

# 2009



## COOPERATIVE RESEARCH UNITS

### PROGRAM YEAR IN REVIEW

In Fiscal Year (FY) 2009, the Cooperative Research Units (CRU) Program operated with an enacted budget of \$16.949 million, which was a \$0.78 million net increase over the enacted FY 2008 budget. The FY 2009 enacted budget increase was followed by a \$2.36 million increase in the enacted budget of \$19.313 million for FY 2010. This \$2+ million funding increase was included in the President's budget and codified by Congress in December 2009. Between FY 2007 and FY 2010, the CRU program has realized a \$4.55 million increase in funding. At the time of this writing a budget of \$19.14 million has been proposed by the President for the CRU program for FY 2011.

Fiscal Year	Budget	Change from previous year	Cumulative increase
2007	\$14.764	—	—
2008	\$16.174	\$1.41	\$1.41
2009	\$16.949	\$0.78	\$2.19
2010	\$19.313	\$2.36	\$4.55

Amounts shown in millions.

### REFILLING VACANT SCIENTIST POSITIONS

The annual increases in funding from FY 2008 through FY 2010 have enabled the CRU program to embark on an aggressive strategy to refill vacant Unit scientist positions. In FY 2009, Assistant Unit Leaders were hired in Hawaii, Nebraska, Oklahoma, and New York. At the time of this writing through early FY 2010, hiring actions have been completed, initiated, and planned for 15 scientist positions located at 13 Units. The location of these hiring actions is displayed on the map located on page 3 of this report. New hiring actions will be undertaken based on the outcome of FY 2011 budget deliberations. The CRU program expects to continue to work with cooperators in identifying high priority hiring actions to rebuild science capacity in the program throughout FY 2011.

In addition to the focus on rehiring vacant positions, the improved funding to the program has enabled CRU to restore federal funding to the Units for operational support, safety, diversity, and equipment for research. CRU has invested significant additional funding for safety-related equipment purchases in particular, to ensure the safety of staff and students. CRU staff have benefitted from federal funding to replace aging vehicles, and the CRU program itself continues to invest federal dollars to upgrade vehicles to improve field safety when Unit staff and students are conducting research for cooperators.

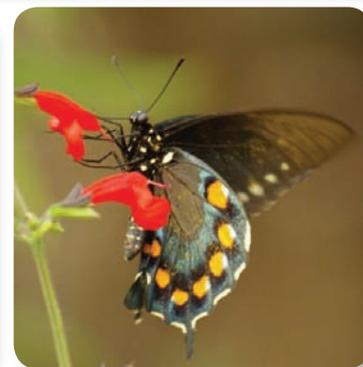
### STRATEGIC DIRECTIONS

In FY 2008, CRU embarked on a new initiative to enhance collaborations with cooperators in the science-based management and conservation of state and federal natural resources. This initiative stemmed from the strategic vision of the National Cooperators' Coalition (NCC) for the CRU program, which targets efforts in CRU to (i) find new ways to work across state boundaries to address challenging landscape scale conservation issues; (ii) develop new and improved methods of educating graduate students to provide the skills and abilities needed by cooperators; and (iii) more effectively integrate CRU science with the conservation and management that motivates it, in the spirit of structured decisionmaking and adaptive management.

A summary of how CRU has advanced the elements of this strategy is found on page 5 of this report. A highlight of the CRU strategic initiative is the partnership established between the CRU program and the U.S. Fish and Wildlife Service (USFWS) National Conservation Training Center (NCTC). Working with the NCTC, CRU has provided week-long training opportunities in introductory structured decisionmaking, problem-based structured decision-making workshops, and adaptive management training to a host of Unit scientists and their state cooperators. This partnership has enabled valuable interactions among Unit scientists, state natural resource managers, and federal USFWS staff. CRU and the NCTC expect to continue this effective training collaboration through FY 2010 and beyond. *continued on page 2*



## Year In Review



# PROGRAM PERFORMANCE

## ACHIEVING THE UNIT MISSION

In 2009, Unit scientists and their cooperators advanced the mission of the CRU Program through joint research, education, technical assistance, and science support. Unit scientists continued to be very productive in 2009, completing a number of projects for federal and state partners. Unit scientists and their students remained actively engaged in service to professional societies delivering over 600 presentations. Many of these presentations were invited seminars (63), indicating that Unit scientists and their research are held in high regard by the scientific and management communities. CRU's service to university cooperators continued to be strong, with 68 academic classes taught in 2009 and an additional 36 workshops and short courses delivered to partners and cooperators.

