NORTH CAROLINA
Cooperative Fish & Wildlife Research Unit

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COOPERATORS

North Carolina State University
North Carolina Wildlife Resources Commission
United States Geological Survey
United States Fish and Wildlife Service
Wildlife Management Institute
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Welcome

We at the North Carolina Cooperative Fish and Wildlife Research Unit are pleased to provide this summary of our activities and accomplishments over the past two years. During this period, we have conducted and facilitated 49 research projects, of which 36 were conducted directly by Unit scientists, and 13 were undertaken by cooperating faculty at North Carolina State University. We place great value on the collaborative relationships that we have developed across institutional boundaries to address multidisciplinary research questions. We are also proud of the role that the Unit serves in facilitating research by our colleagues that utilizes the expertise and knowledge of scientists from a number of departments, colleges, and programs within the University, as well as from our cooperating natural resource agencies.

Our research includes innovative solutions to traditional fish, wildlife, and natural resource management issues, but spans broadly into the fields of conservation biology, landscape ecology, ecosystem processes, global change, ecotoxicology, and genetics. Our field sites are concentrated in North Carolina, but span from coast to coast in the United States and extend into the Caribbean. This report includes summaries of research ranging in subject from threatened and endangered invertebrates, fishes, and birds; invasive aquatic and terrestrial species; and the effects of anthropogenic inputs and contaminants on aquatic ecosystems; to broad-scale effects of land management, conservation planning, and climate change; quantitative population and community dynamics; and innovative sampling technologies and modeling of research results. Much of this research includes graduate student participation; 33 graduate students were advised and mentored by Unit scientists during this period, and 10 have completed their degrees and are pursuing higher degrees or are actively employed in their respective fields.

The past two years have brought ongoing change in the administration and staff of our cooperators, which has been rich with opportunity to build new collaborative relationships and strengthen those existing. Some of these newly appointed administrators are former North Carolina Unit students, which is rewarding. Administrative realignment seems to be everywhere in recent years. North Carolina State University has restructured the life sciences on campus, including formation of a new college and several departments. The Unit departmental home for the past two years has been the Department of Applied Ecology, led by Department Head Harry Daniels, a structure that has allowed us to remain well integrated as productive faculty members at our host University.

This period has been productive and successful for the North Carolina Unit, and in this report, we share a listing of our research products and make them available upon request. The achievements of our scientists, staff, and students have been recognized by others with many formal awards that are listed within, and we share those honors with our cooperators and partners that facilitated them. Yet the most valued reward is to fledge our graduate students into the scientific profession and for our scientific findings to applied toward enhanced natural resource conservation and management.

The success of the North Carolina Cooperative Fish and Wildlife Research Unit for 54 years is largely due to strong, synergistic relationships with our cooperators, partners, colleagues, and friends — and we look forward to continuing those associations to exceed our past accomplishments. Please contact any individual investigator if you would like more information on the research summarized in this report. We also welcome your comments on our past activities and seek your input on the direction that we plan to pursue in the future — please contact us.

The Scientists and Staff of the North Carolina Cooperative Fish and Wildlife Research Unit

The Guest River offers an inviting scene to the human eye, but this tributary to the Clinch River, VA, receives runoff from several coal mining towns, and its waters do not support freshwater mussel populations despite having suitable habitat. Angel White
MISSION STATEMENT

The goals of the North Carolina Cooperative Fish and Wildlife Research Unit are to address the research and technical needs of the U.S. Geological Survey, the U.S. Fish and Wildlife Service, the National Park Service, the North Carolina Wildlife Resources Commission, North Carolina State University, and other appropriate agencies and organizations; to contribute to the quality education of advanced and graduate fisheries and wildlife students at North Carolina State University; and to disseminate the results of research conducted by Unit scientists, staff, students, and cooperators. To advance these goals, the Unit scientists will vigorously pursue funding for projects having scientific merit and those that provide valuable information for natural resource management. Unit personnel will collaborate with cooperators in jointly conducting research and educating graduate students.

The North Carolina Unit will focus on the identification, assessment, interpretation, and alleviation of the effects of current or potential environmental changes or perturbations on fish, wildlife, and natural resources. Through a combination of basic and applied research, the Unit will pursue innovative solutions to natural resource questions. Although some work may be species oriented, community and ecosystem studies will be emphasized. This will require a team approach to hypothesis testing research, involving Unit and University personnel as investigators. When cause-effect relationships are not demonstrable in the field, laboratory or controlled field studies will be conducted.

Educational goals will be achieved by teaching graduate level courses, chairing graduate committees, delivering guest lectures and seminars, and sponsoring or participating in short courses and workshops for cooperators when appropriate.
Cooperators and Personnel

COOPERATING AGENCIES

North Carolina State University
North Carolina Agricultural Research Service
100 Patterson Hall
Raleigh, North Carolina 27695-7643
Richard H. Linton, Dean
Steven A. Lommel, Associate Dean and Director
Harry V. Daniels, Department Head

North Carolina Wildlife Resources Commission
1751 Varsity Drive
NCSU Centennial Campus
Raleigh, North Carolina 27606
Gordon S. Myers, Executive Director
M. Kyle Briggs, Assistant Director
Christian T. Waters, Chief, Division of Inland Fisheries
David T. Cobb, Chief, Division of Wildlife Management

United States Geological Survey
12201 Sunrise Valley Drive
Reston, Virginia 20192
John F. Organ, Chief, Cooperative Research Units
John Thompson, Deputy Chief, Cooperative Research Units
J. Barry Grand, Supervisor

United States Fish and Wildlife Service
Southeast Region
1875 Century Boulevard Northeast, Suite 400
Atlanta, Georgia 30345
Cynthia K. Dohner, Regional Director
Michael Oetker, Deputy Regional Director

Wildlife Management Institute
1101 14th Street, N.W., Suite 801
Washington, D.C. 20005
Steven A. Williams, President
Jonathan Gassett, Southeastern Field Representative

Male Puerto Rican Bullfinch perched on a coffee tree, showing leg-bands and radio-antenna. AMARILYS IRIZARRY
UNIT STAFF

Scientists

Thomas J. Kwak, Unit Leader, Fisheries Professor, Departments of Applied Ecology and Forestry and Environmental Resources

Jaime A. Collazo, Assistant Unit Leader, Wildlife Professor, Departments of Applied Ecology and Forestry and Environmental Resources

Joseph E. Hightower, Assistant Unit Leader, Fisheries, Professor, Department of Applied Ecology

Theodore R. Simons, Assistant Unit Leader, Ecology, Professor, Departments of Applied Ecology and Forestry and Environmental Resources

Support Staff

Mr. Ruby Valeton, Administrative Specialist
James Wehbie, Research Technician
Spencer Gardner, Research Technician

Postdoctoral Research Associates

Jody L. Callihan
Jennifer K. Costanza
Michael V. Cove
C. Ashton Drew
Jesse R. Fischer
Azad H. Khalyani
J. Krishna Pacifici
Bradley A. Pickens
Brian Taverna
Ashley Van
Beusekom
Andrew M. Wilson

Research Staff

Louise B. Alexander
Jennifer M. Archambault
Curtis M. Belyea
Todd S. Earnhardt
Sara Prado
Matthew J. Rubino
Nathan M. Tarr
Adam J. Terando
Steven G. Williams

NC State University Cooperating Faculty

David B. Buchwalter, Department of Environmental and Molecular Toxicology
W. Gregory Cope, Department of Applied Ecology
Christopher S. DePerno, Department of Forestry and Environmental Resources
Robert R. Dunn, Department of Applied Ecology
David B. Eggleston, Department of Marine, Earth and Atmospheric Sciences
Paul L. Fackler, Department of Agricultural and Resource Economics
Jesse R. Fischer, Department of Applied Ecology
Beth A. Gardner, Department of Forestry and Environmental Resources
Nicholas M. Haddad, Department of Applied Ecology
George R. Hess, Department of Forestry and Environmental Resources
Eric B. Laber, Department of Statistics
Jay F. Levine, Department of Population Health and Pathobiology
Christopher E. Moorman, Department of Forestry and Environmental Resources
Stacy A. C. Nelson, Department of Forestry and Environmental Resources
M. Nils Peterson, Department of Forestry and Environmental Resources
Kenneth H. Pollock, Department of Applied Ecology
Roger A. Powell, Department of Applied Ecology
Brian J. Reich, Department of Statistics
Clyde E Sorenson, Department of Entomology and Plant Pathology
Todd A. Steelman, Department of Forestry and Environmental Resources
Laura O. Taylor, Department of Agricultural and Resource Economics

The Red Devil Cichlid is an exotic fish introduced to the rivers and reservoirs of Puerto Rico, with relatively unknown impacts to the native fish assemblage. TOM KWAK

The postlarval stage of goby fishes is harvested as they ascend Puerto Rico rivers in mass migrations that follow seasonal and lunar patterns. Locally called Cetí, these small fish are delicious in traditional Caribbean dishes and on pizza! TOM KWAK
**RESEARCH COLLABORATORS**

Mitchell Aide, University of Puerto Rico  
David Allen, North Carolina Wildlife Resources Commission  
Tom Augspurger, US Fish and Wildlife Service  
Doug Besler, North Carolina Wildlife Resources Commission  
Tyler Black, North Carolina Wildlife Resources Commission  
Jon Blanchard, North Carolina Division of Parks and Recreation  
Rena Borkhataria, University of Florida  
Jared Bowden, University of North Carolina - Chapel Hill  
Ryan Boyles, NC State University  
Gary Breckon, University of Puerto Rico  
Sue Cameron, US Fish and Wildlife Service  
Mark Cantrell, US Fish and Wildlife Service  
Jose Chabert, Puerto Rico Department of Natural and Environmental Resources  
Jeff Cordes, National Park Service  
John Crutchfield, Duke Energy Company  
Jose Cruz-Burgos, US Fish and Wildlife Service, Caribbean Field Office  
Stephen Dinsmore, Iowa State University  
Kevin Dockendorf, North Carolina Wildlife Resources Commission  
Alexis Dragoni, Center for Landscape Conservation, Puerto Rico  
Sam Drooge, US Geological Survey, Patuxent Wildlife Research Center  
Michael Fisk, North Carolina Wildlife Resources Commission  
Steve Fraley, North Carolina Wildlife Resources Commission  
Kay Franzreb, US Forest Service, Clemson University  
Miguel Garcia, Puerto Rico Department of Natural and Environmental Resources  
Walker Golder, National Audubon Society  
Edgardo Gonzalez, Center for Landscape Conservation, Puerto Rico  
William Gould, International Institute of Tropical Forestry, Puerto Rico  
Bob Graham, Dominion North Carolina Power  
J. Barry Grand, Alabama Cooperative Fish and Wildlife Research Unit  
Martha Groom, University of Washington  
Christopher Guglielmo, University of Montana  

