
SOUTH CAROLINA COOPERATIVE FISH & WILDLIFE RESEARCH UNIT



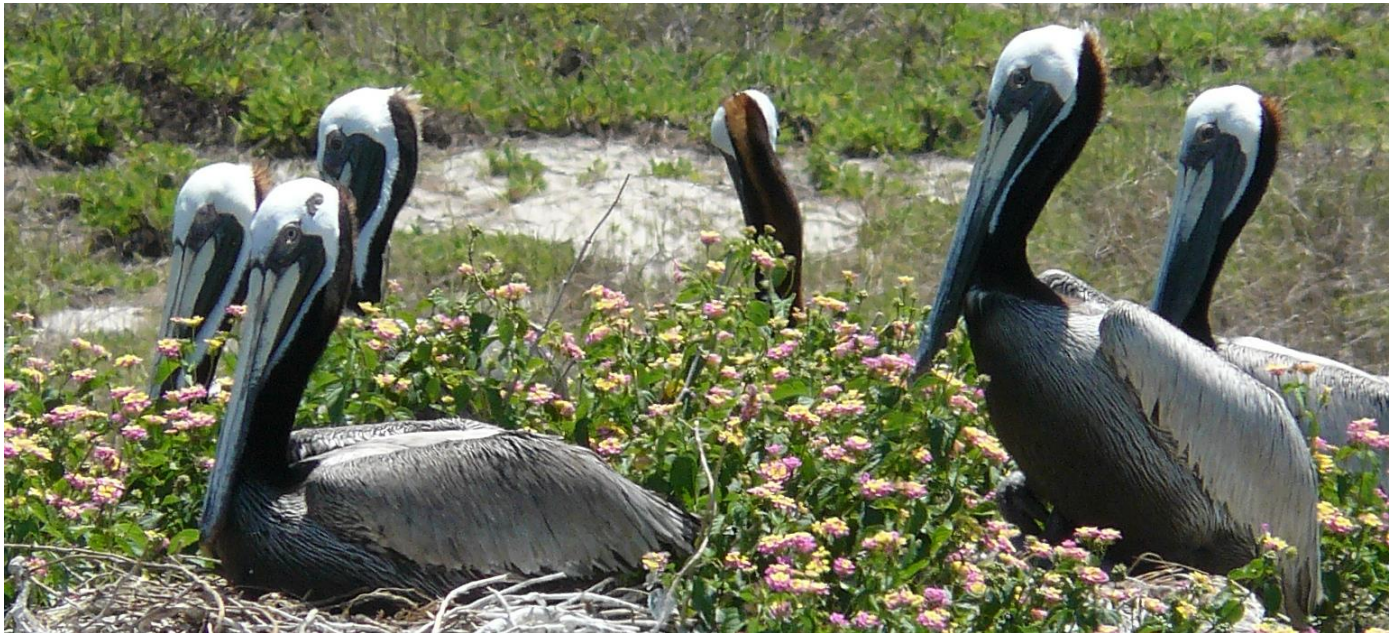
ANNUAL REPORT

2013-2014

In 2013 & 2014, the South Carolina Cooperative Fish & Wildlife Research Unit initiated seven new research projects, brought on five new graduate students, developed one new graduate course, and continued to engage our cooperators to address emerging natural resource issues in the State of South Carolina and throughout the United States. We have developed new research projects with federal, state, and NGO partners that contribute to our understanding and sustainable management of natural resources.

South Carolina Cooperative Fish & Wildlife Research Unit

2013- 2014 ANNUAL REPORT



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Cooperators:

U. S. Geological Survey
Clemson University
South Carolina Department of Natural Resources
U. S. Fish and Wildlife Service
Wildlife Management Institute

Image: Nesting Brown Pelicans – J. Lamb, 2014

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COOPERATORS AND PERSONNEL

COORDINATING COMMITTEE

United States Geological Survey

John Organ, Chief, Cooperative Research units, 12201 Sunrise Valley Drive, Reston, VA 20192

Kevin Whalen, Southern Supervisor, Cooperative Research Units, 12201 Sunrise Valley Drive, Reston, VA 20192

South Carolina Department of Natural Resources

Alvin A. Taylor, Director, South Carolina Department of Natural Resources, PO Box 167, Columbia, SC 29202

Emily Cope, Deputy Director for Wildlife and Freshwater Fisheries, South Carolina Department of Natural Resources, PO Box 167, Columbia, SC 29202

Derrell Shipes, Chief of Wildlife Statewide Projects, Department of Natural Resources, PO Box 167, Columbia, SC 29202

Clemson University

George Askew, Interim Dean, College of Agriculture, Forestry and Life Sciences, Clemson University 101 Barre Hall, Clemson, SC 29634

Greg Yarrow, Chair Natural Resources Division, School of Agricultural, Forest, and Environmental Science, Clemson University

Wildlife Management Institute

Steve Williams, President, Wildlife Management Institute, Gardners, PA 17324

UNIT PERSONNEL

Scientists

Patrick Jodice, Unit Leader, U.S. Geological Survey, and Associate Professor, School of Agricultural, Forest and Environmental Sciences



Katherine McFadden, Assistant Unit Leader-Wildlife, U.S. Geological Survey, and Assistant Professor, School of Agricultural, Forest and Environmental Sciences



VACANT, Assistant Unit Leader

Staff

Carolyn Wakefield, Administrative Assistant

Yvan Satgé, Research Specialist

COLLABORATORS

Clemson University:

Robert Baldwin, School of Agricultural, Forest, and Environmental Sciences
William Bridges, Mathematical Sciences
Saara DeWalt, Biological Sciences
Patrick Gerard, Mathematical Sciences
Autumn-Lynn Harrison, Parks Institute
Laura Jodice, Parks, Recreation and Tourism Management
Yoichiro Kanno, School of Agricultural, Forest, and Environmental Sciences
Robert Powell, Parks, Recreation and Tourism Management
John Rodgers, School of Agricultural, Forest, and Environmental Sciences
Shari Rodriguez, School of Agricultural, Forest, and Environmental Sciences
Greg Yarrow, School of Agricultural, Forest, and Environmental Sciences

South Carolina Department of Natural Resources Cooperators:

Breck Carmichael, Special Assistant to the Director
Jay Butfiloski, Wildlife Biologist
Jamie Dozier, Tom Yawkey Wildlife Center
Du Bose Griffin, Marine Turtle Conservation Program
Felicia Sanders, Wildlife Biologist
Mark Scott, Fisheries Biologist
Mark Spinks, Wildlife Biologist
Tommy Wactor, Wildlife Biologist
David Whittaker, Assistant Deputy Director, Marine Resources Division
SCDNR, Tom Yawkey Wildlife Center