Each year, over 500 students are actively engaged in graduate education and training in natural resources conservation in the CRU program. About 15 percent of these students matriculate each year and enter the natural resources management workforce as employees of State and Federal agencies, non-governmental organizations, and universities. In 2009, of the 522 students directly advised by Unit scientists, 80 were awarded master's degrees and 30 completed their doctoral program. The number of advanced graduate degrees awarded to Unit students in 2009 was consistent with the long-term trend.

Photo: Forereef at Millennium Atoll in the southern Line Islands as part of National Geographic's "Pristine Seas" project. Photo: Enric Sala, National Geographic Society

## PRODUCTIVITY SUMMARY

Peer reviewed publications.....	305
Invited seminars.....	63
Workshops and short courses.....	36
Projects for federal agencies.....	371
Projects for state agencies.....	*489
Papers presented.....	639
Academic courses taught.....	68
Total number of students.....	522
Master's degrees awarded.....	80
Doctoral degrees awarded.....	30

\*estimated from 2008 projections

## CUSTOMER SURVEY RESULTS

CRU continued its program of surveying Research Work Order (RWO) customers. The RWO process is CRU's focal federally-based granting mechanism. Survey respondents indicated a continuing high level of satisfaction (>95%) with the timeliness, scientific rigor, and technical clarity of research provided through the RWO process. Over 80% of respondents indicated they had specific plans to use the research results provided for species, habitat, and/or land management. Over 90% indicated that they would recommend the CRU program based on the research and technical services provided.

Several recommendations were made by survey respondents for CRU managers to maintain the high and continued satisfaction of customers of the RWO program. RWO customers valued the opportunity to meet with CRU field supervisors at their respective Unit's annual cooperator meeting and also appreciated the Unit staff inviting the land managers to participate in study design and field work. The RWO process was designed to provide federal partners access to Unit and cooperating faculty research expertise. CRU will continue the survey program to ensure that the RWO process meets the species, habitat, and land management research needs of cooperators and partners.

## STRATEGIC DIRECTIONS *continued from front page*

Unit scientists continue to be engaged in high priority natural resource management challenges across the Nation on issues of local, regional, and global relevance. Highlights of some of the work by Unit scientists and graduate students are found on pages 6 and 7 of this report. In particular, new funding opportunities in the Department of the Interior became available in FY 2009 and FY 2010 in the arena of climate change. CRU scientists are actively involved in providing the science to support Interior's mission to conserve trust resources, particularly as it relates to the uncertainties and threats to natural resources brought on by climate change. CRU has been active in working with both state and federal cooperators on climate change adaptations. CRU continues to provide a strong linkage between states and the federal resource management

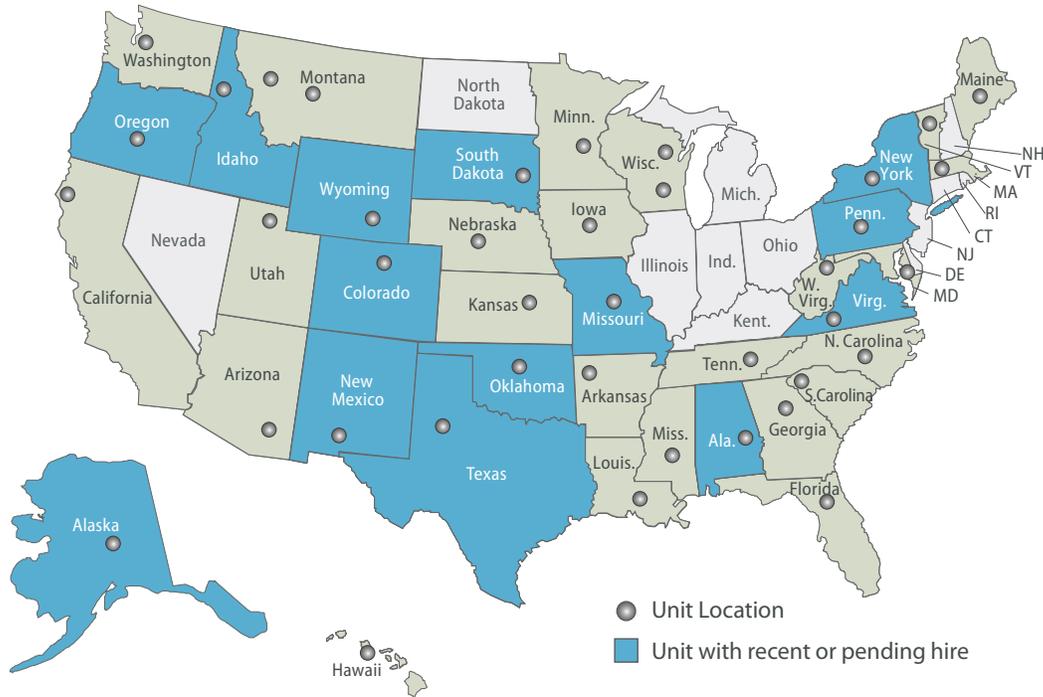
agencies through the program's strong focus on applied research and technical assistance to support decision making.

