
SOUTH CAROLINA COOPERATIVE FISH & WILDLIFE RESEARCH UNIT



ANNUAL REPORT

2015

In 2015, the South Carolina Cooperative Fish & Wildlife Research Unit continued to engage our cooperators to address emerging natural resource issues in the State of South Carolina and throughout the United States. Unit scientists continue to advise and mentor graduate students in both MS and PhD programs, and to provide technical assistance to cooperators.

South Carolina Cooperative Fish & Wildlife Research Unit

2015 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

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

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Clemson University

George Askew, Vice President, Public Service and Agriculture, and Dean, College of Agriculture, Forestry and Life Sciences, Clemson University 101 Barre Hall, Clemson, SC 29634

Greg Yarrow, Chair, Forestry and Environmental Conservation, 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, Department of Forestry and Environmental Conservation

Katherine McFadden (deceased), Assistant Unit Leader-Wildlife, U.S. Geological Survey, and Assistant Professor, Department of Forestry and Environmental Conservation

Staff

Carolyn Wakefield, Administrative Assistant

Yvan Satgé, Research Specialist

COLLABORATORS

Clemson University:

Robert Baldwin, Department of Forestry and Environmental Conservation
Kyle Barrett, Department of Forestry and Environmental Conservation
William Bridges, Mathematical Sciences
Saara DeWalt, Biological Sciences
Patrick Gerard, Mathematical Sciences
David Jachowski, Department of Forestry and Environmental Conservation
Laura Jodice, Parks, Recreation and Tourism Management
Rick Kaminski, Department of Forestry and Environmental Conservation
Yoichiro Kanno, Department of Forestry and Environmental Conservation
Robert Powell, Parks, Recreation and Tourism Management
Thomas Rainwater, Department of Forestry and Environmental Conservation
John Rodgers, Department of Forestry and Environmental Conservation
Shari Rodriguez, Department of Forestry and Environmental Conservation
Jacob Sorber, School of Computing
Greg Yarrow, Department of Forestry and Environmental Conservation

South Carolina Department of Natural Resources Cooperators:

Jay Butfiloski, Wildlife Biologist
Breck Carmichael, Special Assistant to the Director
Jamie Dozier, Tom Yawkey Wildlife Center
Du Bose Griffin, Marine Turtle Conservation Program
Felicia Sanders, Wildlife Biologist
Mark Scott, Fisheries Biologist
Derrell Shipes, Chief of Wildlife Statewide Projects
Mark Spinks, Wildlife Biologist
Tammy 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
Jeff Gleason, USFWS
Mike Hooper, USGS
Scott Johnston, USFWS
Jennifer Keller, National Institute Standards and Technology
Susan C. Loeb, Southern Research Station, USFS
Jack Mayer, Savannah River National Laboratory
Dave Moran, BOEM
Raye Nillius, USFWS Cape Romain Natural Wildlife Refuge

John Stanton, USFWS
Melanie Steinkamp, USFWS
Stacy Vander Pol, National Institute Standards and Technology
Craig Watson, USFWS Ecological Services, Charleston, SC
Bureau of Ocean Energy Management
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 Cooperators:

Bahamas National Trust
Black Rock Forest Consortium
Biodiversity Research Institute
Georgia Sea Turtle Center
International Crane Foundation
Low Country Institute
National Fish and Wildlife Foundation
The Nature Conservancy
Nemours Wildlife Foundation
Palmyra Atoll Research Consortium
Society for the Conservation and Study of Caribbean Birds
St. Catherine's Island Wildlife Survival Center

Cooperating Scientists from other Colleges, Universities, and Institutes:

Jennifer Casselle, Scripps Institute, UCSD
Lisa Ferguson, Wetlands Institute
Christine Fiorello, Oiled Wildlife Care Network
Peter Frederick, University of Florida
Lou Gillette, Medical University of South Carolina
Chris Haney, Defenders of Wildlife
Autumn-Lynn Harrison, Smithsonian Institute
William Mackin, Guilford College
Hannah Madden, St. Eustatius National Parks
Adriana Mancada, El Colegio de la Frontera Sur Unidad Campeche, Mexico
Ken Meyer, Avian Research Conservation Institute
Clint Moore, Georgia Cooperative Fish and Wildlife Research Unit
Darshan Narang, Environmental Management Authority, Trinidad & Tobago
Eugenia Naro-Maciel, City College of New York, Staten Island
Katie O'Reilly, University of Portland
Richard Phillips, British Antarctic Survey
Daniel D. Roby, Oregon Cooperative Fish and Wildlife Research Unit
Rob Ronconi, Acadia University
Ernst Rupp, Grupo Jaragua

John Speakman, Aberdeen University
Robert Suryan, Oregon State University
Richard Veit, City College of New York
George Wallace, American Bird Conservancy
Susan Zaluski, Jost van Dyke Preservation Society, BVI
Michael Ziccardi, Oiled Wildlife Care Network