Federal Agency Cooperators:

Laurel Barnhill, USFWS
Sarah Dawsey, USFWS Cape Romain Natural Wildlife Refuge
Deborah Epperson, BSEE
Dave Moran, BOEM
Jeff Gleason, USFWS
Scott Johnston, USFWS
Susan C. Loeb, Southern Research Station, USFS
Raye Nillius, USFWS Cape Romain Natural Wildlife Refuge
Daniel D. Roby, Oregon Cooperative Fish and Wildlife Research Unit
Thomas Rainwater, USFWS
John Stanton, USFWS
Melanie Steinkamp, USFWS
Stacy Vander Pol, National Institute Standards and Technology
Jennifer Keller, National Institute Standards and Technology
Craig Watson, USFWS Ecological Services, Charleston, SC
Bureau of Ocean Energy Management

South Carolina Cooperative Fish & Wildlife Research Unit

USFWS Region 4, Cape Romain Natural Wildlife Refuge
USFWS Migratory Bird Management Office
USFWS Ecological Services
USFS Southern Forest Experiment Station
National Park Service, Congaree National Park
National Park Service, Big South Fork National River & Recreation Area
National Park Service, Obed Wild and Scenic River
Pacific Islands Regional Office, National Marine Fisheries Service

Private Sector and International Cooperators:

American Bird Conservancy
Avian Research Conservation Institute
The Nature Conservancy
Bahamas National Trust
Black Rock Forest Consortium
Biodiversity Research Institute
Defenders of Wildlife
El Colegio de la Frontera Sur Unidad Campeche, Mexico
Environmental Management Authority, Trinidad & Tobago
Georgia Sea Turtle Center
International Crane Foundation
Low Country Institute
National Fish and Wildlife Foundation
Nemours Wildlife Foundation
Palmyra Atoll Research Consortium
Society for the Conservation and Study of Caribbean Birds
St. Catherine's Island Wildlife Survival Center
St. Eustatius National Parks
The Nature Conservancy
Wetlands Institute

Faculty Cooperators from other Colleges and Universities:

Jennifer Casselle, Scripps Institute, UCSD
Peter Frederick, University of Florida
William Mackin, Guilford College
Clint Moore, University of Georgia
Eugenia Naro-Maciel, City College of New York, Staten Island
Katie O'Reilly, University of Portland
Richard Philips, British Antarctic Survey
Rob Ronconi, Acadia University
John Speakman, Aberdeen University
Robert Suryan, Oregon State University
Richard Veit, City College of New York

GRADUATE EDUCATION

CURRENT STUDENTS

Shefali Azad, M.S. Wildlife & Fisheries Biology (Advisor: McFadden)
Jonathan Brooks, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)
Leanne Burns, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)
Juliet Lamb, Ph. D. Wildlife & Fisheries Biology (Advisor: Jodice)
Abigail Lawson, Ph. D. Wildlife & Fisheries Biology (Advisor: McFadden)
Caroline Poli, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)
Susan Sullivan, M.S. Wildlife & Fisheries Biology (Advisor: McFadden)
Hillary Thompson, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)

RECENT GRADUATES

Katie Keck, M.S. Wildlife & Fisheries Biology (Advisor: McFadden)
Elizabeth Zinsser, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)

COURSES TAUGHT

WFB 861, Applied Population Dynamics, Spring 2014, 3 Credits (McFadden)
WFB 861 Advanced Conservation Biology, Fall 2013, 3 credits (McFadden)
AFLS 191, Research Internship (Undergraduate, Summer 2013, 2 Credits (McFadden)
WFB 861, Foundations of Ecology, Spring 2013, 3 credits (Jodice)

RESEARCH

CURRENT PROJECTS

South Carolina alligator adaptive management strategies: Population dynamics, habitat utilization, and conservation threats

INVESTIGATORS:

Kate McFadden
(SCCFWRU)
Derrell Shipes & Jay
Butfiloski (SCDNR)

STUDENT:

Abby Lawson (Ph.D.,
Clemson University)

SPONSOR:

SCDNR, USGS

DATES:

January 2013 –
December 2016



The American Alligator (*Alligator mississippiensis*) is an iconic species in South Carolina, of ecological, economic, and cultural importance. This study focuses on investigating alligator population dynamics at multiple temporal and spatial scales to inform harvest decisions in an adaptive management framework. Though alligator populations in Florida and Louisiana are well-studied, baseline ecological knowledge is severely limited in northern populations. This study will synthesize historical and contemporary demographic data to address existing information gaps in both South Carolina and the surrounding region. The primary study objectives are to (1) improve alligator monitoring program study design to best reflect annual variation in alligator abundance, (2) identify biotic and abiotic factors (including harvest) that influence said variation, and (3) evaluate the influence of alligator habitat use patterns on management decisions.

In spring 2013, we initiated the first field season of a three-year study aimed at estimating seasonal alligator abundance and evaluating the influence of survey design on abundance estimation precision and accuracy (objectives 1 and 2). Six survey routes, of the eighteen total consistently monitored by SCDNR, were surveyed twice within each of three “reproductive seasons”— breeding, nesting, and hatch. Evaluating seasonal patterns in abundance and detection probability will allow us to determine how varying survey design components (e.g., number of replicates, survey season) influence these parameters and in turn, management decisions. We conducted a total of 58 alligator nightlight surveys between June and September 2014.

We also acquired funding to add a movement ecology component to the study, aimed at evaluating male alligator movement patterns and habitat use (objective 3), and evaluating said patterns in relation to seasonal abundance on surveyed water bodies. Linking movement and survey data will enable us to disentangle variation in detectability from temporary emigration, to improve demographic inference from survey data. In spring 2015, we will fit 10 adult male alligators with satellite transmitters to track hourly movements from April to September in 2015 and 2016.