Susan M. Haig, US Geological Survey, Forest and Rangeland Ecosystem Science Center  
Ryan Heise, North Carolina Wildlife Resources Commission  
Kevin Hining, North Carolina Wildlife Resources Commission  
Mark Johns, North Carolina Wildlife Resources Commission  
Kristine Johnson, National Park Service, Great Smoky Mountains National Park  
Chris Kelly, North Carolina Wildlife Resources Commission  
R. Wilson Laney, US Fish and Wildlife Service  
Craig Llyestrom, Puerto Rico Department of Natural and Environmental Resources  
Michael Loeffler, North Carolina Division of Marine Fisheries  
Jim Lyons, US Geological Survey, Patuxent Wildlife Research Center  
Marcia Lyons, National Park Service  
Jeff Marcus, North Carolina Wildlife Resources Commission  
Eleni Matechou, University of Kent, Canterbury, UK  
Eloy Martinez, Puerto Rico Department of Natural and Environmental Resources  
Robert Mayer, University of Puerto Rico  
Jason Mays, US Fish and Wildlife Service  
Alexa McKerrow, US Geological Survey  
Jerry McMahon, US Geological Survey, Southeast Climate Science Center  
Brian McAuley, North Carolina Wildlife Resources Commission  
Sarah McAuley, US Fish and Wildlife Service  
Vasu Misra, Florida State University  
Frank Moore, University of Southern Mississippi, Hattiesburg  
R. Wilson Laney, University of Puerto Rico  
Byron Morgan, University of Kent, Canterbury, UK  
Geoff Nicholls, Oxford University, Oxford, UK  
Jim Nichols, US Geological Survey, Patuxent Wildlife Research Center  
Rob Nichols, North Carolina Wildlife Resources Commission  
Corey Oakley, North Carolina Wildlife Resources Commission  
Allan O’Connell, US Geological Survey, Patuxent Wildlife Research Center  

Maria De Lourdes Olmeda, Puerto Rico Department of Natural and Environmental Resources  
Scott Pearson, Mars Hill College  
Alberto R. Puente Rolón, University of Puerto Rico at Mayaguez  
Kerry Rabenold, Purdue University  
Patrick Rakes, Conservation Fisheries, Inc.  
Morgan Raley, HydroGENomics  
Jacob Rash, North Carolina Wildlife Resources Commission  
R. Steven Regan, US Geological Survey, National Research Program, Colorado  
Michael Rikard, National Park Service  
Neftali Rios López, University of Puerto Rico at Humacao  
Andy Royle, US Geological Survey, Patuxent Wildlife Research Center  
Michael Runge, US Geological Survey, Patuxent Wildlife Research Center  
Jose Salguero, Puerto Rico Department of Natural and Environmental Resources  
James Saracco, Institute for Bird Populations  
John Sauer, US Geological Survey, Patuxent Wildlife Research Center  
Forrest Sessions, South Carolina Department of Natural Resources  
David Smith, US Geological Survey, Leetown Science Center  
Lydia Stefanova, Florida State University  
Adam Terando, US Geological Survey, Southeast Climate Science Center  
Alejandro Torres-Abreu, Center for Landscape Conservation, Puerto Rico  
Bryn Tracy, North Carolina Division of Water Resources  
Sondra Vega Castillo, University of Puerto Rico at Arecibo  
Jeffrey Walters, Virginia Polytechnic Institute and State University  
Thomas White, US Fish and Wildlife Service, Puerto Rican Parrot Field Office  
Mike Wicker, US Fish and Wildlife Service  
Bennett Wynne, North Carolina Wildlife Resources Commission  
David Yow, North Carolina Wildlife Resources Commission
Honors and Awards

Wildlife Management Institute Administrative Excellence Award
Awarded to Ruby Valeton in 2016 by the U.S. Geological Survey, Cooperative Research Units (CRU) for exceptional service to the North Carolina Cooperative Fish and Wildlife Research Unit and CRU Program.

Fellow, American Fisheries Society
Awarded to Joseph Hightower in 2015 by the American Fisheries Society.

Regional Director’s Honor Award, U.S. Fish and Wildlife Service, Region 4
Jaime A. Collazo was recognized for contributions toward regional strategic habitat conservation in 2015.

U.S. Department of Interior STAR Awards
Received by Unit scientists for superior performance.
Jaime A. Collazo, 2015, 2016
Thomas J. Kwak, 2015, 2016

Early Career Professional Award
Awarded to Jesse R. Fischer by the Education Section of the American Fisheries Society at the 2016 Annual Meeting of the American Fisheries Society, Kansas City, Missouri.

American Fisheries Society/Sea Grant Best Student Paper Award
Awarded to Casey Grieshaber in 2016 Annual Meeting of the American Fisheries Society (parent society), Kansas City, Missouri (T.J. Kwak coauthor).

Second Place Award for Best Master’s Student Poster
Awarded to Alex Fish at the 2015 Annual Conference of The Wildlife Society (parent society), Winnipeg, Manitoba, Canada.

Best Student Subunit (North Carolina State University, Student Fisheries Society)
Awarded to Casey Grieshaber (President) at the 2015 Southern Division of the American Fisheries Society, Spring Business Meeting, Savannah, Georgia.

W. Don Baker Memorial Award for Best Platform Presentation
Awarded to Jennifer Archambault (Second-time recipient) for her presentation at the North Carolina Chapter of the American Fisheries Society 2016 Annual Meeting, Danville, Virginia.

Richard L. Noble Best Student Presentation Award
Awarded to Crystal Lee Pow for her presentation at the North Carolina Chapter of the American Fisheries Society 2016 Annual Meeting, Carolina Beach, North Carolina (T.J. Kwak coauthor).

Best Student Poster Award
Awarded to Alex Fish at the 2015 Annual Meeting of the North Carolina Chapter of The Wildlife Society.

Best Student Poster Award
Awarded to Alex Fish at the 2016 Annual Meeting of the North Carolina Chapter of The Wildlife Society.

Jimmy Pigg Memorial Outstanding Graduate Student Award
Awarded to Tomas J. Ivasauskas in 2015 by the Southern Division, American Fisheries Society.

Joseph and Robin Hightower Graduate Student Award in Fisheries and Wildlife Sciences
Awarded to Alex Fish in 2016 by North Carolina State University.

U.S. Geological Survey, Southeast Climate Science Center, Global Change Fellowship

Foundation for Agromedicine and Toxicology Supplemental Scholarship
Awarded to Jennifer Archambault in 2016 by North Carolina State University.

John E. Skinner Memorial Travel Award
Awarded to Tomas J. Ivasauskas in 2015 by the American Fisheries Society.

Waterbird Society 40th Annual Meeting Student Travel Grant
Awarded to Shilo K. Felton in 2016.

Graduate Student Association Travel Award
Awarded to Casey Grieshaber in 2016 by the North Carolina State University, Graduate Student Association.

Student Fisheries Society Graduate Student Travel Award
Awarded to Casey Grieshaber in 2015 by the North Carolina State University, Student Fisheries Society.
Graduate Education

CURRENT STUDENTS

STUDENT, DEGREE, PROGRAM

Kathryn Battle, MS, Fisheries, Wildlife, and Conservation Biology
ADVISORS: Jaime A. Collazo and Krishna Pacifici

W. Robert Cope, MS, Fisheries, Wildlife, and Conservation Biology
ADVISOR: Thomas J. Kwak

Shilo Felton, PhD, Fisheries, Wildlife, and Conservation Biology
ADVISORS: Theodore R. Simons and Kenneth Pollock

Amarilys Irizarry, MS, Zoology
ADVISOR: Jaime A. Collazo

Tomas J. Ivasonk, PhD, Fisheries, Wildlife, and Conservation Biology
ADVISOR: Thomas J. Kwak

Jessica H. Page, MS, Zoology
ADVISOR: Jaime A. Collazo

RECENT GRADUATES & CURRENT PURSUITS

STUDENT, DEGREE, CURRENT PURSUIT, ADVISORS

Tiffany N. Penland, MS, Fisheries, Wildlife, and Conservation Biology
ADVISORS: Thomas J. Kwak and W. Gregory Cope

Ana C. Rivera, MS, Zoology
ADVISOR: Jaime A. Collazo

Hypersaline lagoons managed by the Cabo Rojo National Wildlife Refuge for resident and migratory shorebirds in southwestern Puerto Rico. JAIME COLLAZO

Michael V. Cove
PhD, Zoology
Post-Doctoral Scholar, North Carolina State University
Theodore R. Simons

Kelen E. Dowdy
MS, Zoology
Research Assistant, Colorado State University
Jaime A. Collazo
Students in a summer field course on Fisheries Management and Techniques sample fishes of the Flat River using backpack electrofishing. TOM KWAK

The majestic Cape Hatteras Lighthouse on the Outer Banks of NC marks important habitat for marine fishes and coastal fauna that are being studied at the NC Coop Unit. TOM KWAK

Kara E. Dziwulski
MS, Zoology 2016
US Fish and Wildlife Service Biologist, Office of International Affairs
Jaime A. Collazo

Augustin C. Engman
PhD, Fisheries, Wildlife, and Conservation Biology 2016
Post-Doctoral Scholar, North Carolina State University
Thomas J. Kwak