GRADUATE EDUCATION

CURRENT STUDENTS

Shefali Azad, M.S. Wildlife & Fisheries Biology (Advisors: McFadden & Jachowski)
Jonathan Brooks, M.S. Wildlife & Fisheries Biology (Advisors: Jodice & Loeb)
Leanne Burns, M.S. Wildlife & Fisheries Biology (Advisors: Jodice & Loeb)
Juliet Lamb, Ph. D. Wildlife & Fisheries Biology (Advisor: Jodice)
Abigail Lawson, Ph. D. Wildlife & Fisheries Biology (Advisor: McFadden & Jodice)
Hannah Madden, M.S. Natural Resources, University West Indies (Advisor: Jodice)
Susan Sullivan, M.S. Wildlife & Fisheries Biology (Advisor: McFadden & Jodice)
Fumika Takahashi, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)
Hillary Thompson, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)

RECENT GRADUATES

Caroline Poli, M.S. Wildlife & Fisheries Biology (Advisor: Jodice)

RESEARCH

CURRENT PROJECTS

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

INVESTIGATORS:

Kate McFadden (SC CRU), Derrell Shipes & Jay Butfiloski (SCDNR), Clint Moore (GA CRU), Patrick Jodice (SC CRU)

STUDENT:

Abby Lawson (Ph.D., Clemson University)

SPONSORS:

SCDNR, USGS

DATES:

2013 – 2017



The American Alligator (*Alligator mississippiensis*) is an iconic species in South Carolina, of ecological and economic importance. This study is investigating alligator population ecology using multiple analytical methods to establish an adaptive management framework for harvest decision-making. The primary study objectives are to (1) improve the study design of the alligator monitoring program to best reflect annual variation in alligator size class-specific 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.

Spring 2015 marked the second 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). Evaluating seasonal patterns in abundance and detection probability will allow us to determine how variations in the components of survey design (e.g., replicate number, season) influence these estimates and, in turn, management decisions. We conducted a total of 74 alligator nightlight surveys between May and September 2015, and established four new routes in under-represented habitat types.

This spring we also initiated a movement ecology study, aimed at evaluating movement patterns and habitat use of male alligators (objective 3), and relating said patterns to variation in seasonal abundance in surveyed areas. Linking movement and survey data will enable us to disentangle variation in detectability from temporary emigration, and to improve demographic inference from survey data. We captured and marked 24 adult male alligators, ranging from 239–369 cm in total length, with satellite transmitters that acquire location fixes every three hours from April–September 2015 and 2016. Both the survey and movement data indicate that seasonal habitat-specific alligator abundance is highly variable, and likely driven by water-level manipulation in impounded wetlands.

Image: Marking alligators – A. Lawson, 2014

Conservation of Green and Hawksbill sea turtles at Palmyra Atoll

INVESTIGATORS:

Kate McFadden (SC
CRU)

Eleanor Sterling
(AMNH)

Eugenia Naro-Maciel
(SUNY)

PROJECT STATUS:

NOAA funded 2011 –
2014

Dr. McFadden's research on endangered and threatened sea turtles at Palmyra Atoll began in 2008. Her contributions continue as Drs. Autumn-Lynn Harrison and Patrick Jodice collaborate with co-PIs of Dr. McFadden to ensure that publications to which she was contributing progress. These include:

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)

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)

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)



Image: Green Sea Turtle – CC, 2013

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

INVESTIGATORS:

Kate McFadden (SC CRU), David Jachowski (Clemson University)

STUDENT:

Shefali Azad (M.S., Clemson University)

SPONSORS:
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 a number of population models 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 models will include 1) sex-specific age-at-harvest matrices derived from harvest records, 2) capture-recapture matrices from genetic analysis of hair snares, 3) bait station hits and trends, 4) acorn mast indices for the region of interest, and 5) human-bear conflict data.

A basic population model using the traditional Downing method, that can also be extended to incorporate future harvest data to reconstruct populations, will be developed. A capture-recapture population model that also takes into account spatial ecology of the species will be used to determine the population density in the study area. The study will explore the use of Bayesian analysis to integrate the results of both models into a more robust estimation of abundance. Finally, the usefulness of trends from bait, acorn mast trends, and conflict scores as estimators of abundance and recruitment will be investigated, and quantified. The project will provide insights into the current and future population dynamics of the species, and aid resource management through education and harvest.

Image: Black Bear – R. Small, 2013

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

INVESTIGATORS:

Kate McFadden &
Patrick Jodice (SC
CRU)

STUDENT:

Susan Sullivan (M.S.,
Clemson University)

SPONSORS:

NRCS

DATES:

2014 - 2015



Wild Hogs (*Sus scrofa*) are an invasive species presently found in the United States in at least 36 states, including South Carolina, and can negatively impact native species, agricultural systems, domestic livestock, and human health. This project aimed to assess the feasibility of a technical assistance program using trap materials through the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) for landowners in South Carolina. We identified five NRCS Environmental Quality Incentives Program (EQIP) eligible landowners with significant wild hog damage on their property and provided technical assistance and materials for camera-activated corral traps from June 2014 to May 2015. During the project, landowners trapped 30 wild hogs, and the camera-activated corral traps took a total of 5,080 pictures with non-target species encountered in 85.8% of pictures. Non-target species encountered in the traps included White-tailed Deer (*Odocoileus virginianus*), Raccoons (*Procyon lotor*), Eastern Cottontail rabbits (*Sylvilagus floridanus*), and Opossums (*Didelphis virginiana*). The results of this project were communicated to NRCS field personnel and other professionals through two wild hog management workshops.