Image: American Alligator – E. Williams, 2014

Conservation of Green and Hawksbill sea turtles at Palmyra Atoll

INVESTIGATORS:

Kate McFadden
(SCCFWRU)

Eleanor Sterling
(AMNH)

Eugenia Naro-Maciel
(SUNY)

PROJECT STATUS:

NOAA funded 2011 –
2013; funding renewal
submitted for 2014



My research on endangered and threatened sea turtles at Palmyra Atoll began in 2008 and has several distinct research arms in varying state of completion. The major research goals/publications of which I am the lead author are listed below by manuscript title:

1) Potential Impacts of Historical Disturbance in a Unique Marine Ecosystem: Heavy Metal Concentrations and Health in Green Turtles at Palmyra Atoll (Central Pacific)(in press, Marine Pollution Bulletin, 2014)

2) Stable nitrogen and carbon isotope ratios in multiple tissues of Green Sea Turtles (*Chelonia mydas*): identifying temporal and spatial variability in foraging habits (in preparation for Marine Ecology Progress Series. Anticipated submission Fall 2014)

3) Variation in isotopic signatures of difference tissue types of green sea turtles at a foraging ground in the Central Pacific (in preparation for Short Communications in Mass Spectrometry. Anticipated submission Fall 2014)

4) Home range, habitat use and foraging habits of green sea turtles at a foraging ground in the Central Pacific (in preparation for Marine Ecology Progress Series. Anticipated submission Dec 2014)

Image: Green Sea Turtle – CC, 2013

Assessing the response of small mammal functional guilds to a simulated pathogen attack in a deciduous forest ecosystem

INVESTIGATOR:

Kate McFadden
(SCCFWRU)

STUDENT:

Katie Keck (M.S.,
Clemson University)

SPONSOR:

Black Rock Forest

DATES:

2008 - 2014



This study was designed to test the hypotheses that I) a simulated pathogen attack in an oak forest would negatively influence some environmental changes in the forest, and II) our approach to emulate disturbance would lead to increases in the most abundant small mammal species due to their adaptability as generalists.

Oaks were systematically girdled to cause tree mortality, mimicking the symptoms of Sudden Oak Death. Intentional girdling to quantify species response to altered habitat conditions is a novel method in small mammal disturbance ecology. Small mammals were live trapped for five summers following girdling to assess population response to girdling over time. In addition to small mammal mark-recapture data, a suite of environmental variables was collected throughout the duration of the study to quantify ecological change.

Six small mammal species were captured over the 14,960 trap nights of this experiment, resulting in 5,135 total small mammal capture events. The two most frequently encountered species were White-footed Mice (*Peromyscus leucopus*) and Eastern Chipmunks (*Tamias striatus*).

We used principal components analysis (PCA) to identify key environmental variables which best represented habitat change over time. A groundcover gradient was observed in PC 1. A canopy cover gradient was observed in PC2. These principal components were included as explanatory variables in mixed models analysis of variance, with small mammal relative abundance as the response variables.

Generalist small mammals whose biomass makes up the largest amount in small mammal assemblages may serve as effective biological indicators of ecosystem health. By monitoring their shifts in abundance and distribution following disturbance events, land managers can better understand the scale and severity of these events and their impacts on multiple trophic levels. As the movement of pathogens globally accelerates, it will be increasingly important for ecologists to understand the bottom-up cascade of impacts related to the loss of foundation tree species.

Image: White-footed Mouse –K. Keck, 2013

Population modeling of Black Bears in South Carolina: Implications for monitoring and management based on multiple data streams

INVESTIGATOR:

Kate McFadden
(SCCFWRU)

STUDENT:

Shefali Azad (M.S.,
Clemson University)

SPONSOR:

SCDNR

DATES:

2014 - 2016

Populations of Black Bear (*Ursus americanus*) in South Carolina, although classified as “Vulnerable” in the state, nonetheless appear to have been increasing over the past few decades, as suggested by both reports of increased human sightings and road-kills as well as from population surveys and harvest records. Although an attempt has been made to assemble reliable population estimates from scent-line surveys and genetic structure studies, there are still logistical challenges associated with accurately estimating the population density of a long-lived and itinerant species.

This project aims to develop and investigate the performance of an integrated population model based on multiple data streams, applied to black bears in the upper Piedmont region of South Carolina. The various data streams used to develop the model will include 1) data on hunting effort, 2) sex-specific age-at-harvest matrices derived from harvest records, 3) historical data on age-specific survival parameters and 4) influence of food supplies on fecundity.

The population model will then be calibrated using population estimates from mark-recapture data generated by hair-snares. Model fitting will be accomplished by minimizing the difference between observed (from mark-recapture estimates) and predicted harvests. The project hopes to identify through Bayesian hierarchical analysis the relative influence of the model parameters to population abundance, and place the same in a managerial context to aid the South Carolina Black Bear Management and Conservation Strategy. It is hoped that the project will provide insights into the current and potential range expansion of the species, and aid resource management through education and harvest.



Image: Black Bear –N. Herbert, 2014

Innovative approaches to manage and reduce Wild Hog damage to agricultural systems and domestic livestock operations in South Carolina

INVESTIGATOR:

Kate McFadden
(SCCFWRU)

STUDENT:

Susan Sullivan (M.S.,
Clemson University)

SPONSOR:

NRCS

DATES:

2014 - 2016



The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) views agricultural practices and environmental conservation as compatible goals. Invasive non-native species, such as the Wild Hog (*Sus scrofa*) in the United States, can negatively impact native flora and fauna, human health, and agricultural systems.

This project aims to assess the feasibility of a technical assistance and cost-sharing program through NRCS using camera trap materials for producers experiencing wild hog damage in South Carolina. The results of this project will be used to develop a “best practices” technical guidance document and will be communicated to natural resource professionals and NRCS field personnel through training workshops.

We identified five NRCS Environmental Quality Incentives Program (EQIP) eligible producers with significant wild hog damage on their property in South Carolina and provided technical assistance and materials for camera-activated wild hog corral traps to these landowners in May 2014. We created a survey questionnaire focusing explicitly on aspects of wild hog management for natural resources professionals in South Carolina. The survey questionnaire results will be incorporated in the creation of a “best practices” technical guidance document for NRCS field personnel as well as other natural resource professionals. We coordinated one wild hog management training workshop for NRCS field personnel and other natural resource professionals in July 2014. The training workshop focused on topics such as wild hog history and ecology, wild hog impacts, wild hog regulations, and included a live demonstration of the latest wild hog management materials and techniques.

Image: Wild Hogs – S. Sullivan, 2014

Nest success and habitat use of Wilson's Plovers in South Carolina

INVESTIGATORS:

Patrick Jodice
(SCCFWRU)
Felicia Sanders
(SCDNR)

STUDENT:

Elizabeth Zinsser (M.S.,
Clemson University)

SPONSOR:

SCDNR, USFWS,
Yawkey Foundations

DATES:

January 2012 –
December 2013



Wilson's Plover (*Charadrius wilsonia*) is a medium-sized plover associated strictly with coastal areas. The US Shorebird Conservation Plan list Wilson's Plover as a "species of high concern" in their prioritization of shorebird species according to relative conservation status and risk. Wilson's Plovers are listed as state threatened in South Carolina. SCDNR surveys from 2009 -2011 suggest approximately 300 pairs nest in SC and they are rare on beaches with development.

