Texas Units are studying lesser prairie chicken population and habitat ecology at unprecedented landscape scales.





The Massachusetts Unit is investigating moose and black bear population and habitat dynamics at the landscape scale, assessing key landscape components critical to the conservation of these wide-ranging large mammals in a human-dominated landscape.



The Georgia Unit is leading an effort on native prairie adaptive management: a multiregion adaptive approach to invasive plant management on Fish and Wildlife Service owned native prairies.





## Ecosystem Services

An ecosystem service is any positive benefit provided to society by fish, wildlife, or components of ecosystems through their functions. Public and private support for natural resource conservation can be fostered through increased awareness and understanding of the multitude of benefits healthy ecosystems provide to society. Ecosystem Services can be documented through monetary/nonmonetary or cultural values. Cultural ecosystem services (CES) are more difficult to quantify, but extremely important in understanding natural resource values to society.





The Virginia Unit has developed a spatially explicit framework for mapping the capacity of ecosystems to provide freshwater recreational fishing, an important cultural service, including societal demand for freshwater recreational fishing based on license data and demonstrates how maps of relative capacity and relative demand could be interfaced to estimate sustainability of a CES.





## Energy

Domestic development of traditional and alternative energy is a national priority. Natural resource agencies have great need for scientific information that will assist them in providing information to provide information to regulatory agencies that can be used to minimize impacts to fish and wildlife resources.

The Colorado Unit is estimating and modeling mortality at wind energy facilities. The designs and guidelines developed will provide tools with which agencies and consulting firms can conduct carcass surveys at wind power development sites in the country and internationally. This will, in turn, provide USFWS law enforcement and migratory bird management personnel with robust data for making management decisions.







The Wyoming Unit is helping to identify the major pathways through which oil and natural gas development affects habitat quality and aquatic organisms. This has implications for prioritizing management practices such as reducing sediment inputs or improving fish passage at road crossings. The Wyoming Unit also is developing a vulnerability index that simultaneously provides a starting point to examine oil and gas development related effects on freshwater biota and a cross-State metric to guide best management practices for development.





## Climate Science

Uncertainty about the effect of changes in climate to fish and wildlife populations and habitats is a major concern of natural resource managers.

The Oregon Unit is characterizing nearshore habitats across a coastal continuum in Oregon and Washington to determine vulnerability of nearshore habitats and their associated avian guilds from climate change, and to determine whether projected site vulnerability varies with latitudinal gradient.

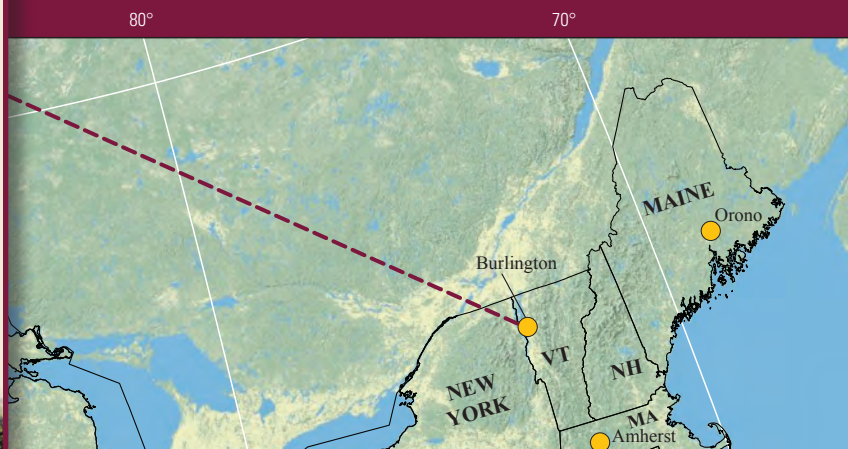


The Montana Wildlife Unit is conducting a long-term (29 year) study examining the causal mechanisms underlying change in ecosystem structure (species composition) and function (trophic interactions) in response to climate variation and elk browsing. The research includes estimation of the relative sensitivity of vegetation, bird, and mammal species to climate variation to project future responses and possible management alternatives; the climate/elk browsing study explores long-term population trajectories and demographic processes of plant, bird, and small mammal species.