Additionally, this project aimed to examine the prevalence of six wild hog diseases in South Carolina as well as the relationship between disease prevalence and age class, sex, and geographic location. From 2007-2014, wildlife biologists from USDA Wildlife Services collected blood and nasal swab samples from wild hogs in South Carolina to test for classical swine fever, swine brucellosis, pseudorabies virus, porcine circovirus, porcine reproductive and respiratory syndrome, and swine influenza virus. Wild hogs tested positive for every disease except classical swine fever in at least one county of South Carolina from 2007-2014. The presence of these pathogens in the state's wild hog population indicates that wild hogs may be disease reservoirs with the potential to transmit diseases to domestic livestock or native wildlife.

Image: Wild Hogs – S. Sullivan, 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 (SC
CRU)

STUDENT:

Juliet Lamb (Ph.D.,
Clemson University)

SPONSORS:

Bureau of Ocean
Energy Management,
USGS

DATES:

2012 – 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 and 2015, we conducted additional fieldwork at eight Brown Pelican breeding colonies in Texas, Alabama, and Florida. 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 regional development levels affect Brown Pelican reproductive ecology across a gradient of ecological conditions. Also in 2014 and 2015, we color-banded 600 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: Eastern Brown Pelican colony in Florida – J. Lamb, 2015

Movement patterns and survival of rehabilitated California Brown Pelicans following the Refugio Oil Spill

INVESTIGATORS:

Patrick Jodice (SC CRU), Christine Fiorello & Michael Ziccardi (OWCN)

STUDENT:

Juliet Lamb (Ph.D., Clemson University)

SPONSORS:

OWCN

DATES:

2015 – 2016

In June of 2015, we began collaborating with a research group at the University of California Davis on a project tracking post-release survival and movements of rehabilitated Brown Pelicans along the California Coast. Initiated and funded by the Oiled Wildlife Care Network (OWCN), this study seeks to compare both movements and mortality rates of non-oiled control pelicans to those observed in pelicans that were rescued, cleaned, and eventually released following the *Refugio* Oil Spill in Santa Barbara, California.

During the initial phase of the project, we determined appropriate transmitter specifications and procured transmitters on short notice. Graduate student Juliet Lamb provided training to OWCN staff members and rehabilitators at their Los Angeles facility, including a demonstration of harness attachment techniques. In all, twelve GPS transmitters were deployed on rehabilitated pelicans, with an additional eight transmitters on wild-caught control birds.

Since deployment of tags we have continued to assist with data management and provided data summaries and support as needed. In 2016-17 we will work with OWCN to analyze and publish the movement data resulting from this effort.



Image: Juliet Lamb demonstrates harness attachment – J. Cox, 2015

Tracking Atlantic and Caribbean Seabirds (TRACS)

INVESTIGATORS:

Patrick Jodice (SC
CRU)

PRIMARY SPONSORS:

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

DATES:

2012 – 2017



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

Nonbreeding habitat assessment of Whooping Cranes in a reintroduced population

INVESTIGATORS:

Patrick Jodice (SC
CRU), Anne Lacy (ICF)

STUDENT:

Hillary Thompson
(M.S., Clemson
University)

SPONSORS:

Nemours Foundation,
Clemson University,
International Crane
Foundation

DATES:

2014 –2016



In the late 1940s, the endangered wild population of Whooping Cranes (*Grus americana*) numbered ca. 15 individuals which nested in northern Canada and wintered in coastal Texas. To safeguard this species from extinction, an Eastern Migratory Population (EMP) of 100 individuals was reintroduced in 2001 at breeding grounds in Wisconsin. Initially the population wintered along the Florida Gulf coast but beginning in 2007, the winter range expanded north to include areas from Florida to southern Indiana. While a general understanding of migratory routes and wintering sites has been obtained for the EMP, a thorough assessment of wintering habitat use has not been conducted.

The objectives of this study are to (1) use satellite telemetry collected between 2002 and 2015 to identify and describe wintering sites, stopover sites, and migration routes used by reintroduced migratory Whooping Cranes at the landscape scale, and (2) use radio telemetry and observations to describe patch scale habitat characteristics of wintering sites. To date, satellite transmitters deployed on 85 birds have recorded an average of 613 locations per bird. From this information we have identified wintering and stopover sites, calculated home range sizes of these areas, identified migration routes, and began describing landscape habitat characteristics. Between December 2014 and February 2015 we collected movement, behavior, and habitat data from 43 birds at wintering and stopover sites. During the coming year, we will continue to analyze these data at both the landscape and patch scales, and build a habitat model to predict suitability of other potential wintering areas. This research will aid in the understanding of non-breeding Whooping Crane habitat use, the management of wintering and stopover sites, and eventually in the recovery of this endangered species.