The major threat to the species in US appears to be loss of breeding habitat on beachfronts. On undeveloped barrier islands, human disturbance also appears to cause nest loss and abandonment of sites. Unfortunately little is known about most aspects of the life history of this species and therefore management and conservation efforts are limited in scope.

To assess nest success rates of Wilson's Plovers in an area with limited human disturbance we monitored 72 nests during 2012 and 2013 on South Island and Sand Island located in Tom Yawkey Wildlife Center and Heritage Preserve. We measured environmental variables at the micro and macro-habitat scale to assess nest site selection and to determine the effect of habitat characteristics on daily survival rate (DSR) of nests. DSR ranged from 0.969 – 0.988 among both sites and years while the probability of nest survival ranged from 0.405 - 0.764. Daily survival rates were positively related to the density of items (e.g. shells, wood) within 1 m of the nest and negatively related to maximum tide height during the observation interval on South Island. The distance between the nest site and the nearest dune also was related to DSR of nests on South Island but the effect varied between years. Daily survival was higher in 2013 than 2012 on South Island. Survival was not significantly related to any habitat or environmental variables on Sand Island. Flooding, predation, abandonment, wind-blown sand, and a nesting sea turtle were the known causes of nest failure. More research is needed to determine the nest success rates across the region and to determine chick habitat requirements and survival rates.

Image: Fieldwork on Sand Island, SC – E. Zinsser, 2013

Identifying areas of importance for Brown Pelicans in the southeastern US using satellite tag data

INVESTIGATORS:

Patrick Jodice
(SCCFWRU)
Felicia Sanders
(SCDNR)

STUDENT:

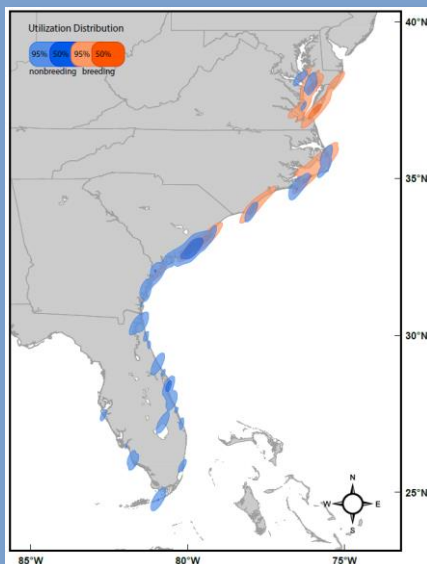
Caroline Poli (M.S.,
Clemson University)

SPONSOR:

USFWS, SCDNR

DATES:

January 2013 –
December 2014



The study was initiated as a component of the Natural Resources Damage Assessment (NRDA) to the *Deepwater Horizon* oil spill with an objective to determine the mortality rate of sub-lethally oiled birds using satellite tracking. As a comparison and reference for oiled birds tagged in the northern Gulf of Mexico, satellite tags were deployed on 40 Brown Pelicans (*Pelecanus occidentalis*) captured near Charleston, SC in December 2010. Tags collected locations for 3 months to 3.5 years.

This project seeks in part to provide information that will improve management for the species during the nonbreeding season. Objectives for analysis of the movement data are to 1) determine annual timing and location of Brown Pelican movements 2) examine consistency between years, 3) examine habitat associations, and 4) determine the extent of spatial overlap with coastal parks and protected areas.

Analyses to date indicate that pelicans primarily use coastal habitat year-round. Migration strategies varied in timing, distance, and destination location for each individual, but behavior was similar between years, suggesting that site fidelity is high for wintering locations and migratory routes in addition to breeding colonies. Individual migration strategies ranged from entirely sedentary with displacement from the breeding colony of less than 50 km to long-distance migration to coastal Guatemala. Birds transitioned across multiple ecoregions, and were more likely to use cold temperate waters March-December and warm tropical waters December-April. This study identifies the Chesapeake Bay and Delmarva Peninsula as areas of high use, particularly for post-breeding dispersal and flight-feather molt July-November, and also for pre-alternate molt in the spring. Analysis of overlap between Brown Pelican movement and protected areas is ongoing.

Map: Breeding and dispersal locations of Brown Pelicans – C. Poli, 2014

Eastern Brown Pelicans: Dispersal, seasonal movements and monitoring of PAHs and other contaminants among breeding colonies in the Gulf of Mexico

INVESTIGATORS:

Patrick Jodice
(SCCFWRU)
Kate McFadden
(SCCFWRU)

STUDENT:

Juliet Lamb (Ph.D.,
Clemson University)

SPONSOR:

Bureau of Ocean
Energy Management,
USGS

DATES:

August 2012 –
December 2016



This study focuses on obtaining information about populations of Brown Pelican (*Pelecanus occidentalis*) across the northern Gulf of Mexico. Study objectives are to (1) document dispersal, seasonal and annual movements, seasonal home range, and site fidelity of marked adult Brown Pelicans among nesting colonies from the Gulf coast and (2) measure levels of contaminants in adult and nestling brown pelicans. Objective 1 will be addressed through satellite telemetry and Objective 2 will be addressed through the acquisition of tissue samples (blood and feathers).

The study will address information gaps relative to Brown Pelicans in the Gulf of Mexico and provide baseline ecological information. In particular, limited information is known regarding foraging behavior for this species and the general ecology of immature eastern Brown Pelicans in the northern Gulf of Mexico is also poorly understood. The project is not intended to be a post-spill study, but rather to address data gaps for management agencies as it pertains to development of additional oil and gas projects in the Gulf. Research will build from and compliment previous and ongoing research efforts of the PI in the Gulf and in coastal SC.

To date, we have deployed 88 remote-downloading GPS tags on adult pelicans in the northern Gulf: 25 tags in Florida, 32 in Louisiana, and 31 in Texas. In 2013, we also collected information from each region on chick growth and diet, and identified regional differences in breeding-season foraging movements, chick condition, and diet composition. In 2014, we conducted additional fieldwork at the four largest Brown Pelican breeding colonies on the Texas coast, which range from heavily-developed Galveston Bay in the north to lightly-developed Corpus Christi Bay in the south. We collected breeding data from each colony including chick survival from hatch to fledge, chick body condition, chick stress levels, chick diet composition, and nestling provisioning rates. Over the coming year, we will be analyzing these data to determine how and whether development levels affect Brown Pelican reproductive ecology in this region. Also in 2014, we color-marked 300 pelican nestlings and are conducting an ongoing citizen science effort to re-sight color bands and investigate the dispersal patterns of juveniles during their first winter.

