South Carolina Cooperative Fish & Wildlife Research Unit

Report of Activities
2009-2010

Cooperating Agencies
U.S. Geological Survey
South Carolina Department of Natural Resources
Clemson University
Wildlife Management Institute

South Carolina Cooperative Fish and Wildlife Research Unit
G27 Lehotsky Hall
Clemson University
Clemson, SC 29632
864-656-0168

Attaching a radio transmitter to an American Oystercatcher chick along the Intracoastal Waterway

Installing video camera unit used to monitored colony disturbance within a Black Skimmer colony in Cape Romain National Wildlife Refuge.

Post-fledge Painted Bunting nest on Chechesse Island

Banded American Oystercatcher chick along the Intracoastal Waterway.

Culmen measurement on Canada Goose at Santee National Wildlife Refuge.

Release of a satellite tagged Canada Goose at Santee National Wildlife Refuge

Front Cover (top to bottom): Kate Sheehan (PhD candidate), Gillian Brooks (MS student) and Sarah Woodward (2010 technician), Samantha Collins (MS student)

USGS South Carolina
Cooperative Fish and Wildlife Research Unit

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Bahamas National Trust
BioDiversity Research Institute
Chechessee Creek Club
Defenders of Wildlife
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Low Country Institute
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St. Catherine's Island Wildlife Survival Center
U.S. Golf Association

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Kate Sheehan, Ph.D. Biological Sciences (Jodice)

Projects in Wildlife Sciences

Black Skimmers in Cape Romain National Wildlife Refuge, SC

Movement patterns, habitat use and conservation assessment of stopover sites for migratory Canada Geese

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Dean Harrigal, SCDNR Marc Epstein, John Stanton & Haven Barnhill, USFWS Molly Giles, M.S. student
Duration:	January 2008 to December 2010
Funding Source:	SCDNR, USFWS
Project Location:	Santee National Wildlife Refuge
Status:	Ongoing

Migrant Canada geese have wintered at the Santee National Wildlife Refuge in South Carolina since the 1940's. Numbers of migrant geese at Santee NWR peaked at 39,000-40,000 during the mid 1960's. However, from the mid 1960's to 1987, there was a 96% decrease in the numbers of geese at the refuge, and currently there are fewer than 1,000 geese wintering in and adjacent to the refuge. This regional decline is thought to be caused by the "short-stopping" of geese in northern parts of the flyway. Factors linked to this south to north shift in distribution include changes in climate, changes in agricultural and urban land use, the creation of public and private waterfowl refuges, and increases in resident or temperate-nesting geese.

In an effort to protect the already declining population of migratory geese wintering at Santee NWR, Clarendon County and parts of neighboring Orangeburg and Berkeley Counties in South Carolina have been closed to late season goose harvest. There has been recent interest in opening a portion of Clarendon County to resident goose harvest, however little is known about the extent to which both migrant and resident populations use this area. The objectives of this project are to: (1) measure individual home range, movement patterns, and habitat use of migratory Canada geese in and adjacent to the Santee NWR, and (2) determine the migratory pathways of Canada geese wintering at Santee NWR.

During the two fall/winter field seasons 36 geese were captured at Santee NWR, with 9 PTT's and 10 VHF transmitters deployed. Researchers have long thought that the migrant geese wintering at Santee NWR were from the Southern James Bay Population, however, data from satellite transmitters deployed on geese captured at Santee NWR during the past two winters has revealed that birds from the Atlantic Population also winter at the refuge. Data obtained from VHF-marked geese shows an average fixed kernel home range size ranging from 214.2 ha to 263.6 ha for all individuals, with core areas ranging in size from 46.0 ha to 55.5 ha. Core areas are focused around the refuge corn and wheat fields, as well as refuge impoundments. Further analyses will include comparisons of home range, movement patterns, and habitat use throughout the winter as well as an assessment of use of lands outside of the Santee NWR.

Movement patterns of seabirds breeding in the Exuma Cays, Bahamas

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Will Mackin, University of North Carolina. Co-PI Jennifer Arnold, Penn State University, Co-PI Richard Phillips, British Antarctic Survey, Co-PI
Duration:	January 2008 to December 2010
Funding Source:	USFWS
Project Location:	Exuma Cays, Bahamas
Status:	Ongoing

During the period May – July 2008 we collected 93 blood samples for H5N1 (avian influenza) analysis from various seabird colonies in the Exuma Cays, Bahamas. Samples were collected from Audubon's Shearwater, White-tailed Tropicbird, Sooty Tern, Bridled Tern, and Brown Noddy. Samples were sent to the National Wildlife Health Lab in Madison, WI, and are now part of the Highly Pathogenic Avian Influenza Early Detection Data System (HEDDS) database http://wildlifedisease.nbii.gov/ai/. No positive cases of H5N1 AI were detected.