Image: Wintering Whooping Cranes – H. Thompson, 2015

Spatial-temporal overlap of Horseshoe Crab (*Limulus polyphemus*) eggs and foraging shorebirds in the Cape Romain Region

INVESTIGATORS:

Patrick Jodice (SC
CRU)
Felicia Sanders
(SCDNR)

STUDENT:

Fumika Takahashi
(M.S., Clemson
University)

SPONSORS:

SCDNR, USFWS

DATES:

2015–2017



American Horseshoe Crab (*Limulus polyphemus*) eggs provide migratory shorebirds with an abundant food source at stopover sites, allowing the birds to rapidly gain weight for their long migration to arctic breeding grounds. Shorebird utilization of Horseshoe Crab eggs has been well documented at northeastern stopover sites such as the Delaware Bay. However this relationship has not been well studied in the southeast, specifically in South Carolina.

The purpose of this study is to determine if there is a correlation between density of Horseshoe Crab eggs and abundance of foraging shorebirds during spring migration at Cape Romain National Wildlife Refuge. To accomplish this, we monitored 10 study plots between April and June 2015 at predicted Horseshoe Crab spawning sites throughout the refuge. We conducted weekly shorebird surveys and sampled plots twice a month for densities of Horseshoe Crab eggs. During our first field season, we collected 491 Horseshoe Crab egg samples and conducted 121 shorebird surveys. Additionally, we coordinated a refuge-wide horseshoe crab spawning survey on the evening of 2 June 2015 to provide further information on Horseshoe Crab reproductive activity across the refuge. In the coming months, we will analyze the data to compare the density of eggs in each plot with the number of foraging shorebirds over time. The results of our study will help to provide a better understanding of Cape Romain NWR as a stopover site for shorebirds and enable us to compare densities of Horseshoe Crab eggs and spawning adults with other stopover sites along the Atlantic coast.

Image: Horseshoe Crabs spawning on Cape Romain beach – F. Takahashi, 2015

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

INVESTIGATORS:

Susan Loeb (USFS),
Patrick Jodice (SC
CRU),

STUDENT:

Jonathan Brooks (M.S.,
Clemson University)

SPONSORS:

USFS, USDA

DATES:

2014 –2016



Historically, hardwood forests in the Eastern United States were comprised of a mosaic of patches in different states of succession. Over the last century, this mosaic has been altered through suppression of wildfire, timber harvest, and farmland abandonment resulting in more homogeneous forests. This shift in forest composition has negatively impacted species that require early successional habitat (ESH). In an effort to reverse declines in these species, many land managers have implemented programs to restore ESH. Bats, which are also experiencing severe population declines due to White-nose Syndrome, frequently utilize ESH for foraging, however little is known about how patch-level landscape characteristics of ESH affects them.

Our objective is to determine how ESH patch area, aggregation, and insect abundance affect bat activity and occupancy within ESH patches. During the summer of 2014 and 2015, we placed acoustical detectors at the center and edge of forest opening of various sizes and aggregation in the Nantahala National Forest, North Carolina. Paired with each detector was a malaise trap for capturing nocturnal flying insects. In 2014, we recorded 1,672 detector hours of acoustical data with an average of 17 passes per hour. Bat activity was significantly higher in small (0.13-2.01 ha) openings than in medium (2.02-6.07 ha) or large (> 6.07 ha) openings, but opening area did not have a significant effect on bat occupancy. We also counted and identified over 12,900 insect specimens. Total insect abundance had a significant effect on Hoary Bat (*Lasiurus cinereus*) activity, but did not affect overall activity. Data analysis will continue during 2016.

Image: Placing acoustical detectors in forest gaps – J. Brooks, 2015

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

INVESTIGATORS:

Susan Loeb (USFS),
Patrick Jodice (SC
CRU)

STUDENT:

Leanne Burns (M.S.,
Clemson University)

SPONSORS:

USGS

DATES:

2014 –2016



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. As the Big South Fork National River and Recreation Area (BISO) Fire Management Plan is revised, this project aims to provide data on seasonal bat use and habitat associations that will enhance the plans' ability to safely and productively manage forests with prescribed fire for rare and endangered bats occupying the area. Currently, acoustic detectors are being used to assess bat presence and activity throughout the annual cycle on BISO by simultaneously monitoring activity levels in forest sites with varying burn histories and adjacent unburned sites.

To date two seasons of summer sampling have been completed, with a second season of winter sampling in progress. Habitat structure and composition were assessed and temperature recorded at each site, with metrological data obtained from a regional weather station. A total of 4079 bat passes at 66 sites were recorded during the 2014 summer season and identified to species when possible.

General linear model procedures were then used to examine the effects of varying burn histories, and forest composition and structure on summer bat presence and activity. Preliminary analyses indicate that bat presence and total activity are significantly greater in burned sites compared to unburned sites, and show a correlation between increased activity and lower stem densities. Additional analyses among burned sites suggest that interactions between forest composition and burn history affect forest structure and activity levels.