Casey A. Grieshaber
MS, Fisheries, Wildlife, and Conservation Biology 2016
Research Associate, North Carolina State University
Thomas J. Kwak and W. Gregory Cope

Nathan Hostetter
PhD, Fisheries, Wildlife, and Conservation Biology 2016
Post-Doctoral Scholar, Patuxent Wildlife Research Center
Theodore R. Simons and Beth Gardner

Morgan A. Parks
MS, Zoology 2015
Biologist, Florida Fish and Wildlife Conservation Commission
Jaime A. Collazo

Phil Patton
MS, Fisheries, Wildlife, and Conservation Biology 2016
PhD student, University of Washington
Jaime A. Collazo and Krishna Pacifici

Eli Rose
MS, Zoology 2015
Research Associate, University of Hawaii
Theodore R. Simons

Liani M. Yirka
MS, Zoology 2016
Accessibility and Inclusion Coordinator, North Carolina Museum of Natural Sciences
Jaime A. Collazo
GRADUATE COMMITTEE PARTICIPATION

Jaime A. Collazo
Marconi Campos Cerqueira, Ph.D., Univ. Puerto Rico
Benjamin Hess, MS, NC State University

Thomas J. Kwak
Jennifer M. Archambault, PhD
Sean B. Buczek, MS
Antonio Carro, PhD (Turabo University, Puerto Rico)
Elizabeth M. Hassell, PhD
Justin J. Nawrocki, PhD
Crystal S. Lee Pow, PhD
Sandra L. Mort, PhD
Anakela Popp, MS

Theodore R. Simons
Courtney Behrle, PhD
Khai Button, PhD
Erica Henry, PhD
Stasia Bembeneck Bailey, PhD
James Garabedian, PhD

COURSES TAUGHT

Fisheries Techniques and Management
Thomas J. Kwak
Summer 2015, Summer 2016

Management of Small Impoundments
Thomas J. Kwak and Jesse R. Fischer
Fall 2016

Ornithology
Theodore R. Simons
Spring 2016

Species Distribution Modeling: Theory and Applications
Jaime A. Collazo, Krishna Pacifici, and Alexa J. McKerrow
Fall 2015
Research: Fisheries and Aquatic

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Longnose Gar collected by backpack electrofishing in summer camp class for Fisheries, Wildlife, and Conservation Biology students. TOM KWAK
A comprehensive examination of endocrine disrupting compounds and intersex fish in North Carolina water bodies

Endocrine disrupting compounds (EDCs) are discharged into water bodies from numerous sources and have been associated with deleterious effects on fish and wildlife globally. EDCs are associated with high incidence of fish intersex, defined as the presence of both male and female characteristics. The goal of this research is to establish a comprehensive understanding of the impact of EDC contaminants to fisheries in the state. Objectives are to develop a GIS-based map of potential sources of EDCs, conduct a statewide survey for the presence of EDCs and intersex in fish, quantify seasonal dynamics of EDCs and intersex fish, conduct field research and experimental bioassays on intersex fish and EDC dynamics in the Pee Dee River Basin, and conduct laboratory assessment of endocrine disruption and intersex in Pee Dee River water mixtures. Findings will guide strategic planning to address this emerging water quality and fisheries management issue.

INVESTIGATORS D. Derek Aday, Seth W. Kullman, W. Gregory Cope, Thomas J. Kwak, James A. Rice, and J. Mac Law

STUDENTS Crystal S. Lee Pow, Ph.D. in Environmental Toxicology; Casey A. Grieshaber, M.S. in Fisheries, Wildlife, and Conservation Biology; Tiffany N. Penland, M.S. in Fisheries, Wildlife, and Conservation Biology

STAFF Dana K. Sackett, Post-Doctoral Scholar

LOCATION Water bodies of North Carolina

DURATION July 2011–June 2017

FUNDING North Carolina Wildlife Resources Commission

Advancing the tools of freshwater mussel conservation: determining the relative sensitivity of in vitro and in vivo propagated juveniles

Over the past two decades, federal and state agencies have invested substantial funding nationwide in the propagation and culture of native freshwater mussels for conservation purposes. These efforts have resulted in tremendous advances in culture and propagation techniques, aquaculture system design, nutritional needs, and long-term growth and maintenance. Most of this success has been attributed to improving standard host fish (in vivo) infection techniques for propagation, but recent advances have made it possible to produce thousands of juvenile mussels with in vitro propagation techniques that require less space and less cost than traditional host fish methods. However, no definitive side-by-side studies have been conducted comparing the chemical sensitivity of in vitro propagated juveniles to in vivo propagated juveniles. Therefore, the overall goal of this study was to conduct a robust side-by-side assessment of the relative sensitivity of in vivo grown and in vitro produced juvenile mussels to selected chemical toxicants. This project has greatly expanded the toxicity data base for native freshwater mussels and toxicants with different modes of action that have been produced with different propagation techniques.

INVESTIGATORS W. Gregory Cope, Thomas J. Kwak, Damian Shea, Thomas Augspurger

STUDENTS Anakela Popp, M.S., Fisheries Wildlife, and Conservation Biology

LOCATION NC State University Mussel Laboratory

DURATION July 2014–June 2017


American eel age and growth assessment

The American Eel (Anguilla rostrata) is a facultative catadromous fish species that occupies a diversity of estuarine and freshwater habitats. Despite an extensive distribution and the ability to tolerate a variety of habitats, concern regarding the status of American Eel has risen based on declining trends in commercial harvest coupled with anthropogenic threats to habitat and the species’ migratory life cycle. Yet assessments of population characteristics in freshwater habitats have been limited. We sampled American Eels from the Roanoke River and Roanoke Rapids Lake, North Carolina, to characterize the American Eel population within the river mainstem and an upstream reservoir into which eels are passed. Additionally, the age, sex, and presence of the Anguillicola crassus parasite in swimbladders of sampled eels will be determined. Finally, age, growth, and mortality of eels will be modeled in relation to location, sex, and the presence of A. crassus. Findings will be synthesized to provide a better understanding of American Eel ecology and management.

INVESTIGATORS Jesse R. Fischer, Thomas J. Kwak

STAFF James D. Wehbie, Research Assistant; Spencer Gardner, Research Assistant; Wilson Xiong, Research Assistant

LOCATION Roanoke River basin, North Carolina

DURATION July 2014–June 2017

FUNDING U.S. Fish and Wildlife Service
Estimating mortality for Southern Flounder using a combined telemetry and conventional tagging approach

The Southern Flounder (Paralichthys lethostigma) is a recreationally, commercially, and ecologically important marine species in North Carolina. Despite its importance, the Southern Flounder population in North Carolina is considered to be depleted, with harvest rates above management targets. The effects of recent regulatory changes on harvest rates are unknown, and no direct estimates of natural mortality exist. We propose to estimate the instantaneous rates of fishing (F) and natural (M) mortality at two spatial scales (coastwide and within the New River estuary), using a combined telemetry and conventional tagging approach. Improved information on the sources, magnitude, and variability (spatial, seasonal, interannual) of fishing and natural mortality will lead to better assessment and management of the North Carolina Southern Flounder stock.

INVESTIGATORS
Frederick S. Scharf (UNCW), Jeffrey A. Buckel, Joseph E. Hightower

STUDENTS
Trevor K. Scheffel, MS, Biology and Marine Biology, UNCW

LOCATION
North Carolina coastal waters, primary effort within New River estuary

DURATION
July 2014–June 2018

FUNDING
North Carolina Marine Resources Fund

Fishery population and habitat assessment in Puerto Rico streams

Puerto Rico is known for its marine fisheries, but the freshwater habitats of the island also support a substantial number of relatively unknown fishes, many of which provide recreational fishery values. We completed research to evaluate stream and river fish and habitat sampling techniques and to develop standardized sampling protocols. We also modeled patterns in occurrence and abundance of stream and river fish populations as related to physical habitat, water quality, riparian and watershed attributes, and river regulation. We quantified contaminant concentrations and dynamics in the stream food web, and elucidated the ecology and migration of amphibidromous fishes. Ongoing objectives include sampling fishes in downstream river reaches, assessing fish age and growth techniques, and studies of fish early life history and recruitment dynamics. Finally, we will synthesize findings from these objectives toward a better understanding of fish biology, ecology, and management.

INVESTIGATORS
Thomas J. Kwak

STUDENTS
W. Robert Cope, M.S. in Fisheries, Wildlife, and Conservation Biology

LOCATION
Tar and Neuse river basins, North Carolina

DURATION
August 2015–July 2018

FUNDING
North Carolina Wildlife Resources Commission

Population status and genetic structure of the Carolina Madtom

The Carolina Madtom, Noturus furiosus, is a small catfish endemic to the Neuse and Tar river basins of North Carolina. The species spans a restricted range in these two basins, and the Neuse basin population appears to be declining. We will conduct research to define the extant distribution and populations of the Carolina Madtom and further quantify sampling bias and efficiency toward understanding and modeling the species distribution and abundance. We will also estimate critical parameters of genetic isolation and diversity within and among populations. These findings will provide critical, timely information for the Species Status Assessment, inform protective listing decisions, and guide conservation planning for the species.

INVESTIGATORS
Thomas J. Kwak, Harry V. Daniels

STUDENTS
Elissa N. Buttermore, M.S. in Fisheries and Wildlife Sciences; William E. Smith, Ph.D. in Fisheries and Wildlife Sciences; Augustin C. Engman, Ph.D. in Fisheries, Wildlife, and Conservation Biology

STAFF
Jesse R. Fischer, Post-Doctoral Scholar

LOCATION
Puerto Rico Islandwide

DURATION
November 2004–August 2017

FUNDING
Puerto Rico Department of Natural and Environmental Resources, U.S. Fish and Wildlife Service
Recent precipitous declines of endangered freshwater mussels in the Clinch River: an in situ assessment of water quality stressors related to energy development and other land-use

Native freshwater mussels (Order Unionoida) are one of the most rapidly declining faunal groups in the North America. About 70% of the nearly 300 freshwater mussel species found in North America are considered vulnerable to extinction or are already extinct. These declines have been attributed to an array of factors associated with pollution and water quality degradation and habitat destruction and alteration, including most recently, rapid expansion of energy development and other extractive land-uses. This research measured contaminant stressors in surface water, sediment, sediment pore water, and resident and caged mussels at sites in the Clinch River of Virginia and Tennessee and evaluated the relationship of the combined stressors and landscape influences to freshwater mussel populations, including federally listed endangered species. The successful completion of this project has provided federal and state natural resource management agencies and other decision makers with the information needed to assess mussel sensitivity to contaminants in relation to these multi-faceted stressors and has improved the conservation and management of this valuable, but imperiled faunal group.