Image: Brown Pelican with GPS tag – J. Lamb, 2014

Foraging ecology of Masked Boobies

INVESTIGATOR:

Patrick Jodice
(SCCFWRU)

STUDENT:

Caroline Poli (M.S.,
Clemson University)

SPONSORS:

Clemson University,
Sacramento Zoological
Society, USGS



In the Gulf of Mexico, interest in protecting marine areas of potential biological importance is growing but little ecological information on which to inform such planning is available. At-sea habitat use of seabirds could inform planning because foraging locations of marine predators often correlate with ecologically significant habitat, and because prey and other predators may benefit from protection provided to mobile species. This project is a collaboration with researchers from Mexico, the Dutch Caribbean, and the UK which resulted from the Capacity Building Workshop offered in June 2012.

Our objectives are to 1) assess spatial overlap between the marine area protected by Arrecife Alacranes National Park, Mexico (AANP) and foraging locations of an abundant seabird species that breeds there, the Masked Booby (*Sula dactylatra*), and 2) determine Masked Booby foraging behavior and oceanographic conditions that correspond to habitat use.

In 2013 GPS tracking devices were deployed on adults breeding in AANP during two seasons. Up to 4 successive foraging trips were recorded over 1-3 days from each of 78 individuals. Birds used coastal shelf habitat south of the colony, and tended to forage outside of AANP. Foraging behavior was similar between incubating and chick-rearing birds and also between males and females. Additionally, no single oceanographic model adequately predicted behavior for the whole population, suggesting that each individual bird uses different environmental cues to locate prey. We are currently quantifying individual behavior and summarizing results in a manner that can be succinctly conveyed to managers. Our data, when combined with other tracking efforts in the northern Gulf and Caribbean, will aid in the identification of at-sea locations of high foraging activity as an indicator of fish activity, a predictor of bird exposure to pollutants in the marine environment, and a scientific basis for decisions regarding reserve structure. This study will be submitted for publication by May 2015.

Image: Tagging a Masked Booby on Alacranes Island, MX – C. Miranda, 2013

Tracking Atlantic and Caribbean Seabirds (TRACS)

INVESTIGATORS:

Patrick Jodice
(SCCFWRU)

PRIMARY SPONSOR:

USFWS, USGS,
American Bird
Conservancy, Avian
Research &
Conservation Institute,
Jost Van Dyke
Preservation Society,
National Fish and
Wildlife Foundation

DATES:

January 2012 –
December 2014



Although ship-based and aerial surveys are the standard methods used to measure abundance and distribution of birds at sea, each is a population-based survey that provides information without regard to the individual. While data from such surveys are sufficient for estimating abundance or distribution, additional data are needed to more fully understand the individual variability associated with the population use of an area and the impact that would have on marine spatial planning issues. We are deploying tracking devices to measure movement patterns of seabirds in the Caribbean, Gulf of Mexico, and Northwest Atlantic. Data from individual tracking efforts will allow us to assess variability in movements and use patterns and to measure features such as residence or first-passage time, fidelity to specific marine locations, and the relationship between marine use areas and colony of origin (which allows for any marine impacts to be assessed in relation to breeding locations and population trends at the breeding grounds). Our research builds upon tracking work we initiated in the Bahamas in 2008-2010 and also takes advantage of the Capacity Building project we initiated in the Caribbean.

To date we have deployed tracking devices on the following species: geolocators on Audubon's Shearwater (*Puffinus lherminieri*) in The Bahamas and Tobago; geolocators on White-tailed Tropicbird (*Phaethon lepturus*) in The Bahamas; geolocators on Red-billed Tropicbird (*Phaethon aethereus*) in Tobago and St. Eustatius; satellite tags, geolocators, and GPS tags on Masked Booby (*Sula dactylatra*) in Jamaica and Mexico; satellite tags on Magnificent Frigatebird (*Fregata magnificens*) in British Virgin Islands; and satellite tags on the endangered Black-capped Petrel (*Pterodroma hasitata*) in the Dominican Republic. Data are being collected and analyzed. Cooperators in each country from federal agencies, Universities, and NGOs are providing logistical support for this research. All of these partnerships were developed through the Capacity Building Workshop we offered in June 2012.

Details on each project, including a complete list of sponsors and collaborators, can be found at www.atlanticseabirds.org

Image: Black-capped Petrel with PTT – R. Ronconi, 2014

Wintering habitat assessment of Whooping Cranes

INVESTIGATOR:

Patrick Jodice
(SCCFWRU)

STUDENT:

Hillary Thompson
(M.S., Clemson
University)

SPONSOR:

Nemours Foundation,
Clemson University,
International Crane
Foundation



In 2001 the Whooping Crane Eastern Partnership began reintroducing Whooping Cranes (*Grus americana*) in a new eastern population that breeds in Wisconsin and migrates to the southeastern United States. The Eastern Migratory Population (EMP) of Whooping Cranes now numbers over 100 individuals; however, due to its low reproductive success, the EMP is not yet self-sustaining. Wintering locations and habits of endangered Whooping Cranes are well-known for the Central migratory population, but relatively less is known about the non-breeding season for the EMP.

A primary need is to better understand the processes that drive wintering habitat choice and, subsequently, breeding success of this population, since energy spent and gained during the non-breeding season can influence reproduction. Understanding winter habitat needs of Whooping Cranes can also inform management of this population and its wintering areas.

This project will use satellite telemetry data collected by the Whooping Crane Eastern Partnership between the winters of 2002 and 2014 to identify and assess landscape characteristics of wintering locations of Whooping Cranes. Our objectives are to (1) Quantify wintering habitat use of adult Whooping Cranes at the patch and landscape scales from monitoring data collected for the EMP between 2001-2013, (2) Using habitat models created in Objective 1, predict suitability of potential wintering areas east of the Mississippi River, (3) Solicit expert opinion to further inform the development of predictive habitat models for novel wintering sites east of the Mississippi River, and (4) Use a structured decision making framework to evaluate possible wintering habitat locations as identified in objectives 2 and 3 above.

Image: Breeding Whooping Cranes – T. Thousand, 2013

*The impact of gap characteristics and prey availability on the activity and assemblage of forest bats***INVESTIGATOR:**

Patrick Jodice
(SCCFWRU)

STUDENT:

Jonathan Brooks (M.S.,
Clemson University)

SPONSOR:

USFS, USDA



In the Central Hardwoods region, U.S.A., early successional habitat (ESH) is declining due to farmland abandonment and suppression of wildfire. As a result, populations of many ESH dependent species have declined. This has generated concern among scientists and land managers and has led many to ask how best to restore ESH. One method is the creation of forest openings through timber harvest.