Image: Fieldwork in burned site – L. Burns, 2015

Modeling use of Obed Wild and Scenic River sport climbing areas by rare and sensitive bats

INVESTIGATORS:

Susan Loeb (USFS),
Patrick Jodice (SC
CRU)

SPONSORS:

National Park Service

DATES:

2015 –2016



Sport climbing is a rapidly growing sport in the US and elsewhere. Although several species of bats commonly roost in cliff faces, the potential for impacts of climbers on bats has received very little study. We initiated a pilot study on the potential impacts of sport climbing on bats in Obed Wild and Scenic River in eastern Tennessee during June-August 2015. Our objectives were to 1) examine Small-footed Bat (*Myotis leibii*) roost use to determine if they avoided climbed cliffs, and 2) determine if foraging and commuting activity varied between climbed and unclimbed areas.

We used radio-telemetry to track Small-footed Bats to day roosts and Anabat SD2 detectors to compare bat activity between climbed and unclimbed areas along climbed cliff faces, and between climbed and unclimbed cliffs. Four adult males were tracked to 9 day roosts. Three roosts were in large boulders on the shore of the river, 1 roost was in a barn, and 5 roosts were in cliff faces (3 on climbed and 2 on unclimbed faces). Activity was high along climbed cliffs and did not differ between climbed and unclimbed areas. However, bat activity was significantly higher on climbed cliffs than unclimbed cliffs. Lower activity on unclimbed cliffs may have been related to lower cliff heights and more clutter along the cliff faces. High bat activity along cliff faces suggests that these habitats are used for foraging and commuting as well as roosting. Our results suggest that additional study of bat activity in relation to climbing activity throughout the annual cycle may reveal details that would aid in the development of climbing management plans.

Image: Climbing area in the Obed – A. Melton, 2006

Creative Inquiry: Using computing engineering to improve seabird conservation (FNR 4700 010)

INVESTIGATORS:

Patrick Jodice & Yvan Satgé (SC CRU),
Jacob Sorber (Clemson University)

SPONSORS:

Clemson University

DATES:

2015 –2016



Travelling through expansive and distant marine regions for foraging, pelagic seabirds present unique conservation challenges. The spatial and temporal use areas of this highly threatened group of birds must be defined to inform assessment of threats. Thanks to the advance in the miniaturization of the technology involved in geo-locating devices, seabird ecologists have been able to track and record daily locations of smaller species of seabirds over several years. Use of this technology, however, is restricted by two main factors: on one hand, the devices have to be recovered to allow access to the data they recorded. On the other hand, while becoming more and more affordable, the cost of these devices is still high and failure to recover them may adversely affect the research. Thus, when studying species that can travel hundreds of miles within a day, spend the winter far off-shore and often come back to nest on remote islands for only a limited period of time, data recovery is the limiting factor of spatial research on small seabirds.

In collaboration with Dr. Jacob Sorber (Clemson University School of Computing), PIs created this Creative Inquiry as a research & development branch to the TRACS projects. The undergraduate course intends to build a land-based computing device that will use wireless technology to alert the PI and their collaborators in the field when the birds they study return from migration. Additionally, students will explore how this device can be used to monitor nest attendance, an important factor in the understanding of seabird breeding biology.

Students enrolling to this two-semester class work together with PIs and learn and develop skills about wireless technology, operating system design, software development, product manufacturing, as well as principles of field ecology and wildlife tracking. This course was awarded funding by Clemson University’s Creative Inquiry and Undergraduate Research.

Image: Nesting Audubon Shearwater in the Bahamas – P. Jodice, 2011

FUTURE RESEARCH DIRECTIONS

Spatial ecology, movement patterns, and at-sea habitat use of nearshore seabirds in the South Atlantic Bight

INVESTIGATORS:

Patrick Jodice (SC
CRU)

PROJECT STATUS:

Proposal submitted for
funding, BOEM



The Eastern Brown Pelican is a species of conservation concern, breeds and winters throughout the southeastern US, and has the capacity to forage out to 30 km from shore. To date, however, data that can be used to assess at-sea habitat use or seasonal movements along the Atlantic coast are limited. Given the interest in development of offshore wind energy and the potential for oil & gas leasing in offshore habitats, data are needed to assess potential interactions with seabirds.

The proposed study would assess at-sea habitat use, movement patterns, and migration paths of adult Brown Pelicans throughout the southeastern US and throughout the annual cycle. We propose to capture ca. 100 adults at nesting colonies in SC, GA, and north FL and to deploy GPS satellite transmitters. Seasonal home range maps will be developed for each individual and core use areas also will be mapped for the population. All of the above data will be used to determine high, moderate, and low use areas at sea throughout the year. Movement and use data will be layered with available marine habitat data to provide environmentally based risk assessments for each species.

The research effort would be led by the USGS Cooperative Research Unit in South Carolina with collaboration from USFWS, SC DNR, GA DNR, FL FWC, NC Wildlife Resources Commission, and Clemson University.

Data would support NEPA analyses and research needs identified at the BOEM sponsored Atlantic Wind Energy Workshop 2011, the BOEM Studies Development Plans for Fy13-15, and avifauna chapter of the information synthesis developed for BOEM for the South Atlantic Planning area (authored by the PI). If funded, the project would support a PhD student or a Post-doctoral Research Associate.