Unit scientists continue to mentor and train several hundred graduate students each year, with approximately 100 Master and Doctoral students graduating per year from host universities. Most of these students go on to establish careers in natural resource management agencies, academia, private consulting, or nongovernmental organizations. The number of students trained and graduated is expected to increase in the coming years as newly hired staff recruit new students and develop additional opportunities for graduate education and training. These students will have the benefit of training and practice in applying highly innovative ways of linking management and science, thereby furthering the strategic focus of the CRU program and its cooperators.

**REBUILDING SCIENCE CAPACITY**

Recent funding increases in the CRU budget have enabled the program to pursue an aggressive strategy to refill vacant scientist positions. In 2009, scientist positions were filled in Hawaii, New York, Nebraska, and Oklahoma. A budget increase of + \$2 million between FY 2009 and FY 2010 has increased scientist hiring activity. As of this writing, 15 additional scientist positions have been recently filled or are actively in the process of being filled (see map below). These positions include both Unit Leaders and Assistant Unit Leaders, and thus reflect both natural shifts within the program (from Assistant Unit

Leader to Unit Leader) as well as the recruitment of new staff into the program. A number of these hiring actions are occurring in Units that have had long-standing unfilled positions (e.g., Idaho, New Mexico, and Wyoming). Importantly, several of these actions will bring certain Units back to full staffing, including Alabama, Pennsylvania, New York, Colorado, and Oklahoma, providing a complete complement of Unit scientific staff to fully leverage cooperator resources. Naturally, staff retirements over this time period have also occurred, creating additional vacancies as CRU is concurrently filling positions. CRU will continue to evaluate priority hiring actions in FY 2011 and beyond depending on the outcome of ongoing budget deliberations.



**2009 PERSONNEL CHANGES**

**NEW HIRES**

- Joseph (TJ) Fontaine, Assistant Unit Leader, Nebraska Unit (1/4/09)
- Alan Friedlander, Assistant Unit Leader, Hawaii Unit (1/20/09)
- Jim Long, Assistant Unit Leader, Oklahoma Unit (7/5/09)
- Angela Fuller, Assistant Unit Leader, New York Unit (10/26/09)

**REASSIGNMENTS**

- F. Joseph Margraf, Supervisor (10/09)

**RETIREMENTS**

- Bern Shanks, Supervisor (9/30/09)
- Michael R. Vaughan, Unit Leader, Virginia Unit (10/1/09)
- Michael J. Conroy, Assistant Unit Leader, Georgia Unit (10/2/09)
- Wayne A. Hubert, Unit Leader, Wyoming Unit (12/31/09)

**AWARDS**

**USGS Diversity Award**

- Christine Moffitt, Assistant Unit Leader, Idaho Unit

**Safety & Health Group Achievement Award, for Motorboat Operators Certification Course Working Group**

- Don Dennerline, CRU Headquarters Staff
- Franklin Percival, Unit Leader, Florida Unit

**CRU Excellence in Science Awards**

- Georgia Unit
- Wisconsin Wildlife Unit

**Service Excellence Awards**

- Jaime Collazo, Assistant Unit Leader, North Carolina Unit
- Mike Conroy, Assistant Unit Leader, Georgia Unit
- Barry Grand, Unit Leader, Alabama Unit
- Jim Peterson, Assistant Unit Leader, Georgia Unit