We also attached geolocators (GLSs) to 11 Audubon's Shearwaters and 13 White-tailed Tropicbirds. GLSs are small (2-3 g) devices that estimate location based on ambient light levels and also record salt-water immersion; hence time foraging at sea also can be estimated. The devices we used were provided by the British Antarctic Survey. These are the first efforts to deploy GLSs on these species or in this region. We recovered 2 GLSs from Audubon's Shearwaters after 5 weeks during the 2008 breeding season. These birds engaged in a combination of long and short foraging trips as estimated from the proportion of time spent at-sea. Locations ranged from local use of the waters throughout the Exumas to periodic use of waters south of Cuba.

We revisited colonies during June 2009. We recovered 4 additional GLSs from Audubon's Shearwaters and 3 from White-tailed Tropicbirds. During the breeding season both species frequented the northern Bahamas but also were located south of Cuba. During winter, shearwaters dispersed along the coast as far north as the northeastern U.S. Tropicbirds dispersed north but also were frequently located east of Bermuda and in waters towards the mid-Atlantic ridge. These locations represent the first annual movement data collected from seabirds in the Bahamas. Our preliminary results indicate that the foraging range during chick-rearing and the wintering range of these two seabirds are far larger than previously thought. This new information changes the perspective of managers and policy makers who are mandated to address marine ecosystem-based management and marine spatial planning. Additional devices were deployed in 2010 on shearwaters at Cay Sal Bank, the southwestern most group of islands in the Bahamas.

South Atlantic information resources: data search and literature synthesis for seabirds

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Joe Tavano, Clemson University, Research Associate
Duration:	October 2009 to December 2010
Funding Source:	Minerals Management Service
Project Location:	South Atlantic Bight
Status:	Ongoing

A recent synthesis of oceanographic data for the South Atlantic Bight is lacking and this is particularly true for avian taxa in this region. Clapp et al. (1982) composed distributions of marine birds from records dating until the early 1980s but no comprehensive synthesis has been conducted since. The need for such a synthesis is warranted given the increase in human activity within this zone (e.g. commercial and recreational fisheries) and proposed or experimental activities focused on energy development. Furthermore the region supports a wide array of breeding and migratory seabirds, many of which are declining or have population trends of unknown trajectories. In many cases research on these species has been minimal and not always made available in easy-to-access outlets.

We conducted an extensive search for literature and data concerning the status, distribution, location, and survey efforts for seabirds in the South Atlantic Bight. Our search included online literature databases, online data clearinghouses, state and federal agency webpages, general online search engines, and personal communication with state and federal biologists. We developed a database containing references for all existing knowledge of seabirds for the South Atlantic Bight. Our sources include peer-reviewed and gray literature, reports to numerous state and federal agencies, theses and dissertations, conference proceedings, GIS datasets, survey data, and unpublished work.

We will synthesize the existing knowledge on distribution and ecology of seabirds in the South Atlantic Bight which includes coastal South Carolina and waters offshore of South Carolina. Data gaps will be identified and areas for future research highlighted. The work will build upon current efforts to increase the knowledge-base of seabird ecology along the South Atlantic US coast. This effort will result in a synthesis that will include species accounts, location accounts, distribution maps, and summaries of research and survey efforts.

Survival rates of seabirds in oiled areas of the Gulf of Mexico

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Lisa Eggert, Clemson University, Co-Principal Investigator Dave Evers, BioDiversity Research Institute, Co- Principal Investigator
Duration:	May 2010 to December 2010
Funding Source:	USFWS
Project Location:	Gulf Coast and SC Coast
Status:	Ongoing