Image: Eastern Brown Pelican – P. Jodice, 2006

PUBLICATIONS

JOURNAL ARTICLES 2014-2015

- 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, and E.S. Dierenfeld. 2014. 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* 28:216-224.
- Collins, S.A.*, F.J. Sanders, and P.G.R. Jodice. Feasibility of headstarting as a conservation tool for American Oystercatchers. Submitted October 2014, In Revision September 2015, Bird Conservation International.
- Ferguson, L.M.*, T.M. Norton, A. Dipl, C. Cray, M. Olivia, and P.G.R. Jodice. 2014. Health assessments of Brown Pelican nestlings from colonies in South Carolina and Georgia. *Journal of Zoo and Wildlife Medicine* 45:835-845.
- Jodice, P.G.R., R.A. Ronconi, E. Rupp, G.E. Wallace, and Y. Satgé. In Press. First satellite tracks of the endangered Black-capped Petrel. *Endangered Species Research*.
- Jodice, P.G.R., J.M. Thibault*, S.A. Collins*, M. Spinks, and F.J. Sanders. 2014. Reproductive ecology of American Oystercatchers nesting on shell rakes. *Condor* 116:588-598.
- Lamb, J.S.*, C.S. Hall, S.W. Kress, and C.R. Griffin. 2014. Comparison of burning and weed barriers for restoring Common Tern (*Sterna hirundo*) nesting habitat in the Gulf of Maine. *Waterbirds* 37: 286–297.
- Lucas, J.S.*, S.C. Loeb, and P.G.R. Jodice. 2015. Roost selection by Rafinesque's Big-eared Bats (*Corynorhinus rafinesquii*) in optimal habitat. *Acta Chiropterologica* 17:131-141.
- McFadden, K.W., A. Gomez, E. Sterling, and E. Naro-Maciel. 2014. 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* 89:160-167.
- 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.

* indicates graduate student advisee

THESES AND DISSERTATIONS 2014-15

Caroline Poli, Department of Forestry and Environmental Conservation, M.S., December 2014: *Spatial Ecology of Pelecaniformes*

ACTIVITIES

TECHNICAL ASSISTANCE

South Carolina Feral Hog Task Force, Scientific Coordinator (McFadden, 2013-2014)

TRAINING DELIVERED

We coordinated two Wild Hog management training workshops for United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) field personnel and other natural resource professionals in July 2014 and August 2015. The workshops aimed to provide an overview of the cooperative Clemson University – USDA NRCS Wild Hog project as well as information on management strategies to reduce Wild Hog problems on NRCS clientele lands in South Carolina. The training workshops focused on topics such as Wild Hog history and ecology, negative impacts, and state regulations for the species. Workshop speakers included representatives from Clemson University, Savannah River National Laboratory, South Carolina Department of Natural Resources, and USDA Wildlife Services. The workshops also provided a live demonstration of the latest Wild Hog management materials and techniques including the JAGER PRO™ and BoarBuster™ camera-activated trap systems.

PRESENTATIONS AND SEMINARS

Invited Presentations

Jodice, P.G.R. 2015. Examining the movement ecology of seabirds across a range of spatial and temporal scales. Department of Wildlife Ecology and Conservation, University Florida, Gainesville, Florida.

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.

Contributed Papers / Presentations / Posters

Brooks, J.D.* and S.C. Loeb. 2015. Effect of forest opening landscape characteristics and vegetation structure on bat occupancy. North American Joint Bat Working Group Meeting, St. Louis, Missouri.

Brooks, J.D.*, P.D. Gerard, and S.C. Loeb. 2014. Impact of forest opening area and distance from edge on bat activity in the southern Appalachian Mountains. North American Symposium on Bat Research. Albany, New York.

Burns, L.*, S. Loeb, W. Bridges, and P.G.R. Jodice. 2015. Relationship of a post-fire structural response to bat presence and activity on the Cumberland Plateau. Ecological Society of America. Baltimore, Maryland.

Burns, L.*, S. Loeb, and P.G.R. Jodice. 2015. Winter activity patterns of bats on the Cumberland Plateau. North American Bat Research Symposium, Monterey, California.