Bats, while not dependent on ESH, frequently use ESH for foraging and therefore may be affected by the creation of forest openings. Depending on the silvicultural treatment, the landscape characteristics of harvests can vary. These characteristics may also impact bat activity and assemblage. Additionally, prey availability and environment can also impact the activity and assemblage of bats. The purpose of this project is to determine how forest opening landscape characteristics, prey availability, and environmental factors affect bat activity and assemblage in forest openings.

To accomplish this, we are recording data on each of these variables in existing forest openings in the Nantahala National Forest, NC. Acoustical monitoring is being used to assess bat species richness and activity. Insect trapping is being conducted to assess the diversity and abundance of insects. Nightly temperature variation is also being recorded using temperature loggers. Between June and August 2014, we were able to sample 20 forest openings. Analysis to date indicates that, for all bat species combined, activity is greatest in forest openings less than 1.98 ha in size. Additional data will be collected during the summer of 2015.

Image: Sampling for insects in forest gaps – J. Brooks, 2014

**Modeling bat assemblages and habitat use across Big South Fork National River and Recreation Area:
Potential effects of prescribed fire**

INVESTIGATOR:

Patrick Jodice
(SCCFWRU)

STUDENT:

Leanne Burns (M.S.,
Clemson University)

SPONSORS:

USGS



While prescribed fire is known to maintain forest health and minimize disease, little is known about its impact on bat activity. Past studies suggest the reduction in vegetation density as a result of burning may increase access and foraging efficiency.

Our objective is to investigate annual activity patterns of bats in Big South Fork National River and Recreation Area (BISO), in Kentucky and Tennessee, to relate habitat occupancy and activity levels of bats during summer to abiotic factors (weather, temperature), biotic factors (forest type, forest structure), and fire history (burned or unburned).

To date, we have compared use of forest sites with varying burn histories (frequency, intensity, and burn year) to adjacent unburned forest sites. We used AnabatII detectors to acoustically monitor activity levels for ≥ 2 nights from May 19 to August 10, 2014 across 22 paired treatment and control areas. Diameter at breast height (DBH) and evidence of fire were recorded for all trees and snags >1.4 m tall and >3 cm DBH in a 0.1 ha circular plot around each detector. We recorded 4079 bat calls at 66 sites. We separated echolocation files into high (≥ 36 kHz) and low (≤ 35 kHz) phonic groups using a combination of AnalookV software and manual examination. Preliminary results indicate activity was related to presence of recent (<10 years) prescribed burns and an associated decrease in stand basal area. The mean number of total bat passes and mean number of high and low frequency calls were significantly higher in burned than in unburned sites.

Future data generated from this project will provide information on seasonal bat use and further habitat associations in BISO, which can then be used to formulate fire prescriptions that minimize the potential for harm of federally threatened or endangered bat species.

Image: AnabatII detector at study site – L. Burns, 2014

FUTURE RESEARCH DIRECTIONS

Socio-ecology of invasive species: Linkages among human attitudes and ecological processes

INVESTIGATORS:

Kate McFadden
(SCCFWRU)
David Jachowski,
Shari Rodriguez
(Clemson University)

PROJECT STATUS:

Proposal submitted for
funding, NSF

Invasive species are dynamic forces in human altered systems. Conceptually, species invasions can be viewed in 3 phases: colonization, establishment, and persistence. While invasion ecology has typically focused on biological factors, there are also socio-ecological factors interacting with the biological spread of a species that may facilitate the spread of a disease (i.e. increased human activity/fragmentation). Thus understanding spread requires consideration of both biological and anthropogenic drivers.

The central goal of this project is to analyze the interactions among environmental, social and economic factors in feral pig expansion across the eastern United States, and to forecast the effects of these interactions on future states of the landscape. The general objectives are to identify the mechanisms by which such interactions occur during species invasion, identify which specific portions of the landscape are most prone to experiencing species invasions and associated ecological and socio-economic consequences. It will also evaluate the implications of different land management and control policies on ecosystem and human responses.



Image: Wild Hog sow and piglets – C. O'Neal, 2011

Determining shorebird utilization of Horseshoe Crab spawning in Cape Romain NWR

INVESTIGATOR:

Patrick Jodice
(SCCFWRU)
Felicia Sanders
(SCDNR)

SPONSORS:

SCDNR, USFWS

PROJECT STATUS:

In development, start
spring 2015

Red Knots (*Calidris canutus*) are known to rely on concentrations of Horseshoe Crab (*Limulus Polyphemus*) eggs as a food source during migration. Although this relation has been examined at key staging sites in Delaware and Chesapeake Bays, details on this relationship are not well understood along the SE US coast.

We plan to survey Horseshoe Crabs at key sites in Cape Romain NWR around full and new moons during spring and early summer. We will use well-established survey protocols that have been developed and tested in the Northeastern US to ensure comparability of data across regions. Our research also will support efforts by colleagues to tag Red Knots with geolocators at Horseshoe Crab spawn sites in SC. Geocator data will be used to identify shorebirds that leave Cape Romain NWR in the spring and fly directly to Arctic nesting grounds.



Image: Foraging Red Knots and Horseshoe Crab – G. Breese/USFWS, 2009

PUBLICATIONS

JOURNAL ARTICLES 2013-2014

- Brooks, G.L.*, F.J. Sanders, P.D. Gerard, P.G.R. Jodice. 2013. Daily survival rate for nests and chicks of Least Terns (*Sternula antillarum*). *Waterbirds* 36:1-10.
- Brooks, G.L.*, F.J. Sanders, P.D. Gerard, and P.G.R. Jodice. 2014. Daily survival rates for nests of Black Skimmers from a core breeding area of the Southeastern USA. *Wilson Journal of Ornithology* 126: 443-450.
- Carlson-Bremer, D., T.M. Norton, F.J. Sanders, B. Winn, M. Spinks, B.A. Glatt, L. Mazzaro, P.G.R. Jodice, T. Chen, E.S. Dierenfeld. In Press. Circulating fat-soluble vitamin concentrations and nutrient composition of aquatic prey eaten by American Oystercatchers in the southeastern United States. *Journal of Avian Medicine and Surgery*.
- Giles, M.M.*, P.G.R. Jodice, R.F. Baldwin, J. Stanton, M. Epstein. 2013. Spring migratory pathways and migration chronology of Canada Geese wintering at the Santee NWR. *Canadian Field Naturalist* 127: 17-25.
- Hackney, A., R. Baldwin, P.G.R. Jodice. 2013. Mapping risk for nest predation on a barrier island. *Journal of Coastal Conservation* 17:615-621.
- McFadden, K.W. and S. Meiri. 2013. Dwarfism in insular carnivores: a case study of the pygmy raccoon. *Journal of Zoology* 289:213-221.
- McFadden, K.W., A. Gomez, E. Sterling, E. Naro-Maciel, In Press. Potential Impacts of Historical Disturbance in a Unique Marine Ecosystem: Heavy Metal Concentrations and Health in Green Turtles at Palmyra Atoll, Central Pacific. *Marine Pollution Bulletin*.
- Naro-Maciel, E. S.J. Gaughran, N.F. Putman, G. Amato, F. Arengo, P. Dutton, K.W. McFadden, E.C. Vintinner and E. J. Sterling. 2014. Predicting connectivity of green turtles at Palmyra Atoll, central Pacific: a focus on mtDNA and dispersal modeling. *Journal of the Royal Society Interface*. 11:20130888.
- Sterling, E., K. W. McFadden, K. Holmes, E. Vintinner, F. Arengo, E. Naro-Maciel. 2013. Ecology and conservation of marine turtles in a Central Pacific foraging ground. *Chelonian Conservation Biology* 12:2-16.