The Vermont Unit is leading an integrated assessment of the role of climate in forest ecosystem health and function through a combination of monitoring, experimental, and modeling activities. The resulting maps of current and projected forest structure and function will be used to assess various management alternatives in a spatial structured decision framework. This framework will allow land managers to compare the probability of management activity success on a pixel by pixel basis, reflecting the complexity of the heterogeneous landscape in the Northeast.



The Louisiana Unit is studying the eastern oyster in the Gulf of Mexico to enable predictions of carrying capacity for proposed regional aquaculture parks, identification of areas for restoration and protected areas, and predictions of oyster growth and production under predicted water diversion, sea level rise, and climate change scenarios.



The Louisiana Unit is conducting research to enable the predictive modeling of submerged aquatic vegetation (SAV) resources under different scenarios of landscape and climate change.





## Invasive Species

Invasive species of plants, animals, and microorganisms pose significant risks to native species, ecosystems, and human, fisheries, and wildlife health. The economic, environmental, and health-related costs of invasive species exceed those of all other natural disasters combined. Biological invasions may affect the resilience of complex systems, and can cause sudden and effectively irreversible, regime changes.



The Montana Fisheries Unit is developing control methods for invasive introduced lake trout in Yellowstone Lake. Native Yellowstone cutthroat trout are threatened with extirpation by lake trout, which will have cascading effects in the Yellowstone ecosystem.

The Wyoming Unit is involved in experimental techniques to restore native sage-steppe habitat and document bird community changes, as well as documenting the effects of cheatgrass invasion on wildlife community composition.



The Nebraska Unit is leading an effort to develop a broad invasive species adaptive management response plan as part of an aggressive research and management program to attempt to manage current invasive species and prevent future invasions.







To understand the impact of invasive large catfish on the native fish communities of Atlantic rivers, the North Carolina Unit developed an ecosystem model that incorporates empirical data on trophic pathways and energy transfers from the base of the food web (primary producers and detritus) up to the apex of the trophic pyramid (flathead catfish and other piscivores). This modeling exercise allowed description of the ecological impact of an initial introduction of flathead catfish, as well as long-term changes in the native fish community—the most conclusive evidence of dramatic ecological impacts. The Unit also modeled various management scenarios to limit abundance of the invasive and enhance native fish populations.



The Iowa Unit, in collaboration with Iowa DNR, began a study to understand the interactions and effects of introduced common carp, invading zebra mussels, and the native biological community on water quality in Clear Lake. The ultimate goal is to organize this knowledge into a simulation model for predicting future changes and the outcomes of management actions.



## Accolades

Unit scientists and their students received approximately 80 awards in 2015 from universities, agencies and professional societies with recognition at the local, national and international levels. Highlights include the following:

- Outstanding Contribution to Student Career Development, University of Georgia (Cecil Jennings)
- Bob Watts Communication Award, Montana Chapter of The Wildlife Society (Mike Mitchell)
- Dwight Webster Memorial Award of Merit, Northeastern Division of the American Fisheries Society (Donna Parrish)
- Outstanding Graduate Mentor and Advisor Award, University of Alaska Fairbanks College of Natural Science and Mathematics (Abby Powell)
- Wildlife Management Institute (WMI) Administrative Excellence Award, Wildlife Management Institute (Verna Blackhurst)
- 2015 Bernie E. Rushing, Jr. Faculty Outstanding Researcher Award, Texas Tech University (Reynaldo Patiño)
- Lifetime Achievement, Mississippi Chapter American Fisheries Society (Leandro Miranda)
- Fisheries Management Hall of Excellence, American Fisheries Society (Leandro Miranda)
- Elective Member, American Ornithologists Union (Conor McGowan)
- Fellow, American Ornithologists' Union, (Courtney Conway)
- President-elect, Cooper Ornithological Society (Anna Chalfoun)
- Hamerstrom Award, Prairie Grouse Technical Council (David Haukos)
- Graduate Faculty of the Year, Clemson University Department of Forestry and Environmental Conservation (Patrick Jodice)