- Burns, L.*, S. Loeb, W. Bridges, and P.G.R. Jodice. 2015. Influence of prescribed fire on bat activity in the Big South Fork National River and Recreation Area. North American Joint Bat Working Group. St. Louis, Missouri.
- Burns, L.*, S. Loeb, W. Bridges, and 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.
- Jodice, P.G.R., R.A. Ronconi, E. Rupp, G.E. Wallace, and Y. Satgé. 2015. First satellite tracks of the endangered Black-capped Petrel. Waterbird Society Annual Meeting, Bar Harbor, Maine.
- Lamb, J.* and P.G.R. Jodice. 2015. Brown Pelican fledgling success and diet in the Northwestern Gulf of Mexico. Pacific Seabird Group Annual Meeting, San Jose, California.
- Lamb, J.* and P.G.R. Jodice. 2015. Physiology and geography predict individual migratory strategies in the Brown Pelican. Texas Bays and Estuaries Meeting, Port Aransas, Texas.
- Lamb, J.* and P.G.R. Jodice. 2015. Should I stay or should I go? Physiology and geography predict individual migratory strategies in the brown pelican. Pacific Seabird Group Annual Meeting, San Jose, California.
- Lamb, J.*, Y.G. Satgé, and P.G.R. Jodice. 2015. Conservation implications of individual variation in Brown Pelican migration strategies. International Congress for Conservation Biology, Montpellier, France.
- Lamb, J.*, Y. Satgé, and P.G.R. Jodice. 2015. Variation in Brown Pelican energy provisioning rates across a range of juvenile forage fish availability. Waterbird Society Annual Meeting, Bar Harbor, Maine.
- Lawson, A.J.* and P.G.R. Jodice. 2015. Do changes in size class composition influence ontogenetic niche shifts in American alligators? Ecological Society of America Annual Meeting. Baltimore, Maryland.
- Lawson, A.J.*, P.G.R. Jodice, and C.T. Moore. 2015. American alligator adaptive management in South Carolina. James C. Kennedy Waterfowl and Wetlands Center Technical Advisory Meeting, Georgetown, South Carolina.
- Lawson, A.J.*, P.G.R. Jodice, and C.T. Moore. 2015. Integrative alligator population ecology: population dynamics, habitat selection, and foraging patterns. South Carolina Alligator Research Symposium, Ft. Johnson, South Carolina.
- Lawson, A.J. and K.W. McFadden. 2015. Monitoring South Carolina Alligator populations: challenges and opportunities. South Carolina Chapter of The Wildlife Society Annual Conference, Florence, South Carolina.
- Loeb, S. and P.G.R. Jodice. 2015. Are bats and sport climbing compatible? A pilot study. North American Bat Research Symposium, Monterey, California.
- Poli, C.*, A-L. Harrison, and P.G.R. Jodice. 2015. Comparative foraging behavior of Masked Boobies and Red-footed Boobies breeding in the Gulf of Mexico. Waterbird Society Annual Meeting, Bar Harbor, Maine.

Poli, C.*, A-L. Harrison, and P.G.R. Jodice. 2015. Dispersal patterns and habitat use of Brown Pelicans (*Pelecanus occidentalis*) along the US Atlantic coast. Waterbird Society Annual Meeting, Bar Harbor, Maine.

Poli, C.*, A-L. Harrison, and P.G.R. Jodice. 2015. Variability in foraging behavior of Masked Boobies breeding at Islas Muertos, Mexico. Pacific Seabird Group Annual Meeting, San Jose, California.

Satgé Y., J. Lamb*, and P.G.R. Jodice. 2015. Brown pelican fledgling success and diet: potential drivers of changing regional distribution in the Texas coast. Texas Bays and Estuaries Meeting. Port Aransas, Texas.

Sullivan, S.*, W. Bridges, K.W. McFadden, J. Mayer, P.G.R. Jodice, and G. Yarrow. 2015. Prevalence of six viral and bacterial diseases in Wild Hogs in South Carolina (2007-2014). Southeastern Association of Fish and Wildlife Agencies Annual Conference. Asheville, North Carolina.

Sullivan, S.*, W. Bridges, K.W. McFadden, J. Mayer, P.G.R. Jodice, and G. Yarrow. 2015. Prevalence of six viral and bacterial diseases in Wild Hogs in South Carolina (2007-2014). The Wildlife Society Annual Meeting. Winnipeg, Manitoba.

Thompson, H. L.* and P.G.R. Jodice. 2015. Habitat selection of wintering Whooping Cranes in the eastern migratory population. Southeastern Ecology and Evolution Conference, Athens, Georgia.

Thompson, H. L.* and P.G.R. Jodice. 2015. Habitat selection of wintering Whooping Cranes in the eastern migratory population. Clemson Biological Sciences Annual Student Symposium, Clemson, South Carolina.

Thompson, H.L.* and P.G.R. Jodice. 2015. Non-breeding movements and habitat use of Whooping Cranes using satellite telemetry. Society for Conservation GIS Conference, Pacific Grove, California.

Thompson, H.L.*, A.E. Lacy, and P.G.R. Jodice. 2015. Non-breeding habitat use of reintroduced Whooping Cranes (*Grus americana*) in the southeastern United States. Waterbird Society Annual Meeting, Bar Harbor, Maine.