* indicates graduate student advisee

THESES AND DISSERTATIONS 2013 - 2014

Elizabeth Zinsser, School of Agricultural, Forest and Environmental Science, M.S., January 2012 – December 2013: *Nest success and habitat use of Wilson's Plovers*

Katie R. Keck, School of Agricultural, Forest and Environmental Science, M.S., Aug 2012- May 2014: *Assessing the response of small mammal functional guilds to a simulated pathogen attack in a deciduous forest ecosystem.*

ACTIVITIES

TECHNICAL ASSISTANCE

USFWS and SCDNR Candidate Species Listing Process (Jodice & McFadden, Dec 19, 2012)

South Carolina Feral Hog Task Force, Scientific Coordinator (McFadden, 2013-present)

USDA Environmental Assessment of Feral Hogs (McFadden, January 10, 2013)

TRAINING ATTENDED

Structural Equation Modeling (Jodice, 2014)

Bayesian Population Analysis (McFadden, 2014)

Research Integrity and Ethics using the DOI as a model (McFadden, 2014)

TRAINING DELIVERED

Best Practices in Feral Hog Management, NRCS (McFadden, 2014)

PRESENTATIONS AND SEMINARS

Invited Presentations

Harrison, A-L., C. Poli, P.G.R. Jodice. 2014. Multi-scale habitat modeling in seabirds provides opportunities for conservation action. North American Congress for Conservation Biology, Missoula, Montana.

Jodice, P.G.R. 2014. Seabird ecology and conservation in the Northwest Atlantic and Gulf of Mexico: Insights from individual tracking. Department of Biology, Wake Forest University, Winston-Salem, North Carolina.

McFadden, K. 2014. Interdisciplinary tools in Marine Conservation. Guest Lecturer, Fisheries Ecology, Clemson University.

McFadden, K. 2014. Conservation Biology and Implications for Management. Guest Lecturer, Conservation Biology, Clemson University.

McFadden, K. 2014. Interdisciplinary tools in conservation biology. Guest Lecturer, Daniel High School, Clemson, SC

Contributed Papers / Presentations / Posters

Burns, L.*; S. Loeb, W. Bridges, P.G.R. Jodice. 2014. Influence of prescribed fire on bat activity in the Big South Fork National River and Recreation Area. North American Society for Bat Research, Albany, New York. Poster presentation.

Ferguson, L.M.*; J. Speakman, P. Redman, P.G.R. Jodice. 2014. Energetics of Brown Pelican Nestlings. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Oral presentation.

Jodice, P.G.R., W. Mackin, Y. Satgé, A-L. Harrison, R.A Phillips. 2014. Use of mid-latitude and pelagic waters by Bahamian seabirds. American Ornithological Union, Estes Park, Colorado. Oral presentation.

Jodice, P.G.R., W. Mackin, Y. Satgé, C. Poli*, A-L. Harrison, R.A Phillips. 2014. Bahamian seabirds transition from Caribbean to mid-latitude and pelagic waters between the breeding and nonbreeding seasons. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Oral presentation.

Jodice, P.G.R, R. Ronconi, G. Wallace, H. Friefeld, E. Rupp, Y. Satgé. 2014. First satellite tracks for Black-capped Petrels. American Ornithological Union, Estes Park, Colorado. Oral presentation.

Keck, K.* and K.W. McFadden. 2014. Loss of foundation tree species: consequences for small mammals in forest ecosystems. North American Congress for Conservation Biology, Missoula, Montana. Oral presentation.

Lamb, J.S.*; P.G.R. Jodice. 2014. Comparative performance of cellular and satellite transmitters deployed on Brown pelicans in the Northern Gulf of Mexico. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Poster presentation.

Lamb, J.S.*; P.G.R. Jodice. 2014. Gradients in breeding Brown Pelican foraging radius, chick condition, and diet across the Northern Gulf of Mexico. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Oral presentation.

Lamb, J.S.*; P.G.R. Jodice. 2014. Year-round spatial overlap between energy infrastructure and Brown Pelican movements in the Gulf of Mexico. International Marine Conservation Congress, Glasgow, Scotland. Poster presentation.

Lamb, J.S.*; P.G.R. Jodice. 2014. Year-round use of a coastal protected area network by Brown Pelicans in the Gulf of Mexico. International Marine Conservation Congress, Glasgow, Scotland. Oral presentation.

Lamb, J.S.*; D. Newstead, B. Ballard, L. Koczur, P.G.R. Jodice, M.C. Green. 2014. A bridge between oceans: evidence for use of the Tehuantepec Isthmus by waterbirds during dispersal and migration. Waterbird Society Annual Meeting, La Paz, Mexico. Oral presentation.

Lawson, A.J.* and K.W. McFadden. 2014. Optimizing survey designs for complex habitat: evaluating season variation of alligator abundance estimates derived from nightlight surveys in South Carolina. International Crocodile Specialist Group Working Meeting. Lake Charles, Louisiana. Poster Presentation

Lawson, A.J.* and K. W. McFadden. 2013. Influence of habitat on American alligator densities in coastal South Carolina derived from nightlight survey data (1971- 2012). The Wildlife Society Annual Conference, Milwaukee, Wisconsin. Poster presentation.

Madden, H., A. Ellis, P.G.R. Jodice. 2014. Reproductive ecology and success of Red-billed Tropicbirds on St. Eustatius. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Oral presentation,

Majyambere, M.* and K.W. McFadden. 2013. Effects of habitat on small mammal diversity and abundance in Nyungwe National Park. Rwanda. International Congress for Conservation Biology. Baltimore, Maryland. Oral presentation.