In 2015, the American Fisheries Society established its Fellows Program to recognize members who have made outstanding or meritorious contributions to the diversity of fields that are included in the American Fisheries Society. Contributions can include, but are not restricted to, efforts in leadership, research, teaching and mentoring, resource management and conservation or both, and outreach/interaction with the public. Congratulations to the fifteen inducted Fellows that are, or were, Unit scientists: Bradford Brown (former), Bob Carline (retired), Bill Fisher (retired), Rich Gregory (retired), Chris Guy, Joe Hightower (retired), Wayne Hubert (retired), Hiram Li (retired), Joe Margraf, Pat Mazik, Steve Miranda, Christine Moffitt, Donna Parrish, Nick Parker (retired), Carl Schreck, and Bob White (retired).



## AFWA Resolution

The Association of Fish and Wildlife Agencies (AFWA), at its Annual Meeting in Tucson, Arizona, this past September approved a Resolution on Unit funding.

The Resolution was put forward by the AFWA Science and Research Committee, and was passed unanimously by all State fish and wildlife directors at the business meeting. The Resolution is addressed to Congress and presents a justification and rationale for Congress to fully fund the Units. This will be very useful for our partners because it demonstrates to Congress universal support from the States for the Unit program. Thanks to AFWA for their support!

## Professional Services

Unit scientists held approximately 170 professional service positions (scientific society officers, technical committees, working groups, panels, and so on) and served in 64 editorial positions in FY 2015.







## North American Conference Special Session Dedicated to the Units

One of four concurrent special sessions held at the North American Wildlife and Natural Resources Conference in March 2015 was focused on the Coop Units. Dale Hall, CEO of Ducks Unlimited and former USFWS Director and Jim Martin, founder of the Berkley Conservation Institute and former director of the Oregon Fisheries Division co-chaired the session. Both Dale and Jim are Coop Unit alumni. Kevin Whalen presented the first paper, co-authored by John Thompson that described the Coop Unit model. Carl Schreck presented the second paper, co-authored by Dan Roby, Katie Dugger, and Jim Peterson that gave an overview of the breadth and depth of science that an individual Unit can deliver on behalf of its cooperators, whereby the outputs exceed the sum of its parts. Dave Haukos gave the next paper, co-authored by Clint Boal, Scott Carleton, and Blake Grisham that presented a case study of the multi-Unit, multi-State, multi-agency effort to conserve lesser prairie chickens, where the Units have the central role in this large landscape collaboration. John Organ gave the final paper, co-authored by Steve Williams (WMI), Jonathan Mawdsley (AFWA), Doug Austen (AFS), Ken Williams (TWS), Eric Hallerman (NAUFWP), Paul Souza, (USFWS), and Anne Kinsinger (USGS) that articulated a vision for the future of the Coop Units. Once the final papers have cleared WMI editorial staff, the proceedings will be shared.



## NCC Coalition Committee

The National Cooperators Coalition (NCC) met at the North American Wildlife and Natural Resources Conference in Omaha, Nebraska, in March and at the Association of Fish and Wildlife Agencies Annual Meeting in Tucson, Arizona, in September 2015. The NCC Steering Committee also met in Denver, Colorado, in June 2015. The Boone and Crockett Club, instrumental in the original establishment and formation of the Units, became a formal member of the NCC this year. The NCC was instrumental in development of the AFWA funding resolution for the Units and is in the process of revising and updating their strategic vision so they can maximize their support of the Units and can provide strategic direction and guidance.