* graduate student advisee

SERVICE

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

P. Jodice, Scientific Committee, 2nd World Seabird Conference (2014-present)

STUDENTS

J. Brooks, Committee Member, Clemson Graduate Student Government Three-minute Thesis Competition, 2015

L. Burns, Senator, Clemson Graduate Student Government, 2014-2016

L. Burns, CAFLS Dean Graduate Student Advisory Board. 2015-2016.

J. Lamb, Council Member (elected), The Waterbird Society, 2016-2019

J. Lamb, Vice President, Natural Resources Graduate Student Association, 2014-2015

A. Lawson, Secretary of Communication, Clemson Graduate Student Government Executive Cabinet, 2015-2016

S. Sullivan, Secretary and Treasurer, Natural Resources Graduate Student Association, 2014-2015

AWARDS AND HONORS

P. Jodice, Graduate Faculty of the Year, Dept. Forestry and Environmental Conservation

STUDENTS

L. Burns, Wade Stackhouse Fellowship, 2015-2016

L. Burns, Marion Bailey Assistantship for Research in National Parks, 2014-2015

L. Burns, North American Symposium on Bat Research, Best poster award, 2014

L. Burns, Clemson University Professional Enrichment Grant, 2014 & 2015

L. Burns, Clemson Annual Biological Student Symposium, 3rd place student poster, 2015

L. Burns, Sigma XI Scientific Research Society Grant in Aid of Research, 2015

J. Lamb, Clemson University Professional Enrichment Grant, 2015

J. Lamb, Wade Stackhouse Fellowship, 2015-2016

J. Lamb, Marion Bailey Assistantship for Research in National Parks, 2014-2015

J. Lamb, Student Presentation Award, Texas Bays and Estuaries Meeting, 2015

J. Lamb, Awarded 2nd place in Access To Understanding Scientific Writing Competition, 2015

- A. Lawson, Clemson University Professional Enrichment Grant, 2015
- A. Lawson, Best PhD Poster, The Wildlife Society Annual Meeting, 2014
- C. Poli, Best MS Student Paper Award, Pacific Seabird Group Annual Meeting, 2015
- S. Sullivan, Clemson University Professional Enrichment Grant, 2015
- H. Thompson, 3rd place Student Paper Award, Society for Conservation GIS Annual Meeting, 2015

PRESS/PUBLIC OUTREACH

Outreach: Bats in our Backyard. Big South Fork National Park Campfire Program, Oneida, TN. Leanne Burns, 2014.

Outreach: Brown pelican research on Gaillard Island. Oral presentation at Buccaneer Yacht Club in Mobile, AL. Juliet Lamb, 2015.

Outreach: Migrations of a wildlife scientist. Pendleton High School, SC. Hillary Thompson, 2014.

Outreach: South Carolina American alligator ecology and conservation. Coastal Exploration Series, South Carolina Department of Natural Resources. Abby Lawson, 2015.

Press: Counting gator; first-of-its-kind survey to guide future of hunting. Charleston Post and Courier Newspaper, SC. 2015.

Press: On the wings of whoopers: Winter migration of two girls tracking Whooping Cranes in the Southeast. Nemours Gazette of the Nemours Wildlife Foundation, SC. Hillary Thompson, 2015.

Press: Whooping Cranes wintering across the southeastern United States. The Eagle's Eye newsletter of St. Mark's National Wildlife Refuge, FL. Hillary Thompson, 2015.

Press: World's largest Alligator satellite telemetry study raises the bar in the Lowcountry. U.S. Geological Survey Top Story. Abby Lawson et al., 2015.

Media: Project Pelican: South Carolina researchers studying seabirds in Gulf of Mexico. WMBB News 13 ABC News, Panama City, FL. 2015

Media: Research group tracking Lowcountry's alligators to learn habits. WCIV-TV ABC News, Charleston, SC. 2015.



Prof. Katherine (Kate) McFadden, wildlife ecologist and conservation scientist, died on October 28, 2014. She was 41 years old.

Kate was the Assistant Unit Leader at the USGS South Carolina Cooperative Fish & Wildlife Research Unit and an Assistant Professor at Clemson University. Kate grew up in Georgia, but traveled extensively for her education and field research. She received her B.A. in Biology from the University of California Santa Cruz, her M.S. in Wildlife and Fisheries Sciences from Texas A&M University, and her Advanced Certificate in Environmental Policy and her Ph.D. in Ecology and Environmental Biology from Columbia University in New York. Kate was an NSF Teaching Fellow, a Knauss Postdoctoral Marine Policy Fellow, and a Fulbright Scholar. Prior to arriving at Clemson University, Kate also served as Scientific Director for the Environmental Science and MPA Program at Columbia University, Assistant Professor in the Department of Ecology, Evolution, and Environmental Biology at Columbia University, and Associate Research Scientist at the American Museum of Natural History.

Kate's ecological work always served a strong conservation purpose, and her research took her far and wide, encompassing many species in both the terrestrial and marine realms. Her projects included field seasons on remote atolls in the Hawaiian Islands, where she worked on the endangered Hawaiian Monk Seal; on Cozumel Island, where she studied endangered, endemic carnivores; in Rwanda where she surveyed for rare wildlife as a Fulbright Scholar; on Palmyra Atoll, where she worked on many aspects of the ecology of Green Sea Turtles; and in the southeastern US, where she and her graduate students initiated research on American Alligators, Feral Hogs, and Black Bears.

Kate's contributions to conservation and education are numerous. She was the author of many scientific papers, abstracts, and reports and she was a graduate advisor and teacher to many students at multiple universities. The dedication, commitment, and passion she poured into teaching and mentoring were remarkable and at times seemed boundless. Kate's enthusiasm for science, her love of the outdoors, nature, and the conservation of species and ecosystems, and her vibrant, loving, personality will continue to influence and motivate us for years to come.