<table>
<thead>
<tr>
<th>INVESTIGATORS</th>
<th>W. Gregory Cope, Thomas J. Kwak, Damian Shea, Jess W. Jones</th>
</tr>
</thead>
<tbody>
<tr>
<td>STUDENTS</td>
<td>Christine M. Bergeron, Postdoctoral Scholar</td>
</tr>
<tr>
<td>STAFF</td>
<td>Jennifer M. Archambault, Jeremy A. Leonard, Peter R. Lazaro</td>
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<tr>
<td>LOCATION</td>
<td>Clinch River of Virginia and Tennessee</td>
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<tr>
<td>DURATION</td>
<td>May 2012–December 2015</td>
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Robust Redhorse recovery and habitat restoration: assessing water quality stressors and food web contaminant dynamics

The Robust Redhorse (Moxostoma robustum) is a rare and imperiled, large catostomid fish found in only three regulated river drainages in the southeastern U.S. It has been known to be negatively affected by habitat modification and fragmentation from hydroelectric dams, introduced species, sedimentation, and water pollution and is protected by state endangered status in Georgia and North Carolina. To further elucidate the impact of water quality and contaminant dynamics on the Robust Redhorse, the aquatic food web, and 53 priority aquatic species, we are pursuing field research in the Pee Dee River of North Carolina and South Carolina. Our approach includes systematic sampling, experimental field bioassays, fish histopathology, food web stable isotope analyses, and population and food web analyses to synthesize results for Robust Redhorse recovery from population and ecosystem perspectives.

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<thead>
<tr>
<th>INVESTIGATORS</th>
<th>Thomas J. Kwak, W. Gregory Cope, Ryan J. Heise, Forrest W. Sessions</th>
</tr>
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<tbody>
<tr>
<td>STUDENTS</td>
<td>Casey A. Grieshaber, M.S. in Fisheries, Wildlife, and Conservation Biology; Tiffany N. Penland, M.S. in Fisheries, Wildlife, and Conservation Biology</td>
</tr>
<tr>
<td>STAFF</td>
<td>Jesse R. Fischer, Post-Doctoral Scholar; Jennifer M. Archambault, Research Associate</td>
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<tr>
<td>LOCATION</td>
<td>Yadkin/Pee Dee River of North Carolina and South Carolina</td>
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<tr>
<td>DURATION</td>
<td>July 2013–December 2017</td>
</tr>
<tr>
<td>FUNDING</td>
<td>North Carolina Wildlife Resources Commission, North Carolina and South Carolina State Wildlife Grants Program</td>
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Sicklefin Redhorse ontogeny, recruitment, and priority habitats in regulated rivers

The Sicklefin Redhorse is a recently recognized fish of the sucker family Catostomidae and a candidate for endangered species protection. It is among the largest undescribed animal species in North America, and little is known of its biology and ecology. This research will build on previous objectives on spawning migration, movement patterns, microhabitat suitability, and behavior. New objectives focus on early life history and include describing developmental morphology and chronology, estimating reproductive success, describing ontogenetic shifts in Sicklefin Redhorse habitat use during early life stages, determining effects of nonnative species on recruitment, and augmenting the database of spawning areas in the basin. These findings will be used by management and regulatory agencies and utility companies to set guidelines and priorities for dam operation and licensing in the Tennessee River basin.

<table>
<thead>
<tr>
<th>INVESTIGATOR</th>
<th>Thomas J. Kwak</th>
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<tr>
<td>STUDENT</td>
<td>Tomas J. Ivasauskas, Ph.D. Candidate in Fisheries and Wildlife Sciences</td>
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<tr>
<td>LOCATION</td>
<td>Little Tennessee and Hiwassee river basins, North Carolina</td>
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<tr>
<td>DURATION</td>
<td>October 2011–August 2017</td>
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<tr>
<td>FUNDING</td>
<td>U.S. Fish and Wildlife Service, Duke Energy</td>
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</table>
Sources of mortality and movements of Weakfish tagged in North Carolina

Despite its importance to commercial and recreational fisheries and ecologically, Weakfish (Cynoscion regalis) population numbers are at record lows. Improved information about movements and natural mortality is a top research priority for both the Atlantic States Marine Fisheries Commission and North Carolina. We propose to estimate fishing mortality (by sector), natural mortality, and stock boundaries and mixing of Weakfish using conventional and telemetry tagging in North Carolina. Additionally, we will determine diets of a potentially important Weakfish predator, Bottlenose Dolphin, and compare their predation rates to known finfish predators. Improved information on the sources, magnitude, and interannual variability of fishing and natural mortality would lead to better assessment and management of the U.S. east coast stock of Weakfish.

INVESTIGATORS
Jeffrey A. Buckel, Joseph E. Hightower

STUDENT
Jacob R. Krause, PhD, Fisheries, Wildlife, and Conservation Biology

LOCATION
North Carolina coastal waters

DURATION
July 2013–June 2017

FUNDING
North Carolina Marine Resources Fund

Stocked trout survival, behavior, and ecology in North Carolina streams

Stocking surface waters with hatchery-reared trout to support local recreational fisheries is common practice among state and federal agencies. The effectiveness of some fisheries is dependent on the extended availability of stocked trout for angling. The goal of this research is to define the extent and causes of stocked trout migration and mortality among species and to elucidate the mechanisms responsible. We combined intensive and extensive studies to determine the persistence of stocked trout in designated reaches and streams, and then the associated processes and mechanisms were sought in a subset of stream reaches. Fish behavior and ecology were examined to gain an understanding of the factors that may affect stocked fish growth, condition, and survival. Results may be used to inform and guide management actions to improve resource management strategies and to educate fishery constituents and the public.

INVESTIGATOR
Thomas J. Kwak

STAFF
H. Jared Flowers, Research Associate; Jesse R. Fischer, Post-Doctoral Scholar

LOCATION
North Carolina mountain trout streams

DURATION
July 2011–September 2016

FUNDING
North Carolina Wildlife Resources Commission

The Doris Duke Charitable Foundation National Educational Partnership for Conservation

Solving the complex and accelerating conservation problems associated with global change will require innovative solutions of a diverse workforce of people from a broad range of backgrounds and cultures. The University of Florida is leading a grant award to allow undergraduate students to participate in mentored research activities in conservation biology and natural resources. The primary objective is to develop long-term, sustainable educational programming to increase the number of undergraduate students from underrepresented groups in the conservation workforce. A secondary objective is to support the research of faculty and graduate students through experiential learning. Ten undergraduate scholars of diverse backgrounds are being mentored. They receive year-round mentorship for two years and participate in intensive summer research and agency internship experiences. This is a valuable program, and programs, universities, agencies, and society will benefit from the rewards.

INVESTIGATORS
Harry V. Daniels, Thomas J. Kwak, Jaime A. Collazo

STUDENTS
Adriane O. Gill, PhD in Zoology; Crystal S. Lee Pow, PhD in Environmental Toxicology

LOCATION
North Carolina State University

DURATION
September 2013–August 2017

FUNDING
The Doris Duke Charitable Foundation through University of Florida
Research: Wildlife and Habitats

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A study of the effects of pine straw raking on flora and fauna in longleaf pine communities

Pine straw raking can be an important revenue stream in managed longleaf pine forests in the North Carolina Sandhills, but there is a potential for this extractive activity to compromise biological assets in this ecosystem. In particular, there is concern for the impact of this activity on herbaceous plants, ground-dwelling arthropods, and other animals. We are conducting research comparing raked and unraked areas on Fort Bragg through intensive pit-fall trapping of insects and vegetation surveys; we are also more intensively sampling ecologically important native cockroaches and carrion-feeding insects. To date, we have found little impact of raking on insect diversity and abundance. While we are still assessing effects on the diversity and abundance of low growing plant species, we have identified little impact of raking on vegetation, apart from some possible reductions in blueberries following raking. Ancillary studies documented little impact on the Bachman’s Sparrow at the scale of raking as it is conducted on Fort Bragg.

INVESTIGATOR
Clyde E. Sorenson

STUDENT
Sam Buzuleciu, Ph.D., Entomology and Plant Pathology

STAFF
Erika Bonnema, Synda McCracken, student research technicians

LOCATION
Fort Bragg, North Carolina

DURATION
January, 2015–December, 2017

FUNDING
U.S. Army, Fort Bragg

Assessing the effects of storms, coastal development, and shoreline erosion on waterbird populations in coastal North Carolina

This research represented the first phase of an ongoing effort to trace historic changes to waterbird populations and habitats in coastal North Carolina over the past century by producing a catalog of relevant historic maps and contemporary imagery. This catalog will inform future analyses seeking to quantify changes in shorebird habitats from development projects such as the Intracoastal Waterway early in the last century, to more recent urban development, and to periodic storms such as Hurricane Sandy in 2012. Combining historic habitat data with existing data on the distribution and abundance of shorebirds in North Carolina will provide a better understanding of historic trends for shorebirds and their coastal habitats. We searched for publicly available maps and remotely sensed datasets that have the potential to inform efforts to map sandy beaches along all or part of the North Carolina coast in the near or distant past. The digital database includes 164 annotated data sources.