## The Cooperative Fish and Wildlife Research Units Program is Proud to Serve Its Cooperators

### ALABAMA

Auburn University  
Alabama Department of Conservation and Natural Resources

### ALASKA

University of Alaska Fairbanks  
Alaska Department of Fish and Game

### ARIZONA

University of Arizona  
Arizona Game and Fish Commission

### ARKANSAS

University of Arkansas  
Arkansas Game and Fish Commission

### CALIFORNIA (Fish and Wildlife)

Humboldt State University  
California Department of Fish and Game

### COLORADO

Colorado State University  
Colorado Division of Wildlife

### FLORIDA

University of Florida  
Florida Game and Fish Commission

### GEORGIA

University of Georgia  
Georgia Department of Natural Resources

### HAWAII-FISH

University of Hawaii  
Hawaii Department of Land and Natural Resources

### IDAHO

University of Idaho  
Idaho Department of Fish and Game

### IOWA

Iowa State University  
Iowa Department of Natural Resources

### KANSAS

Kansas State University  
Kansas Department of Wildlife and Parks

### LOUISIANA

Louisiana State University  
Louisiana Department of Wildlife and Fisheries

### MAINE

University of Maine  
Maine Department of Inland Fisheries and Wildlife

### MARYLAND

University of Maryland, Eastern Shore  
Maryland Department of Natural Resources

### MASSACHUSETTS

University of Massachusetts  
Massachusetts Division of Fisheries and Wildlife  
Massachusetts Div. of Marine Fisheries

### MINNESOTA

University of Minnesota  
Minnesota Department of Natural Resources

### MISSISSIPPI

Mississippi State University  
Mississippi Department of Wildlife, Fisheries, and Parks

### MISSOURI

University of Missouri Columbia  
Missouri Department of Conservation

### MONTANA-FISH

Montana State University  
Montana Department of Fish, Wildlife, and Parks

### MONTANA-WILDLIFE

University of Montana  
Montana Department of Fish, Wildlife, and Parks

### NEBRASKA

University of Nebraska Lincoln  
Nebraska Game and Parks Commission

### NEW MEXICO

New Mexico State University  
New Mexico Department of Game and Fish

### NEW YORK

Cornell University  
New York Department of Environmental Conservation

### NORTH CAROLINA

North Carolina State University  
North Carolina Wildlife Resources Commission



## OKLAHOMA

Oklahoma State University  
Oklahoma Department of Wildlife Conservation

## OREGON

Oregon State University  
Oregon Department of Fish and Wildlife

## PENNSYLVANIA

Pennsylvania State University  
Pennsylvania Fish and Boat Commission  
Pennsylvania Game Commission

## SOUTH CAROLINA

Clemson University  
South Carolina Department of Natural Resources

## SOUTH DAKOTA

South Dakota State University  
South Dakota Department of Game, Fish, and Parks

## TENNESSEE-FISH

Tennessee Tech University  
Tennessee Wildlife Resources Agency

## TEXAS

Texas Tech University  
Texas Parks and Wildlife Department

## UTAH

Utah State University  
Utah Division of Wildlife Resources

## VERMONT

University of Vermont  
Vermont Department of Fish and Wildlife

## VIRGINIA

Virginia Polytechnic Institute and State University  
Virginia Department of Game and Inland Fisheries

## WASHINGTON

Washington State University  
University of Washington  
Washington Department of Ecology  
Washington Department of Fish and Wildlife  
Washington Department of Natural Resources

## WEST VIRGINIA

West Virginia University  
West Virginia Division of Natural Resources

## WISCONSIN-FISH

University of Wisconsin Stevens Point  
Wisconsin Department of Natural Resources

## WISCONSIN-WILDLIFE

University of Wisconsin Madison  
Wisconsin Department of Natural Resources

## WYOMING

University of Wyoming  
Wyoming Game and Fish Commission

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Page 11: Lower left, Rio Grande cutthroat trout by U.S. Fish and Wildlife Service; lower right, Roanoke logperch by U.S. Fish and Wildlife Service.

Page 13: Upper left, river otters by National Park Service.

Page 15: Upper right, black bear by U.S. Fish and Wildlife Service.