This research is a component of the NRDA avian injury assessment at the Gulf of Mexico – Deepwater Horizon Mississippi Canyon oil spill and these data will serve as the primary measure of survival rates for the NRDA process for seabirds (pelicans, terns, skimmers) in the Gulf of Mexico. The primary objective is to determine the rate of mortality in sublethally oiled birds through the use of individual tracking studies. The primary species of interest are brown pelican (*Pelecanus occidentalis*), royal tern (*Sterna maxima*), and black skimmer (*Rynchops niger*). Colonial species of secondary interest are laughing gull (*Larus atricilla*), sandwich tern (*Sterna sandvicensis*), and least tern (*Sterna antillarum*). Other species may be included depending upon how the research progresses and the status of various species. The initial research area has included the coastal islands of Louisiana. Satellite tags with activity sensors, VHF tags with mortality switches, microGPS tags, or geolocators will be deployed to evaluate survival and movement of the focal species. The type of device deployed will be chosen based on the body mass of the individual. Data collected will be used to estimate mortality rates of adult birds, determine movement patterns, and determine habitat use patterns. We also will attempt to deploy satellite tags and VHF tags on reference (i.e., birds not impacted by oil) in South Carolina. The data being collected also will improve our understanding of movement patterns and foraging habitat use of nearshore seabirds in the Gulf of Mexico which will benefit marine spatial planning and risk assessment for offshore energy development.

Nest success of Black Skimmers and Least Terns in Cape Romain National Wildlife Refuge

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Felicia Sanders, SCDNR, Co-Principal Investigator Gillian Brooks, M.S. student
Duration:	January 2009 to April 2011
Funding Source:	USFWS, SCDNR
Project Location:	Cape Romain National Wildlife Refuge
Status:	Ongoing

Cape Romain National Wildlife Refuge (CRNWR) supports abundant seabird nesting. Recently, however, nearshore seabirds in this region have been declining. The Least Tern (*Sternula antillarum*) and Black Simmer (*Rynchops niger*) both nest in CRNWR and each appears to be experiencing declines in nesting numbers. The purpose of this study is to identify variables which influence nest success of the Least Tern and Black Skimmer.

Nest and chick survival were measured during the 2009 and 2010 breeding seasons. A total of 263 Least Tern and 363 Black Skimmer nests were monitored. Nests were monitored every 2-4 days until nest fate was determined. A nest was defined as successful if one or more eggs hatched. Apparent hatch success for Least Terns and Black Skimmers during 2009 was 0% at Lighthouse Isl., 5.4% and 62% at Cape Island, and 83% and 59% at Middle White Banks, respectively. For 2010, apparent hatch success was 40% and 81% at Lighthouse Isl., 42% and 3.5% at Cape Island, 94% and 68% at Middle White Banks, and 0% at Raccoon Key, respectively. Preliminary analysis suggests the primary causes of nest failure in 2009 were washover/flooding and predation while 2010 appeared to be the primary cause of nest failure. Activity at nests was also monitored by infrared time-lapse video cameras over the two breeding seasons. Cameras documented colony disturbance and predation by Black Vultures (*Coragyps atratus)*, Great-Horned Owl (*Bubo virginianus*) and American mink (*Neovison vison)*.

In 2009, 38 Least Tern chicks were color-banded on Middle White Banks and we conducted re-sighting surveys every 2-4 days until no Least Tern fledglings were observed utilizing the study site. Of the 38 individuals banded, 22 (58%) were re-sighted at least once at $\geq$ 17 days. In 2010, 60 Least Tern chicks were color-banded at the same site. Of the 60 banded, 13 (22%) were re-sighted at least once at $\geq$ 17 days. We are confident the lower resighting rate during 2010 was not due to a decrease in detection as the re-sighting effort was increased in 2010. At present, Black Skimmer chick survival has only been determined for Middle White Banks in 2010. Minimum survival was estimated by conducting an island wide count/search of banded Black Skimmer fledglings on 28th July. Of the 60 Black Skimmer chicks color banded, 22 (42%) were re-sighted at 28 days or older. Further analysis will be conducted this fall.

Protection and management of seabird colonies in South Carolina

Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Lisa Eggert, Ph.D. student
Duration:	May 2006 to May 2011
Funding Source:	SCDNR
Project Location:	Crab Bank, Deveaux Bank, Bird Key Stono, Charleston County, SC
Status:	Ongoing

Seabirds nest in colonies on approximately nine islands along the coast of South Carolina. These islands are characterized by sandy beaches, absence of mammalian predators, low vegetation, and an upland that provides habitat for nesting shorebirds and colonial seabirds. One of the main challenges faced by managers at these colonies is balancing the needs of breeding and migratory birds with those of island visitors. The goal of the study is to monitor seabirds and collect baseline measures of breeding parameters to better evaluate the health and condition of seabird populations at protected nesting islands.