INVESTIGATORS
Theodore R. Simons, Sara Schweitzer, Kate Spear

STAFF
Nathan Tarr and Curtis Belyea

LOCATION
North Carolina State University

DURATION
August 2014–February 2016

FUNDING
U.S. Geological Survey

Assessing the effects of the National Park Service predator and vehicle management practices on nesting shorebirds at Cape Hatteras National Seashore

Shorebird populations are declining worldwide. As an indicator species for coastal environments, the American Oystercatcher is especially vulnerable to anthropogenic disturbance and habitat loss, because it often nests in the open, on sandy beaches favored by recreationists and generalist predators. This study addresses both the individual and population-level responses of oystercatchers to anthropogenic disturbance and habitat loss at two spatial scales. We conducted a two-year experimental study of the responses of incubating adults to off-road vehicles at Cape Hatteras and Cape Lookout National Seashores. We are also examining variations in vital rates and individual behavioral differences of nesting oystercatchers using 20 years of data on nesting success in North Carolina. Ongoing modeling of rangewide demographic data collected by members of the American Oystercatcher Working Group is examining the metapopulation structure of Atlantic and Gulf Coast American Oystercatcher populations.

INVESTIGATORS
Theodore R. Simons and Kenneth Pollock

STUDENT
Shilo Felton, Ph.D. Fisheries Wildlife and Conservation Biology

LOCATION
Cape Hatteras and Cape Lookout National Seashores, North Carolina

DURATION
August 2013–September 2017

FUNDING
U.S. National Park Service
Assessing endangered Marsh Rabbit and Woodrat habitat Use and Feral Cat populations using photographic, video, and RFID capture-recapture data

We used dynamic occupancy models to determine factors associated with Marsh Rabbit occurrence, colonization, extinction, and the co-occurrence of Marsh Rabbits and free-ranging cats. Rabbit occurrence was positively related to freshwater habitat and patch size, but was negatively related to the number of individual cats detected at each site. Furthermore, Marsh Rabbit colonization was negatively associated with relative increases in the number of individual cats at each site over between primary surveys. Dynamic co-occurrence models also suggested that the two species are negatively associated spatially, but co-detections at sites were positively associated. We used dynamic multistate occupancy models to evaluate changes in Woodrat distribution and stick nest building behavior in response to cat removal. The distribution of Woodrats at supplemental nests increased from <25% to nearly 40% between 2013-2015. Our results support current recovery objectives and management strategies because nest supplementation is an important tool for the recovery of the Key Largo rodent community, and exotic predator removal is positively related to recolonization and behavioral changes in the endemic small mammal fauna of the Florida Keys.

INVESTIGATORS: Theodore R. Simons, Allan O’Connell, and Beth Gardner
STUDENT: Michael V. Cove, Ph.D. Zoology
LOCATION: Key Deer and Crocodile Lakes National Wildlife Refuge, Florida
DURATION: July 2011–August 2017
FUNDING: U.S. Fish and Wildlife Service

Breeding productivity and density of Bachman’s Sparrow (federal and state species of special concern) in different training regimes on Fort Bragg, North Carolina

The longleaf pine ecosystem has been reduced to <95% of its historic range. Many species dependent on the longleaf pine–wiregrass community, including Bachman’s Sparrow, have declined concomitantly. Many military installations use frequent prescribed fire to maintain the open canopy and diverse groundcover characteristic of the historic longleaf pine systems, which in turn maintains high quality habitat for Bachman’s Sparrow. Yet, military training activities result in ground disturbance that may negatively affect Bachman’s Sparrow nesting success and site occupancy. We investigated the potential effects of military training on sparrow breeding ecology on Fort Bragg Military Installation. We attached radio transmitters to 45 female Bachman’s Sparrows, which helped us locate 110 nests. And, we monitored 120 sparrow territories to assess overall productivity in areas with low and high levels of training activity.

INVESTIGATORS: Christopher E. Moorman, Christopher S. DePerno
STUDENTS: Alexander C. Fish, MS, Fisheries, Wildlife, and Conservation Biology; Daniel Choi and Moriah Boggess, undergraduates, Fisheries, Wildlife, and Conservation Biology
LOCATION: Fort Bragg Military Installation, North Carolina
DURATION: August 2013–December 2016
FUNDING: U.S. Department of Defense

Crystal Skipper butterfly monitoring efforts and host plant propagation in Carteret County, North Carolina

The Crystal Skipper (Atrytonopsis quinteri) is a newly identified butterfly found only along a 30-mile stretch of barrier islands in central North Carolina, commonly known as the Crystal Coast. Previous research suggests the greatest threat to the Crystal Skipper is anthropogenic induced destruction and fragmentation of its sand dune habitat. Although preserving large areas of continuous sand dune habitat is ideal, small natural areas such as undeveloped lots and unlandscaped yards can support small butterfly populations and maintain connectivity by serving as stepping stones. We plan to monitor known populations of Crystal Skipper butterfly populations and estimate relative abundance. We will also survey areas of suitable habitat on adjacent sites outside of the known species range to verify population distribution. Seeds of the butterfly’s larval host plant, Seaside Little Bluestem (Schizachyrium littorale), will be collected for plant propagation efforts and made available to the public to assist in local habitat restoration.

INVESTIGATOR: Nick Haddad
STUDENTS: Erica Henry, PhD, Zoology; Elsita Kiekebusch, PhD, Zoology
STAFF: Heather Cayton
LOCATION: Carteret County, North Carolina
DURATION: November 2016–August 2017
FUNDING: U.S. Fish and Wildlife Service
Development of a wildlife habitat matrix to inform forest management on Fort Bragg

Forest ecosystems in the southeastern United States evolved with frequent lightning-ignited fires, a natural process generally mimicked with prescribed fire today. Fire management regimes in the longleaf pine (*Pinus palustris*) ecosystem are driven largely by policies focused on recovery of the federally endangered Red-Cockaded Woodpecker (*Picoides borealis*), and sometimes other threatened or endangered species. However, management paradigms driven by single species like the Red-Cockaded Woodpecker may encourage homogeneity when focal species require a narrow suite of vegetation conditions, particularly when competing vegetation types are not linked to other ecological indicators. Yet, management to maintain heterogeneous habitat conditions is complex and requires large-scale habitat planning that considers multi-species response to a variety of alternative management scenarios. To aid these complex planning processes, habitat planning models can be constructed using spatial data and known habitat relationships for target wildlife species. These twin components — that managers can differentially affect vital rates, and vital rates can differentially affect population growth and persistence — are well understood, but have not been merged in a user-friendly way that can help guide on-the-ground management in the absence of intensive demographic data for target species. Therefore, we developed a modeling approach to connect management actions (i.e., prescribed burning, midstory hardwood removal) to population dynamics for focal species.

**INVESTIGATORS** Christopher Moorman, Christopher DePerno, Scott Mills  
**STUDENT** John Thomas, Undergraduate, Fisheries, Wildlife, and Conservation Biology  
**STAFF** Eugenia Bragina  
**LOCATION** Fort Bragg Military Installation, North Carolina  
**DURATION** August 2014–May 2018  
**FUNDING** U.S. Department of Defense

Inclusions of upland hardwoods embedded in the longleaf pine matrix were mapped to help direct wildlife habitat planning.

Engagement of Latin American colleagues in a Research Symposium on the Biology and Conservation of American Oystercatchers

The American Oystercatcher Working Group sponsored a symposium on Oystercatcher Biology and Conservation as part of the 2015 Waterbird Society annual meeting which was held 11–15 August at the College of the Atlantic in Bar Harbor, Maine. This project secured and administered funding from several branches of the U.S. Fish and Wildlife Service to publish the symposium proceedings, and to provide travel support for six Latin American colleagues actively engaged in shorebird research and conservation to attend the symposium. The proceedings, comprised of 13 research articles, will be published in February 2017 as a special issue of the journal Waterbirds. Funds were administered through a Cooperative Ecosystem Studies Unit cooperative agreement between the U.S. Fish and Wildlife Service and North Carolina State University.

**INVESTIGATOR** Theodore R. Simons  
**STUDENTS** Shilo Felton, Ph.D. Fisheries, Wildlife, and Conservation Biology  
**LOCATION** North Carolina State University  
**DURATION** March 2015–December 2017  
**FUNDING** U.S. Fish and Wildlife Service
Evaluation of priority game species use and propagation feasibility of high value Sandhills native wildlife plants

Restoration of native plant communities is a priority for many land managers. On public lands, restoration of these communities has to be balanced with public use and input. On lands where public hunting is a component, land managers may be pressed to provide wildlife openings (i.e., food plots) that contain primarily non-native plantings. Although some managers have advocated openings consisting of native plants, rather than the more traditional non-native species, the relative value of the different plant communities to wildlife has not been studied extensively. We compared White-Tailed Deer, Wild Turkey, and Coyote use of four different wildlife opening types: non-native cool season openings, non-native warm season openings, naturalized plant community openings, and naturalized plant communities supplemented with seeds of native, wildlife forage species. We quantified wildlife use of the four opening types and control sites in adjacent forest using camera traps. The number of White-Tailed deer photos per trap night was greater in cool season and warm season openings than in controls, native, or native supplemented openings, but relative use of each opening type peaked during the season of peak vegetation production. Wild Turkey photos per trap night were greater in cool season openings during the spring and winter and greater in warm season openings during the winter than in the control plots or in the native plant openings. Coyote photos per trap night did not vary among opening types. Although openings planted with non-native plants were most attractive to deer and turkey, we suggest openings managed for native plant species also can provide unique food and cover resources for hunted wildlife, especially in forested landscapes with sparse understory vegetation.