McFadden, K. and E. Naro-Maciel. 2013. Green sea turtles and marine ecosystem health: a case study from Palmyra Atoll. Central Pacific. International Congress for Conservation Biology. Baltimore, Maryland. Poster presentation.

Poli, C.*, A-L. Harrison, P.G.R. Jodice. 2014. Foraging ecology of Masked Boobies breeding in the Gulf of Mexico. Pacific Seabird Group Annual Meeting, Juneau, Alaska. Oral presentation.

Poli, C.*, P.G.R. Jodice. 2014. Foraging seabirds inform marine spatial planning in the Gulf of Mexico. International Marine Conservation Congress, Glasgow, Scotland. Oral presentation.

* graduate student advisee

SERVICE

Patrick Jodice:

Board of Directors (Elected), World Seabird Union (2012-present)

Chair Faculty Search Committee (Wildlife Ecologist), Clemson University

Proposal Review Panel, National Science Foundation

Scientific Committee, 2nd World Seabird Conference

Reviewer (2013-2014): Wilson J. Ornithology, ICES Journal of Marine Science, Journal of Nature Conservation, Waterbirds, Deep Sea Research II, Marine Ecology Progress Series

Kate McFadden:

Search Committee Member (Wildlife Ecologist), Clemson University

Coordinator for Scientific Strategic Planning, SC Wild Hog Task Force (2012- present)

Scientific Chair, Palmyra Atoll Research Coordinator (2013- present)

Alligator Harvest Management Strategies using Structured Decision Making Working Group, University of Georgia (2013- present)

Secretary, Sigma Xi Research Society, Clemson Chapter (2013- present)

Member, Ecology Curriculum Committee, Clemson University

Member, South Carolina Chapter, The Wildlife Society (2011- present)

Reviewer (2012-2014): Acta Theriologica, Journal of Ecology, Oryx, Journal of Ocean Management, Journal of Small Mammal Conservation, Journal of Animal Ecology, Journal of Mammalogy

PRESS/PUBLIC OUTREACH

Clemson University's Radio: Your Day. Alligators in South Carolina. Abby Lawson and Kate McFadden, July 2014

Press Release: Clemson Researchers Begin Tracking Alligators, September 2014

Press Release: Pioneering project tracks Black-capped Petrels, June 2014



Clemson researchers begin tracking alligators

 MEDIA RELEASE



Clemson researchers will satellite track alligators in the state's coastal plain as part of a study to gain greater understanding of how landscape features affect habitat use and how their movement influences the accuracy of population estimates.

Image Credit: Ellen Williams

wetlands, count eye reflection and estimate alligator size by approximating the distance from eyes to snout tip.

But what works for Louisiana and Florida might not be best for counting alligators in South Carolina's complex and varied alligator habitat, says Dr. Katherine McFadden, assistant unit leader of the South Carolina Cooperative Fish and Wildlife Research Unit and Assistant Professor in Clemson's School of Agricultural, Forest and Environmental Sciences.

"South Carolina alligator habitat is very diverse. It includes tidal marshes, wooded swamps,

CLEMSON — Clemson University's South Carolina Cooperative Fish and Wildlife Research Unit will begin satellite tracking alligators in the state's coastal plain as part of a study to gain greater understanding of their population numbers, movement and ecology.

The satellite tracking is the next phase of a study to provide scientific support for the South Carolina Department of Natural Resources as it designs a long-term adaptive alligator harvesting strategy.

The researchers will track the alligators by GPS to understand how landscape features affect habitat use and how their movement between habitats influences the accuracy of population estimates.

The state currently uses a nightlight survey design based on monitoring programs in Florida and Louisiana.

Wildlife managers shine spotlights into waterways and



June 2014: Satellite tracking experts are following the daily movements of one of the world's more mysterious seabirds: the Black-capped Petrel. The first-ever tracking project is taking place thanks to leadership by the U.S. Geological Survey (USGS), South Carolina Cooperative Fish and Wildlife Research Unit at Clemson University, Grupo Jaragua in the Dominican Republic, and ABC.

These elusive birds spend nearly all their lives over the North Atlantic Ocean and Caribbean Sea. They only come to land to breed, and their only known breeding sites are hidden in the rugged mountains of Hispaniola, the Caribbean island shared by Haiti and the [Dominican Republic](#).

Local people refer to them as "Diablotin" or "little devil," thanks in part to their eerie calls.

Discovery in the Dominican Republic

Efforts to learn more about the lives led by the 'little devils' gained momentum when researchers from ABC partner Grupo Jaragua found several dozen Black-capped Petrel nests in the Dominican Republic. In April, a field team captured three of the birds at their nesting burrows. The petrels were equipped with lightweight, solar-powered transmitters designed to help develop detailed, real-time maps of the long trips these birds take over the open ocean.

(You can follow along! [See Black-capped Petrel travels here.](#))

The tagged birds flew out to sea the next evening to start looking for food, according to Canadian seabird expert Rob Ronconi, who led a field team from Grupo Jaragua. Ever since, the daily journeys of these birds have been recorded by the transmitters affixed to their backs, which send precise locations up to passing satellites and then down to electronic maps maintained by Pat Jodice with the USGS South Carolina Cooperative Fish and Wildlife Research Unit at Clemson University.



Black-capped Petrel with transmitter.



Map of the petrels' paths. [Follow them!](#)

Dr. Jodice said the petrels surprised him right away, partly by foraging in "somewhat unexpected" places in the southern Caribbean Sea and partly by covering as many as 420 miles in the course of a single day. Holly Freifeld, co-coordinator of the tracking project, says the tracking data will be used to help identify the leading threats to Black-capped Petrels when they are at sea. The list of potential threats includes exposure to oil spills, ingestion of marine debris, and attraction to the lights of oil rigs and fishing boats.

"What we need is detailed information about where and when petrels forage, for example," Freifeld said. "That will make it easier for us to locate areas that need protection and to assess other threats that these birds face at sea."

Back from the Brink—Barely

Once the birds were relatively common, but hunters helped push them to the brink of extinction in the 19th and 20th centuries. Now, habitat destruction linked to poverty is a major threat to the petrel's breeding grounds on Hispaniola. Approximately 2,000 breeding pairs are thought to exist.

The Black-capped Petrel is classified as "Endangered" by the International Union for the Conservation of Nature and is under review for potential listing under the Endangered Species Act.

ABC is working with partner groups to protect key petrel habitats in the Dominican Republic, as well as [other seabirds](#) throughout the Western Hemisphere.

(Go behind the scenes of the petrel tagging project on [ABC's blog](#).)