**Leadership Excellence Award**

- Bill Fisher, Unit Leader, New York Unit

# PROGRAM UPDATES

## NEW WEB SITE FOR COOPERATIVE RESEARCH UNITS

The new web site for the CRU Program ([www.coopunits.org](http://www.coopunits.org)) will be available March 2010 and will complete a multi-year effort to: better meet the needs of CRU staff and program cooperators; accomplish goals established in the CRU Strategic Plan; and meet ever-increasing web security requirements established by the Department of Interior for hosting the site. Significant additional functionality of the web site will include the delivery of state and federal project information, generation of uniform web pages for all units (while providing access to individually maintained pages), and notification of cooperator meetings and agendas. The data collection, reporting and user management functions are now handled by an independent, commercially available system (Digital Measures) that is in use at over 800 major universities across the country. CRU's goal is a synthetic, online system that becomes an integral part of annual business practices, which includes collecting and organizing data for individual and unit performance reviews, annual reports, budget documents, and many other reporting purposes. Please visit the new web site at your convenience to see what changes and improvements have been incorporated, and provide input on needed future developments or specific information you would like to see available on-line.



A screen shot of the new Cooperative Research Units web site.

## NATIONAL COOPERATORS' COALITION

In 2009, the CRU National Cooperators' Coalition (NCC), a consortia of non-federal partners and cooperators of the CRU program, established a new Steering Committee. Steve Riley of the Nebraska Game and Parks Commission (Wildlife Division Assistant Administrator) was elected to chair the Committee. Steve has been active in establishing for the first time a web site for the NCC, which outlines the NCC's strategic vision for the CRU program. The NCC holds its annual meeting at the North American Fish and Wildlife Conference. The NCC web site may be accessed at: <http://sites.google.com/site/fishwildlifeunits/home>.



The Little Colorado River, Grand Canyon, Arizona; the Kansas Unit is working with partners to evaluate translocations of the federally-endangered humpback chub in the Grand Canyon. Photo: Kristen Pitts.



A newly banded Mourning Dove, as part of a detailed examination of reproductive strategies in this species conducted by Dave Otis and graduate student Dave Miller of the Iowa Unit. Photo: Dave Miller.



A pygmy rabbit, the smallest North American rabbit; this species is under petition for protection under the Endangered Species Act. Photo: Tom Edwards.



Mississippi Unit graduate student, Eddie Parham, takes body measurements after radio-marking an American alligator on the Pearl River, Mississippi, with personnel of the Mississippi Department of Wildlife, Fisheries, and Parks. Photo: Francisco Vilella.

## NEW COLLABORATIONS IN SCIENCE-BASED DECISIONMAKING

In 2009, CRU advanced the three part strategic initiative based on the vision of the NCC for the CRU program. The goal of the initiative is to continually enhance the ability of cooperators and partners to make sustainable, science-based decisions for conservation. Highlights of action on CRU's initiative in 2009 are as follows:

### TRANSBOUNDARY COLLABORATION

Conducting large-scale research that transcends ecological and state boundaries is needed to address large-scale ecological changes predicted to occur in the future. Transboundary collaboration in science is necessary to answer research questions that cannot be adequately addressed at the state scale. In June 2009, a pilot sub-regional team of CRU scientists met in Salt Lake City, Utah, to identify species management questions requiring a geographic scale analysis that transcends state boundaries. Unit scientists from Wyoming and Montana have met with state cooperators to explore a multi-state elk population modeling analysis, based on existing and new elk tagging data. Through 2010 and beyond, other options for transboundary collaboration will be explored and possibly linked to the USFWS research needs and priorities identified through Landscape Conservation Cooperatives.

### ENHANCING THE MANAGEMENT-RESEARCH CONNECTION

A major thrust of CRU's new Action Plan is to tie science more effectively to conservation and management. In 2009, CRU continued to support cooperators and partners in the use of structured decisionmaking and adaptive management (SDM/AM). Unit scientists in Georgia, Idaho, Pennsylvania, Montana, and Alabama worked with state and federal cooperators using a structured decisionmaking process to address challenging natural resource issues. A key activity in 2009, was establishing an important partnership with the NCTC to provide training to Unit staff and their state cooperators on SDM/AM. In 2009, CRU sponsored the week-long training of state cooperators from Alabama, New Mexico, Kansas, Texas, Montana, Utah, and Vermont. CRU will continue to work with the NCTC in the future to deliver SDM/AM training to Unit staff and state cooperators.