INVESTIGATORS  
Christopher E. Moorman, Christopher S. DePerno

STUDENTS  

LOCATION  
Fort Bragg Military Installation, North Carolina

DURATION  
September 2013–June 2016

FUNDING  
U.S. Department of Defense

INVESTIGATING NORTHERN BOBWHITE POPULATION DEMOGRAPHICS AND HABITAT SELECTION IN THE LONGLÈAF-WIREGRASS ECOSYSTEM

Growing-season prescribed fire may suppress woody vegetation and promote herbaceous groundcover better than dormant-season fire; hence, it is increasingly used to restore fire-adapted plant communities. Despite the potential ecological benefits of growing-season fire, many land managers use only dormant-season prescribed fire to avoid destruction of bird ground nests, including those of Northern Bobwhite (Colinus virginianus). Our objective was to determine Northern Bobwhite nest survival and nest-site selection in the presence of early, growing-season prescribed fire on a 3-year return interval. We compared vegetation composition and structure between nest sites and paired random sites to identify important predictors of nest-site selection and to model the effects of habitat covariates (including time-since-fire) on nest survival. We captured and attached radio transmitters to individuals during the late winter months. We tracked radio-marked individuals to locate nests and determine nest survival. We located 14 nests in 2016, 2 of which were burned during prescribed fire. We captured and attached radio transmitters to individuals during the late winter months. We tracked radio-marked individuals to locate nests and determine nest survival. We located 14 nests in 2016, 2 of which were burned during prescribed fire. All 14 nests were located within units that were burned at least 2 years prior, putting these nests at a greater risk for being burned.
destroyed by prescribed fire that occurred on a 3-year return interval. Preliminary results suggest that restricting burning to April through early June should limit an overlap between prescribed burns and the peak of Northern Bobwhite nesting activity in July. Additionally, longer fire return intervals may be needed to allow development of woody understory structure selected by bobwhites for nesting, especially on poor soils like those on our study site in the Sandhills physiographic region.

INVESTIGATORS Christopher E. Moorman and Christopher S. DePerno
STUDENT Sarah B. Rosche, M.S., Fisheries, Wildlife, and Conservation Biology
LOCATION Fort Bragg Military Installation, North Carolina
DURATION August 2015–August 2018
FUNDING U.S. Department of Defense

The endangered St. Francis’ Satyr butterfly can be successfully mated in captivity under optimal environmental conditions.

Long-term monitoring and habitat restoration for the US federally endangered St. Francis’ Satyr butterfly I
The St. Francis’ Satyr (Neonympha mitchellii francisci) is a federally endangered butterfly found only on Fort Bragg Army Installation in central North Carolina. It depends on frequent disturbance by fire and beavers to maintain its preferred habitat, ephemeral wetlands, and in recent years there has been a sharp decrease in population numbers. We are working to increase the population level through a combination of habitat restoration and the establishment of a captive-rearing program. Our efforts include the creation and maintenance of high quality wetland restoration sites via hardwood removal and stream inundation. We are also working to expand the success of our captive rearing program through experiments that test for optimal mating and greenhouse conditions.

INVESTIGATOR Nick Haddad
STUDENTS Erica Henry, Ph.D., Zoology; Elsita Kiekebusch, Ph.D., Zoology
STAFF Heather Cayton, Erick Aschehoug
LOCATION Fort Bragg, North Carolina
DURATION May 2015–April 2016
FUNDING U.S. Army, XVIII Airborne Corps and Fort Bragg

Long-term monitoring and habitat restoration for the US federally endangered St. Francis’ Satyr butterfly II
The St. Francis’ Satyr (Neonympha mitchellii francisci) is a federally endangered butterfly found only on Fort Bragg Army Installation in central North Carolina. It depends on frequent disturbance by fire and beavers to maintain its preferred habitat, ephemeral wetlands, and in recent years there has been a sharp decrease in population numbers. Our work continues to expand the amount of habitat under restoration and further research into demographic and behavioral responses of individuals to restoration over multiple life stages. Last year, we had several successful captive mating events, and we are working to enhance our greenhouse conditions to promote more captive mating that will provide us with a large, permanent captive population. We are continuing our restoration research this year in order to increase our knowledge of butterfly response to restored habitat and to improve habitat quality.

INVESTIGATOR Nick Haddad
STUDENT Elsita Kiekebusch, Ph.D., Zoology
STAFF Heather Cayton
LOCATION Fort Bragg, North Carolina
DURATION May 2016–April 2017
FUNDING U.S. Army, XVIII Airborne Corps and Fort Bragg
## Monitoring and testing demographic effects of restoration for the US federally endangered St. Francis' Satyr butterfly

The St. Francis' Satyr (*Neonympha mitchellii francisci*) is a federally endangered butterfly found only on Fort Bragg Army Installation in central North Carolina. It depends on frequent disturbance by fire and beavers to maintain its preferred habitat, ephemeral wetlands, and in recent years there has been a sharp decrease in population numbers. We are working to restore critical wetland habitat at Ft. Bragg through hardwood removal and stream inundation, and to understand how St. Francis' satyrs respond to different restoration treatments. Our research uses a combination of mark-recapture surveys, vegetation surveys, and captive rearing to gain a better understanding of how restoration affects St. Francis' Satyr demography and how we can improve restoration techniques to create higher quality habitat.

**INVESTIGATOR** Nick Haddad  
**STUDENT** Erica Henry, Ph.D., Zoology  
**STAFF** Heather Cayton, Erik Aschehoug, Frances Sivakoff  
**LOCATION** Fort Bragg, North Carolina  
**DURATION** May 2014–April 2015  
**FUNDING** U.S. Army, XVIII Airborne Corps and Fort Bragg

## Monitoring Federal Trust Avian Species in managed shade coffee plantations under the Partners for Fish and Wildlife and Coastal Programs in Puerto Rico

The Partners for Fish and Wildlife and Coastal Programs of the U.S. Fish and Wildlife Service (USFWS) has worked to restore and enhance important habitat for Federal Trust Species on private lands in Puerto Rico and U.S. Virgin Islands. Conversion of sun- to shade-grown coffee through agroforestry practices is one mechanism being employed since 2001. The objective of this work is to develop a monitoring scheme that will help the USFWS quantify the benefits derived from the Program toward fostering the persistence of Federal Trust Species. A secondary objective is to determine at what time since implementation of management actions are those benefits detected, as this has implications for strategic habitat conservation. Preliminary results support the hypothesis that frugivores are more abundant with time since restoration; the opposite is the case for granivores/insectivores. An ecological effect is detectable at 5-6 years post-restoration.

**INVESTIGATOR** Jaime A. Collazo  
**STUDENT** Amarilys Irizarry, M.S., Zoology  
**STAFF** Krishna Pacifici, Brian Reich, Eric Laber  
**LOCATION** Sandhills Physiographic Region, North Carolina  
**DURATION** September 2014–August 2017  
**FUNDING** U.S. Fish and Wildlife Service

## Optimal sampling of animal communities

The US Fish and Wildlife Service has approximately 2.4-2.5 million acres of private lands enrolled in the Safe Harbor Program (SHMA). The objective of this work is to develop a sampling scheme that will help USFWS quantify the benefits of SHMAs on non-surrogate species across southeastern United States. The sampling scheme will be geared towards estimating parameters that quantify species richness and the dynamics of single species or avian communities over time. This work will tap existing occupancy-based models, develop extensions if needed, but center their application around a sound and flexible sampling design for implementation across the southeast. The first phase of the work was completed in 2016. The second phase, optimizing sampling, will be conducted in spring 2017.

**INVESTIGATOR** Jaime A. Collazo  
**STUDENT** Jessica H. Page, M.S., Zoology  
**STAFF** Krishna Pacifici, Brian Reich, Eric Laber  
**LOCATION** Sandhills Physiographic Region, North Carolina  
**DURATION** September 2014–September 2018  
**FUNDING** U.S. Fish and Wildlife Service
Reducing burning impacts on native forage: implications for terrestrial vertebrate nutrition and food availability

Frequent fire-return intervals (<3-yr) have been suggested to optimize the benefits of prescribed fire in many fire-dominated ecosystems. There are several ecological benefits to frequent fires such as suppression of encroaching fire-intolerant plant species, increased reproductive allocations of native herbaceous plant species, and increased plant diversity at the stand level. However, declines in frugivorous wildlife species have been documented in frequently burned areas, raising concern for fire-regime effects on fruit production. Additionally, fire prescriptions used in restoration programs often are based on average historical fire regimes and do not consider natural stochastic variability in fire season and frequency. Applying prescribed fire based on averages could alter the relative abundance of important plant species and structure. Thus, we used two approaches to quantify the effects of homogeneous application of frequent fire on fruit and forage availability for wildlife: (1) a manipulative, replicated field experiment following 4 or more rotations of a 1-yr, 2-yr, and 3-yr fire-return interval; and (2) a large-scale assessment of soft hard mast abundance after 22 years of a historical-based growing-season fire prescription that failed to consider the variability in historical fire regimes. Results indicated managed fire regimes may fail to mimic spatial distribution, frequency, and intensity of historical disturbances even when the fire prescription is based on empirical reference fire regimes. To maximize structural heterogeneity and conserve key ecosystem functionality, fire prescriptions should include variations in frequency, season, application method, and fire weather conditions, rather than focusing on an average historical fire regime.

INVESTIGATORS Christopher E. Moorman and Christopher S. DePerno
STUDENTS Colter Chitwood, Ph.D., Fisheries, Wildlife, and Conservation Biology; Marcus Lashley, Ph.D., Fisheries, Wildlife, and Conservation Biology
STAFF Colter Chitwood, Marcus Lashley, Indrani Sasmal
DURATION September 2013–December 2016
LOCATION Fort Bragg Military Installation, North Carolina

Reproductive ecology of three endangered plant species on Fort Bragg, North Carolina

Fort Bragg currently sustains populations of three federally listed endangered species of plants. Populations of all three, Michaux’s Sumac (Rhus michauxii), Rough-Leaved Loosestrife (Lysimachia asperulaefolia), and American Chaffseed (Schwalbea americana), are dependent on frequent disturbance in the form of the low-intensity fire necessary for the maintenance of the longleaf pine savanna ecosystem. Recruitment to existing populations of these plants is generally low, and gaps in our knowledge of their natural history hinder recovery efforts. The pollination ecology of all three species is poorly known, as is the extent of gene flow between populations and the fate of seed. We have initiated investigations to identify important arthropod pollinators for these plant species and to characterize their pollination efficacy. We have collected materials to establish microsatellite libraries for these plants, so that gene flow and seed paternity can be measured. We have also initiated construction of pollen libraries, and are developing techniques and protocols to measure seed predation and disappearance. This project was initiated relatively late in the flowering season for these plants, but we have made progress on identifying pollinators of R. michauxii.