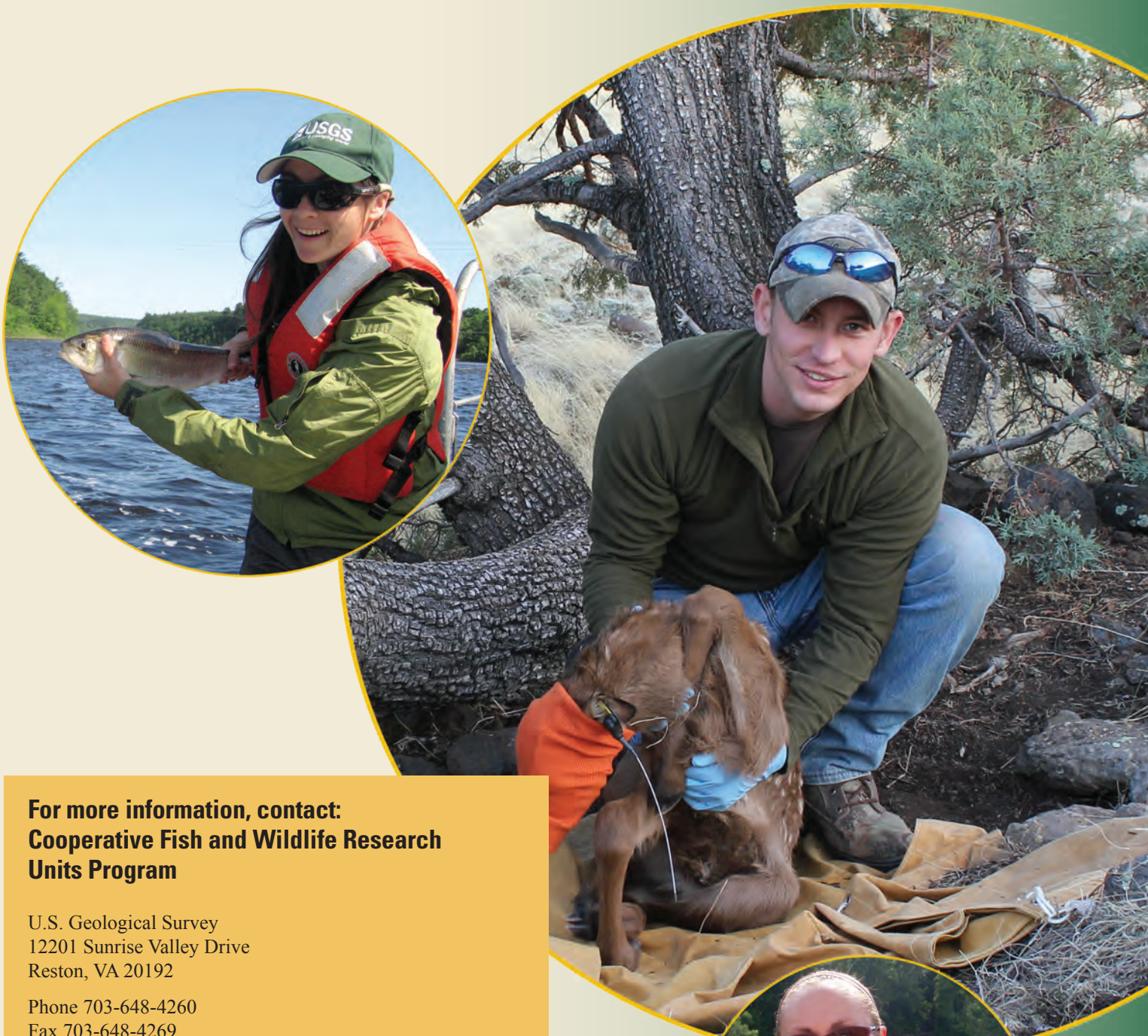
Page 16: Lower right, wild turkey by Aaron DeLonay, USGS.

Page 17: Middle left, wild turkeys by Randolph Femmer, USGS.

Page 22: Wind turbines by Don Becker, USGS.

Page 23: Golden eagle by U.S. Fish and Wildlife Service.





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