### GRADUATE EDUCATION

During 2009, teams of Unit scientists evaluated approaches to develop new and enhanced graduate curricula, provide new experiential and distance learning opportunities for Unit students, and enable co-instruction across host universities. In cooperation with the NCTC, Unit scientists delivered specialized webinar classes to state and federal cooperators. Additionally, Unit staff worked to develop a Distance Learning Survey for Unit scientists, which will be used to plan next steps in 2010 and beyond for boosting competencies of CRU graduate students (see box below).

### DISTANCE LEARNING SURVEY

A key component of CRU's three part strategic initiative is to evaluate new and enhanced graduate curricula and training opportunities. This initiative component seeks to ensure that core courses for fish and wildlife students are available and to determine what new specialized course topics are needed to boost competencies of CRU graduate students.

Distance Learning, where university courses may be packaged and taught remotely via the internet, has become increasingly popular. CRU Unit scientists have delivered webinar presentations on selected topics with the assistance of the NCTC. Tiering from this successful concept, CRU staff and scientists formed a team, including staff at the NCTC, to evaluate different distance learning approaches for CRU's education initiative, particularly as it relates to the development of courses needed to advance other program initiatives (e.g., SDM/AM training).

A survey was issued to Unit scientists to gather basic program-wide data. Early results indicate that the majority of Unit scientists (57%) have not participated in distance education, although a significant proportion, nearly half, have had some experience with distance learning. The top five courses listed by respondents as unavailable and of highest need (in order) were: structured decisionmaking/adaptive management; landscape ecology; estimation of population parameters; ecosystem ecology/management; and human dimensions. These basic data will help CRU craft a strategy that builds upon existing expertise, enabling the program to develop a viable distance learning program beginning in FY 2010 and beyond.



From top: Russell Parr, M.S. student at the Georgia Unit, with a tripletail captured during sampling off the coast of Jekyll Island, Georgia. Photo by: Paul Medders/Georgia DNR; Great Blue Heron photographed at study site as part of study by Utah Unit researchers on management of riparian areas in Utah with regard to bird species of special concern and endangered bird species. Photo: Hillary White; Maine Unit field assistant Margaret Homerding collects stream water chemistry data for a study of affects of marine derived nutrients on stream food webs in central Maine. Photo: Margaret Guyette.

# RESEARCH HIGHLIGHTS

## COURTNEY CONWAY ARIZONA UNIT

### Endangered Yuma Clapper Rail

Arizona Unit researchers have been working over the past 9 years on the Lower Colorado River to evaluate the effects of prescribed fire as a management tool to improve habitat for the endangered Yuma Clapper Rail. Dams have eliminated the historic spring floods that once scoured the riverine marshlands and created early successional habitat. Researchers have been testing whether fire can be used as a surrogate for those floods to help restore populations of rails. Results suggest that the fires have increased rail numbers, and a paper summarizing results was recently accepted by Ecological Applications. Researchers have been working closely with the Arizona Game and Fish Department, and with fire teams from the USFWS and the Bureau of Land Management. Other collaborators include the Bureau of Reclamation, the USGS, and the U.S. Department of Agriculture. The project is ongoing, but these promising results are already being used by management agencies on the river who have begun implementing fire as a tool to restore rail habitat.



## MEGAN LAPEYRE LOUISIANA UNIT

### Sea Level Rise

As sea level rise is becoming a reality, many coastal plain marshes are literally drowning as vertical accretion fails to keep up with changes in water levels. One new approach to assist coastal marshes in keeping their heads above water is to directly increase marsh elevation by adding a thin layer of dredged sediments to the marsh or interior pond surface. In a recent study of six sites in the Mississippi Delta, trajectory response models predicted that marsh productivity in deteriorating brackish marsh sites approached healthy reference marsh levels over a seven-year period, suggesting that sediment enhancement may be a viable approach that provides long-term benefits to the restored marsh sites.

Little Lake, Louisiana; brackish marsh and interior pond immediately after addition of a thin-layer of sediment from dredged material. Photo: Megan La Peyre.



## JIM LAYZER TENNESSEE UNIT

### Snail Darters in the Upper Tennessee River Drainage

The Tennessee Unit recently completed an assessment of the status and microhabitat of the threatened snail darter – a species considered by many to be synonymous with the Endangered Species Act of 1973. When it was listed as endangered, the only known population occurred in the soon to be inundated reach of the Little Tennessee River. In response to a request from the USFWS, the Unit evaluated the status of snail darters in nine streams including two streams into which they had been translocated. Robust populations were found in the French Broad and Hiwassee rivers, relatively few individuals in five streams and none in two streams. Snail darters demonstrated affinities for certain microhabitats and avoided silt-covered substrates. The effects of siltation on spawning habitat and macrobenthic production are well known and may explain the low abundance of snail darters in other streams surveyed where silt-covered shoals predominated.