INVESTIGATORS Clyde E. Sorenson
STAFF Elsa Youngsteadt, Post-Doctoral Research Associate; Erika Bonnema, Student Technician
LOCATION Fort Bragg, North Carolina
DURATION May 2016–August 2018
FUNDING U.S. Army, Endangered Species Branch
Strategic management and monitoring for the recovery of the Key Largo Woodrat

The Key Largo Woodrat (KLWR) is a federally endangered subspecies endemic to the island of Key Largo, Florida. More than two-thirds of the KLWR’s historic habitat – tropical hardwood hammock – has been lost to development. The habitat that remains is fragmented and occupied by at least two known non-native, invasive predators – feral cats and pythons. The recovery of the KLWR has also been limited by a lack of natural nesting habitat. Nest supplementation is used as a recovery strategy and while woodrats readily use nests and are easily sampled at nests, the distribution of supplemental nests is still limited. Additional nests, deployed in a grid pattern, would allow for a robust assessment of the KLWR’s entire distribution via non-invasive sampling methods, and population estimation via capture-recapture. This innovative work is particularly valuable considering the KLWR’s recent population decline (prompting captive breeding 2003 to 2011) and low detectability using more invasive methods. Furthermore, the placement of supplemental nests and genetic sampling of individual KLWR along the landscape will serve to link subpopulations and determine the effectiveness of supplemental nests as corridors.

INVESTIGATOR    Theodore R. Simons
STAFF           Michael V. Cove, Post-doctoral Research Associate
LOCATION        Crocodile Lake National Wildlife Refuge, Key Largo, Florida
DURATION        September 2016–December 2017
FUNDING         U.S. Fish and Wildlife Service

Testing a decision model to maximize suitable habitat for migratory shorebirds in saline lagoons

Managers of the Cabo Rojo National Wildlife Refuge, Puerto Rico, wish to provide quality feeding habitat for aquatic birds through hydrologic management of impoundments. We developed a decision model designed to maximize accessible habitat (depth) for foraging shorebirds at salinity levels that promote high prey density. The model needs to be tested. Companion work indicated that shorebird numbers have decreased 70% (1980s–2015). Shorebirds use three neighboring wetland areas, complementing each other as resources, and accessible habitat varies seasonally. Results advocate for coordinated management of managed and natural wetlands.

INVESTIGATOR    Jaime A. Collazo
STUDENT         Morgan A. Parks, M.S., Zoology
STAFF           Paul L. Fackler
LOCATION        Puerto Rico and North Carolina State University
DURATION        July 2012–September 2015
FUNDING         U.S. Fish and Wildlife Service
Research: Integrated Ecology

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Honey Bee feeding on a coffee flower in Puerto Rico; see its pollen- and nectar-packed legs. SARA PRADO
Assessing the use and application of diverse data sources and species distribution models

Change in land use patterns and climate are factors influencing avian species status and trends in North America. Changes are expected to be pervasive, and thus, central to discussions about sustainable populations and how to inform decisions aimed at strategic habitat conservation and monitoring. We will develop an analytical framework that integrates multiple data sources to efficiently and effectively understand current and future avian distribution patterns and the potential for sustaining populations. In recent years, non-traditional data gathering approaches (e.g., citizen science) have gained impetus and prominence, due to their appeal and acceptance by the public. The analytical foundation to model such diverse data (i.e., Breeding Bird Survey, citizen scientists) was completed and published (Ecology, In Press). Results indicate substantial gains in modeling species distribution for avian species. Work continues to make the analytical framework dynamic (multi-year) and suitable for decision problems.

INVESTIGATOR Jaime A. Collazo
STUDENT Two students, to be selected
STAFF Krishna Pacifici, Brian Reich, Eric Laber, Alexa McKerrow
LOCATION North Carolina State University
DURATION August 2014–September 2018
FUNDING U.S. Geological Survey, Gap Analysis Program

Applying downscaled climate projections to inform decisions on strategic habitat conservation for amphibians in Puerto Rico

The Puerto Rico Department of Natural and Environmental Resources and the U.S. Fish and Wildlife Service want to implement a strategic habitat conservation strategy that ensures the long-term persistence of amphibians in the advent of climate change. We partnered with the U.S. Geological Survey, Southeast Climate Science Center to obtain foundation data regarding patterns of occupancy and abundance as a function of climatic and habitat covariates. Results indicate higher occupancy and abundance at intermediate elevations and precipitation rates. Shaded coffee plantations harbored intermediate levels of occupancy, highlighting their potential for multi-species conservation. Next steps are aimed at determining physiological limits and identifying areas of conservation interest with the aid of climatic projections.

INVESTIGATOR Jaime A. Collazo
STUDENT Kelen Dowdy, M.S., Zoology
STAFF Krishna Pacifici, Adam Terando, Brian Reich, Eric Laber
LOCATION Puerto Rico and North Carolina State University
DURATION June 2014–June 2017

Applying downscaled climate projections to inform decisions on strategic habitat conservation for amphibians in Puerto Rico

The Puerto Rico Department of Natural and Environmental Resources and the U.S. Fish and Wildlife Service want to implement a strategic habitat conservation strategy that ensures the long-term persistence of amphibians in the advent of climate change. We partnered with the U.S. Geological Survey, Southeast Climate Science Center to obtain foundation data regarding patterns of occupancy and abundance as a function of climatic and habitat covariates. Results indicate higher occupancy and abundance at intermediate elevations and precipitation rates. Shaded coffee plantations harbored intermediate levels of occupancy, highlighting their potential for multi-species conservation. Next steps are aimed at determining physiological limits and identifying areas of conservation interest with the aid of climatic projections.

INVESTIGATOR Jaime A. Collazo
STUDENT Kelen Dowdy, M.S., Zoology
STAFF Krishna Pacifici, Adam Terando, Brian Reich, Eric Laber
LOCATION Puerto Rico and North Carolina State University
DURATION June 2014–June 2017

Assessing South Atlantic Landscape Conservation Cooperative terrestrial indicators

The South Atlantic Landscape Conservation Cooperative (SALCC) developed a list of terrestrial data products expected to serve as indicators to both guide landscape-scale, long-term natural resource conservation planning and to monitor the success of the plan as it is implemented. Selected through regional workshops and expert elicitation, these indicators are believed to broadly represent the critical ecosystem processes and components necessary to ensure the integrity of the targeted natural resources. We showed that these data allow the SALCC to assess performance of the terrestrial indicators for their ability to capture other spatial ecosystem components (species and habitats), processes (fire, freshwater flow), and threats (land use change, climate change, and sea level rise). When combined with other ongoing discussions and data review by the SALCC, it resulted in multiple updates and improvements to the terrestrial indicators.

INVESTIGATOR Jaime A. Collazo
STAFF Louise B. Alexander-Vaughn, C. Ashton Drew
LOCATION North Carolina State University
DURATION September 2013–September 2014
FUNDING South Atlantic Landscape Conservation Cooperative
Cooperative landscape and conservation and adaptive science collaborative conservation design project: science support for the South Atlantic Landscape Conservation Cooperative Conservation blueprint

The South Atlantic Landscape Conservation Cooperative (SALCC) has sponsored a project to design a shared blueprint for landscape conservation actions that sustain natural and cultural resources in the South Atlantic region. The blueprint was based on natural resource indicators and targets already selected by the SALCC (http://www.southatlanticlcc.org/page/indicators) and cultural resource indicators and targets under development. The evaluation of indicator representation within prioritizations was a useful method to show where improvements could be made; some indicators dictated hotspots, some had a limited extent and were well represented, and others had a limited effect. Overall, we demonstrate that a broad-scale (408,276 km² of terrestrial and 411,239 km² of marine environments) conservation plan can be realized at a fine-scale resolution, which will allow implementation of the regional plan at a local level relevant to decision-making.

INVESTIGATOR Jaime A. Collazo
STUDENTS Liani M. Yirka, M.S., Zoology
LOCATION Eastern North Carolina
DURATION April 2015–December 2016
FUNDING North Carolina Wildlife Resources Commission

Demographic rates and prioritization of habitat for conservation for Painted Buntings in North Carolina

Populations of Painted Buntings have been declining since the 1970s, and thus, it is a species of conservation interest in North Carolina. We estimated age and sex-specific survival, and estimates of recruitment rates to better assess the status of the species in North Carolina. Although findings come from two North Carolina populations, adult survival estimates were consistent with previously reported estimates in southeastern U.S. coastal habitats (~60%). Recruitment rates were consistent with successful reproduction and connectivity among coastal populations (in-situ and external recruitment). We estimated persistence probability for areas of conservation interest using occupancy analyses and a habitat threat-risk assessment tool. The approach informs decisions regarding area-selection for habitat conservation.

INVESTIGATORS Jaime A. Collazo
STUDENTS Liani M. Yirka, M.S., Zoology
LOCATION Eastern North Carolina
DURATION April 2015–December 2016
FUNDING North Carolina Wildlife Resources Commission
Identifying likely Conservation Opportunity Areas (COAs) and providing GIS data and mapping for the 2015 revision of North Carolina Wildlife Action Plan

This project is an effort to augment and enhance the 2015 North Carolina State Wildlife Action Plan. We evaluated various threats to habitats and identify likely Conservation Opportunity Areas (COAs) to benefit Species of Greatest Conservation Need (SGCN). We integrated data from the 2015 North Carolina Wildlife Action Plan (WAP), USGS Gap Analysis Program (GAP), and the "Statewide Terrestrial Habitat Threats and Risks Projections: A Decision Support Tool for Strategic Wildlife Habitat Conservation in North Carolina." By combining these datasets, we generated a measure of unprotectedness for each habitat. The most unprotected for each region/community were then submitted to the online Habitat Threats tool to assess the number and severity of habitat threats. This enables end users to identify potential COAs where protection of SGCNs is low and habitat threats are high. We also developed an online GIS portal to serve the NCWRC and their conservation partners.