## STANDARD METHODS

for  
Sampling North American  
Freshwater Fishes



Scott A. Bonar  
Wayne A. Hubert  
David W. Willis, editors

American Fisheries Society

## BETTER DATA EQUALS BETTER MANAGEMENT STANDARDIZING SAMPLING METHODS

### Summary of Standard Sampling Methods for North American Freshwater Fishes

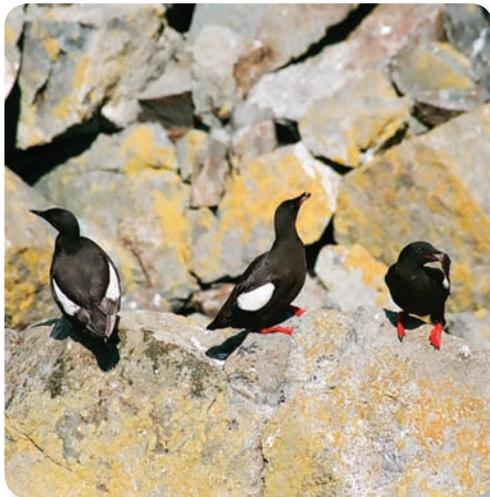
Unit scientists Scott Bonar and Wayne Hubert, along with colleague David Willis of South Dakota State University, edited this comprehensive reference book on fisheries sampling methods published by the American Fisheries Society (AFS) in 2009. Twenty-five CRU scientists from all across the nation contributed, either as authors, reviewers, sponsors or data contributors. Publication was supported by 11 federal, state, and non-governmental agencies. The book provides standard sampling methods recommended by the AFS for assessing and monitoring freshwater fish populations in North America. Methods apply to ponds, reservoirs, natural lakes, and streams and rivers containing cold and warmwater fishes. Range-wide and eco-regional averages for indices of abundance, population structure, and condition for individual species are supplied to facilitate comparisons of standard data among populations. Information is also provided on converting nonstandard to standard data, statistical and database procedures for analyzing and storing standard data, and methods to prevent transfer of invasive species while sampling.

Nearly 300 biologists and managers from 107 agencies, universities, and businesses contributed to the book as authors, reviewers, or sponsors. Unit scientists involved include: David Beauchamp, Washington; Scott Bonar, Arizona; Phaedra Budy, Utah; William Fisher, New York; W. James Fleming, Headquarters; Christopher Guy, Montana; M. Lynn Haines, Western Region; Wayne Hubert, Wyoming; Alison Iles, Arizona; Thomas Kwak, North Carolina; Joseph Margraf, Western Region; Norman Mercado-Silva, Arizona; L.E. (Steve) Miranda, Mississippi; Donna Parrish, Vermont; Craig Paukert, Kansas; James Peterson, Georgia; Bernard Pientka, Vermont; Kevin Pope, Nebraska; Charles Rabeni, Missouri; David Rogowski, Arizona; Bernard Shanks, Western Region; Gary Thiede, Utah; Kevin Whalen, Headquarters; Byron Ken Williams, Headquarters; and Dana Winkelman, Colorado.

## CYNTHIA LOFTIN MAINE UNIT

### New Monitoring Tools for Seabird Behaviors

Scientists from the Maine Unit are working with collaborators to evaluate innovative remote monitoring tools to quantify natural patterns of seabird behavior. New methods are needed to quantify natural behavior because traditional approaches, such as direct observation, are cost intensive and can introduce confounding effects. Accurate behavioral information is needed to quantify seabird responses to human disturbance stemming from aquaculture and wind farm activity near breeding islands. Unit scientists are combining active observer, passive recording (temperature loggers, time-lapse cameras, motion activated cameras), and computer-automated counts from digital photographs to document nest attendance of gulls [Herring Gulls (*Larus argentatus*), Great Black-backed Gulls (*Larus marinus*)] and Common Eiders (*Somateria mollissima*), and colony attendance of Black Guillemots (*Cepphus grylle*) and gulls on Jordan's Delight Island, Maine. Preliminary results indicate that two temperature-sensing devices deployed in eider nests successfully detected hatch and abandonment dates of the photographed nests. Also, analyses of the computer-automated gull counts found that the software provided reliable counts of gulls. This tool is currently being used to identify changes in gull numbers in response to boat, avian predator, and observer disturbances at the study site.



Black Guillemots loafing outside their nest burrows on rock rubble on Jordan's Delight Island, Maine. Photo: Dawn Bravaro.

## SCOTT BONAR ARIZONA UNIT

### Spawning Biology of the Devil's Hole Pupfish

In the midst of the Mohave Desert there lies a small crack in the earth. This crack opens to a flooded cave system called Devil's Hole. In this hole lives an animal that supposedly has the smallest distribution of any vertebrate species in the world: the Devil's Hole Pupfish. Both the Hole and the Pupfish have always been sources of great interest. President Harry S. Truman made Devil's Hole part of Death Valley National Monument because of the unique geology and the irreplaceable fish. In the 1970's, water pumpers in the area, hoping to develop the desert for alfalfa production, were blocked by the U.S. Supreme Court when they were draining the fishes' habitat. Over the past ten years, the population of fish has been declining for unknown reasons and there are currently less than 100 individuals in existence. Researchers from the University of Arizona and the Arizona Unit, in collaboration with the USFWS, the National Park Service, the Nevada Department of Wildlife and others, are testing methods to breed the fish in captivity to increase populations. This work is being conducted along with recovery efforts in Devils Hole in an attempt to save the fish from extinction.

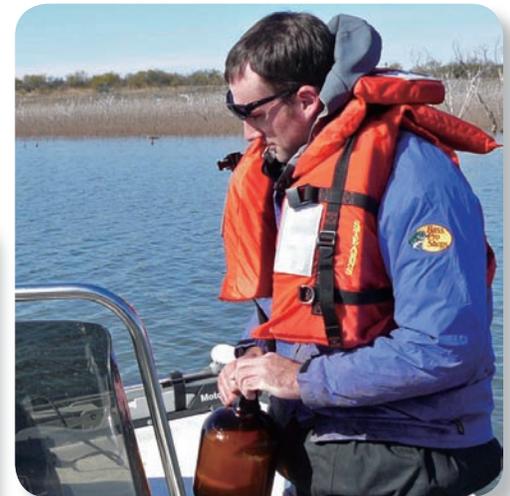


Devil's Hole Pupfish. Photo: USFWS.

## REYNALDO PATINO TEXAS UNIT

### Golden Algal Blooms

Water scarcity is a serious concern in Texas, where surface water is derived almost entirely from rainfall. Concerns over water quality are also of growing importance, not only in Texas but also elsewhere in the country and the globe. The Texas Unit is conducting a retrospective analysis of relationships between historical changes in water quality and the relatively recent spread of a harmful invasive species, golden alga, which has caused considerable damage to aquatic resources in Texas and an increasing number of states in the nation. This research, in part funded by the USGS National Climate Change and Wildlife Science Center, is being conducted with assistance from Texas Parks and Wildlife Department and aims to determine water quality variables that best associate with algal blooms and their links to climate change.



Texas Unit Ph.D. student Matt VanLandeghem takes water samples from O.H. Ivie Reservoir, one of the last remaining reservoirs in west Texas that have yet been spared by golden algal blooms, as part of a collaborative project with Texas Parks and Wildlife Department. Photo: Reynaldo Patino.