INVESTIGATOR
Jaime A. Collazo

STAFF
Steven G. Williams

LOCATION
North Carolina State University

DURATION
January 2014–December 2016

FUNDING
North Carolina Wildlife Resources Commission

Interactions of human-caused mortality, genetic introgression, and management among wild Red Wolves: developing scientific consensus

After being nearly driven to extinction, Red Wolves (Canis rufus) were rescued from extinction by the establishment of a captive breeding program in 1973 and in 1987. Red Wolves were first released into a Coyote-free (Canis latrans) area in northeastern North Carolina. Since then, there has been great uncertainty about the future of the Red Wolf population. To understand this uncertainty and to provide valuable information regarding the future of the Red Wolf, a workshop involving world-class, leading experts in endangered species policy, law, conservation genetics, taxonomy, and population biology was convened. The main contribution of the workshop was the evaluation of the primary competing evolutionary origin hypotheses for the Red Wolf. Under all scenarios, it was clear there was a logical and valid pathway to make a determination that the Red Wolf is a listable entity under the Endangered Species Act or other protective classifications. Under the three hypotheses that have scientific evidence (2 species, 3 species, or 4 species) there was unanimous support by the participants for the Red Wolf to be a listable entity.

INVESTIGATORS
Krishna Pacifici, Scott Mills,
Jaime A. Collazo

LOCATION
Atlanta, Georgia and North Carolina State University

DURATION
October 2015–September 2017

FUNDING

Modeling and mapping landscape pattern resilience and vulnerability

Understanding how landscape pattern has changed in the past is critical for conserving those resources in the future. This project uses state-of-the-art landscape pattern analysis along with global data on forest change from 2000 to 2012 to measure the resilience of interior forests. We analyzed changes in forest interior over that period in relation to changes in total forest area. We found that the global net rate of forest interior area loss was 3.1 times the global net rate of all forest area loss and the net loss of forest interior area was more than twice the net loss of all forest area. Therefore, forest interior patterns were not resilient over time. We also found that landscape patterns as well as land cover history were two of the major factors associated with whether a Forest Inventory and Analysis (FIA) plot was classified as forest land use. Our results show that globally, forests have been shifting to a more fragmented condition. This increase in fragmentation has important implications for wildlife habitat, and especially species that depend on interior forests.

INVESTIGATOR
Jaime A. Collazo

STAFF
Jennifer Costanza, Kurt Ritters

LOCATION
North Carolina State University

DURATION
August 2012–July 2015

FUNDING
U.S. Forest Service
National biogeography analysis and synthesis

Threats posed by climate change, urbanization, and invasive species, underscore the need for proactive management. However, conservation planning at regional and national extents continues to be limited by the lack of consistent, detailed and current data on biological resources. The current challenge is to find reliable and efficient methods to characterize the Nation’s biological resources while enhancing and maintaining the currency of the information and broadening the application of those data. The goal of this project is to provide data, synthesis and analyses to increase our understanding of the status of biodiversity and drivers of change. We will emphasize factors affecting national trust resources. To meet the project’s goal, we will (1) analyze trends in biodiversity, investigating drivers of change and potential implications for future changes in diversity; (2) synthesize data and update species-habitat distribution maps to determine the current status of biodiversity in the Nation; and (3) assist in building a National Biogeographic Map and a central tool for disseminating the synthesis of information.

Research and applications in support of the National Gap Analysis Program

This project is focused on three critical themes for the National Gap Analysis Program: applications, monitoring, and refinement. The Program completed nationally consistent core datasets (i.e., land cover, public areas database, vertebrate predicted distributions), and seeks to conduct various analyses on a national extent and develop decision support tools for landscape level applications. We completed the national extent distribution models for a wide range of terrestrial vertebrates and are developing the approach for incorporating expert/knowledge base and uncertainty into the Gap species-habitat models. We also partnered with the Biofuels Center of North Carolina and U.S. National Park Service to integrate GAP land cover and species models to assess potential impacts of biofuels production and model species responses to prescribed fire, respectively. Work also included assessment of LiDAR to assess effects of fire in the Great Smoky Mountains National Park, and conducted assessment on the utility of expert opinion to guide management of human-modified habitats in western North Carolina.

INVESTIGATOR
Jaime A. Collazo

STUDENTS
Two students, to be selected

STAFF
Curtis M. Belyea, Todd S. Earnhardt, Matthew J. Rubino, Nathan M. Tarr, Steven G. Williams

LOCATION
North Carolina State University

DURATION
May 2016–September 2019

FUNDING
U.S. Geological Survey

Graduate students sampled coastal lagoons in Puerto Rico to develop a decision tool for hydrologic management.

INVESTIGATOR
Jaime A. Collazo

STUDENTS
Morgan A. Parks, M.S., Zoology; Beatriz Gonzalez, M.S., Marine and Earth Science

STAFF
David Eggleston, Stacy Nelson

LOCATION
Puerto Rico

DURATION
September 2012–August 2015

FUNDING
Puerto Rico Department of Natural and Environmental Resources

Restoration and management of coastal lagoons in Puerto Rico

The Puerto Rico Department of Natural and Environmental Resources (DNER) partnered with the North American Wetlands Conservation Act (NAWCA) Program to manage the hydrology of La Providencia Lagoon, Puerto Rico, for aquatic birds. We developed a decision tool designed to assist with the hydrologic management of the lagoon. We found that, in its current state, the lagoon is suitable for waterfowl, large shorebirds, and wading birds. Management for smaller shorebirds would require substantial resources and effort (e.g., time). This is partly because sea level rise has increased about 3 inches since the 1960s, and water levels fluctuate with tide cycles.

STAFF
Krishna Pacific, Jennifer Costanza, C. Ashton Drew, Todd Earnhardt, Matt Rubino, Nathan Tarr, Curtis M. Belyea, Todd S. Earnhardt, Steven G. Williams

LOCATION
North Carolina statewide, North Carolina State University

DURATION
August 2011–September 2016

FUNDING
U.S. Geological Survey
Strategic decision planning for threatened and endangered (T&E) species recovery in Puerto Rico

We will facilitate a Structured Decision Making process with the T&E Species Program staff of the Caribbean Field Office (Ecological Services), Puerto Rico. The goal of this project is to identify the decisions made to conserve endangered species, characterize the reasons for and outcomes from these decisions, and estimate the opportunities and constraints affecting these decisions. These decisions require varying amounts of resources and effort, depending on such factors as knowledge of the species biology and ecology, location of the species on public or private lands, and nature of the threats to the species. Our project facilitated the design of a structured approach to a previously unstructured problem. Together, we completed a decision-making workshop and created a fully-functional decision tool to prioritize recovery actions. Importantly, this prioritization is not a panacea, and model output must always be carefully weighed, as no model captures all biological, social, economic, and political variables.

INVESTIGATOR
Jaime A. Collazo

STAFF
C. Ashton Drew

LOCATION
Puerto Rico, North Carolina State University

DURATION
September 2014–March 2015

FUNDING
U.S. Fish and Wildlife Service

Statewide terrestrial habitat threats and risks projections based on climate change, urbanization, and strategic conservation decisions

The North Carolina Wildlife Resources Commission (NCWRC) has taken steps to facilitate science-based, publicly-informed prioritization of the lands proposed for acquisition or management. This project delivered a spatially-explicit Decision Support Tool (DST) to support state-wide habitat acquisition and management decisions by projecting future threats/risks to terrestrial and aquatic habitats. A total of 22 threats were included in the tool, including climate and land use projections to 2050. The tool outputs threat or exposure characterization analysis, summarizing the number of threats, their occurrence (proportion within an area of interest), and their intensity or severity relative to an area of interest. Depending on how an Area of Interest (AOI) polygon is created, the DST also yields an estimate of proximity (spatial) of threats. These data are essential to assess the ecological effects of a given threat.

INVESTIGATOR
Jaime A. Collazo

STAFF
Steven G. Williams, Alexa McKerrow

LOCATION
North Carolina State University

DURATION
January 2013–December 2014

FUNDING
North Carolina Wildlife Resources Commission

Vertebrate biodiversity of agricultural fields: a database and metrics to facilitate conservation partnerships in productive landscapes

Opportunities to engage private landowners in the management and conservation of the State’s fish and wildlife species offer tremendous potential benefits. We proposed to develop and empirically test a biodiversity metric for agricultural landscapes using Christmas tree agriculture as a case study, and in doing so, promote better understanding and stronger partnerships between conservation managers and agricultural land owners. This project expanded our knowledge of Eastern Cottontail ecology on Christmas tree farms and suggested that these agricultural lands provide suitable habitat for the species. We also explicitly evaluated the utility of expert knowledge to guide wildlife management in human-modified habitats. We stress the importance of collecting expert knowledge data using a standardized elicitation protocol that minimizes expert subjectivity, followed by quantitative assessments, such as the one described in this study. Results showed that expert knowledge is no substitute for empirical data, particularly when little is known about the ecological setting in question.

INVESTIGATOR
Jaime A. Collazo

STUDENT
Kara E. Dziwulski, M.S., Zoology

STAFF
Steven G. Williams, Alexa McKerrow

LOCATION
Western North Carolina

DURATION
January 2013–December 2015

FUNDING
North Carolina Wildlife Resources Commission
Publications and Presentations

JOURNAL ARTICLES


THESIS AND DISSERTATIONS


PRESENTATIONS


Rudershausen, P. J., J. A. Buckel, and J.E. Hightower. 2015. Having your cake and eating it too: simple gear modifications to reduce sub-legal bycatch but maintain target catch in the U.S. South Atlantic Black Sea Bass and Blue Crab trap fisheries. Southern Division, American Fisheries Society. January 28–February 1, Savannah, Georgia.


INVITED SEMINARS


Jesse Fischer and students sample the fishes of Lake Raleigh on the Centennial Campus of NC State University using boat electrofishing in a course on the Management of Small Impoundments. TOM KWAK