## UNIVERSITY COOPERATORS

### STATE NATURAL RESOURCE AGENCY COOPERATORS

### U.S. GEOLOGICAL SURVEY

#### Alabama Fish and Wildlife Unit

Auburn University  
Alabama Department  
of Conservation and  
Natural Resources

#### Alaska Fish and Wildlife Unit

University of Alaska-Fairbanks  
Alaska Department of  
Fish and Game

#### Arizona Fish and Wildlife Unit

University of Arizona  
Arizona Game and Fish Commission

#### Arkansas Fish and Wildlife Unit

University of Arkansas  
Arkansas Game and  
Fish Commission

#### California Fish and Wildlife Unit

Humboldt State University  
California Department  
of Fish and Game

#### Colorado Fish and Wildlife Unit

Colorado State University  
Colorado Division of Wildlife

#### Florida Fish and Wildlife Unit

University of Florida  
Florida Game and Fish Commission

#### Georgia Fish and Wildlife Unit

University of Georgia  
Georgia Department of  
Natural Resources

#### Hawaii Fishery Unit

University of Hawaii  
Hawaii Department of Land  
and Natural Resources

#### Idaho Fish and Wildlife Unit

University of Idaho  
Idaho Department of Fish and Game

#### Iowa Fish and Wildlife Unit

Iowa State University  
Iowa Department of  
Natural Resources

#### Kansas Fish and Wildlife Unit

Kansas State University  
Kansas Department of  
Wildlife and Parks

#### Louisiana Fish and Wildlife Unit

Louisiana State University  
Louisiana Department of  
Wildlife and Fisheries

#### Maine Fish and Wildlife Unit

University of Maine  
Maine Department of Inland  
Fisheries and Wildlife

#### Maryland Fish and Wildlife Unit

University of Maryland,  
Eastern Shore  
Maryland Department of  
Natural Resources

#### Massachusetts Fish and Wildlife Unit

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

#### Minnesota Fish and Wildlife Unit

University of Minnesota  
Minnesota Department of  
Natural Resources

#### Mississippi Fish and Wildlife Unit

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

#### Missouri Fish and Wildlife Unit

University of Missouri-Columbia  
Missouri Department  
of Conservation

#### Montana Fishery Unit

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

## WILDLIFE MANAGEMENT INSTITUTE

### U.S. FISH AND WILDLIFE SERVICE

#### Montana Wildlife Unit

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

#### Nebraska Fish and Wildlife Unit

University of Nebraska-Lincoln  
Nebraska Game and  
Parks Commission

#### New Mexico Fish and Wildlife Unit

New Mexico State University  
New Mexico Department  
of Game and Fish

#### New York Fish and Wildlife Unit

Cornell University  
New York Department of  
Environmental Conservation

#### North Carolina Fish and Wildlife Unit

North Carolina State University  
North Carolina Wildlife  
Resources Commission

#### Oklahoma Fish and Wildlife Unit

Oklahoma State University  
Oklahoma Department of  
Wildlife Conservation

#### Oregon Fish and Wildlife Unit

Oregon State University  
Oregon Department of  
Fish and Wildlife

#### Pennsylvania Fish and Wildlife Unit

Pennsylvania State University  
Pennsylvania Fish and  
Boat Commission  
Pennsylvania Game Commission

#### South Carolina Fish and Wildlife Unit

Clemson University  
South Carolina Department  
of Natural Resources

#### South Dakota Fish and Wildlife Unit

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

#### Tennessee Fishery Unit

Tennessee Tech University  
Tennessee Wildlife  
Resources Agency

#### Texas Fish and Wildlife Unit

Texas Tech University  
Texas Parks and Wildlife Department

#### Utah Fish and Wildlife Unit

Utah State University  
Utah Division of Wildlife Resources

#### Vermont Fish and Wildlife Unit

University of Vermont  
Vermont Department of  
Fish and Wildlife

#### Virginia Fish and Wildlife Unit

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

#### Washington Fish and Wildlife Unit

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

#### West Virginia Fish and Wildlife Unit

West Virginia University  
West Virginia Division of  
Natural Resources

#### Wisconsin Fishery Unit

University of Wisconsin Stevens Point  
Wisconsin Department of  
Natural Resources

#### Wisconsin Wildlife Unit

University of Wisconsin  
Wisconsin Department of  
Natural Resources

#### Wyoming Fish and Wildlife Unit

University of Wyoming  
Wyoming Game and  
Fish Commission

## COOPERATIVE RESEARCH UNITS PROGRAM

U.S. Geological Survey  
12201 Sunrise Valley Drive  
Mail Stop 303  
Reston, Virginia 20192  
Phone: 703-648-4260  
Fax: 703-648-4269

Byron K. Williams, Chief  
Kevin Whalen, Deputy Chief  
W. James Fleming, Unit Supervisor  
Joe Margraf, Unit Supervisor  
Mike Tome, Unit Supervisor  
Rita Raines, Administrative Officer

Cover photos, clockwise from top: Brian Hodge, M.S. student, California Unit, with steelhead captured in the Klamath Basin, as part of a study of this fishes population structure and the consequences of the "half-pounder" life history. Photo: Brian Hodge; White-tailed Tropicbird with geolocator, Exumas, Bahamas. Photo: Patrick Jodice; Florida Unit graduate student samples contents of bottomless lift net as part of a study to determine community composition of nekton utilizing the tidal wetlands in Back River Marsh, Florida. Photo: Wiley Kitchens; Pipevine Swallowtail (*Battus philenor*) foraging on a Salvia flower. Photo: Joseph Fontaine.