The first objective of this study was to map habitat use by seabirds during the breeding season. To meet this objective we conducted intertidal surveys during the 2007 and 2008 breeding seasons to identify areas of high bird use. We conducted 12 surveys at Crab Bank, 18 surveys at Bird Key Stono, and 17 surveys at Deveaux Bank. We also measured habitat characteristics of the intertidal zones of these three islands. Over 30 species of waterbirds were recorded during these surveys, and data suggest that use varies spatially and temporally during the breeding season. Our next objective was to measure reproductive and behavioral parameters of breeding seabirds. In 2007 and 2008 we measured Black Skimmer (*Rynchops niger*) nest success at three nesting islands. Across all colonies and years, mean hatching success was 0.45 ± 0.26 chicks hatched per nest and mean productivity was 0.27 ± 0.21 chicks fledged per pair. Temperature loggers were placed in 108 nests to determine the effect of temperature patterns during incubation on nest success; these data are being analyzed. Brown Pelican (*Pelecanus occidentalis*) reproductive parameters were monitored during all years of the study. Across all colonies and years, mean hatching success was 2.0 ± 0.26 chicks hatched per nest and mean productivity was 1.48 ± 0.26 chicks fledged per pair. We recorded provisioning and attendance behavior of pelicans at the Deveaux Bank colony in 2008. These data are being analyzed and will be comparable to those published by Sachs and Jodice (2009) from Crab Bank. Our final objective was to determine condition and health of seabird populations. To meet this objective, we monitored health parameters of 43 nestling Brown Pelicans to establish reference values and investigate the role of ticks nestling health. The field work portion of this study was completed in October 2008. A final report was submitted in June 2010 and the dissertation is currently being prepared for defense.

Habitat use and reproductive success of Painted Buntings on golf courses in South Carolina

Principle Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Laurel Barnhill, SCDNR, Co- Principal Investigator Chris Marsh, Low Country Institute, Co-Principal Investigator Jessica Gorzo, M.S. student
Duration:	January 2008 to May 2011
Funding Source:	National Fish and Wildlife Foundation
Project Location:	Golf courses in Beaufort County
Status:	Ongoing

The Painted Bunting (*Passerina ciris*) has been placed on the Audubon WatchList due to a steady decline since 1966. The reason for the decline is unknown, but habitat loss is suspected to be the predominant factor. Painted buntings have established 2 breeding populations in the US, one in the southwest and one in the coastal southeast. The southeastern distribution ranges from southern North Carolina to northern Florida. This coastal population often uses salt marshes for foraging and nests in dense shrubbery or Spanish moss.

The lowcountry of South Carolina supports a large breeding population of Painted Buntings. This area has experienced substantial development in the form of golf courses and associated communities. Thus, shrub habitat typically used for nesting by Painted Buntings is being removed and altered, and wetland systems often used for foraging are being modified. This changing landscape presents management concerns for Painted Bunting populations.

During the breeding season of 2008 and 2009, we searched Spring Island and Chechessee Creek Club in Okatie, SC for nests. Once found, nests were monitored until they succeeded or failed. We recorded signs of success or failure, nest height, nest plant species, and GPS location. During these two seasons we located 18 nests. Of these, 13 were located in shrub habitat and the remainder in trees. Three nests occurred in clumps of Spanish moss. Most nests were located during incubation and most failed although causes of failure were difficult to document.

During the 2010 breeding season, we surveyed the breeding bird community of 24 golf courses along the coast from Beaufort to Hilton Head, SC. On each golf course, point counts were conducted on a 440m grid with 200m detection radius. Points were selected for use if any portion of in-play area of the golf course fell within the 200m radius of the point. There, all birds seen and heard were tallied. Each course was surveyed twice in a morning, and twice throughout the season. Upcoming analyses will use GIS data to examine point- and golf course-scale landscape characteristics with respect to the breeding bird community. Painted buntings will receive special focus in our results. We will assess vegetation characteristics with presence/absence of painted buntings and additional species of concern, thus lending insight to possible land management techniques for southeastern coastal golf courses.

Enhancing productivity of American Oystercatchers in Cape Romain National Wildlife Refuge

Principle Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator Felicia Sanders, SCDNR, Co- Principal Investigator Samantha Collins, M.S. student
Duration:	January 2010- December 2011
Funding Source:	USFWS, SCDNR
Project Location:	Cape Romain National Wildlife Refuge
Status:	Ongoing

Cape Romain National Wildlife Refuge (CRNWR) supports abundant populations of nesting shorebirds and is a critical breeding and wintering region for the American Oystercatcher (*Haematopus palliatus*). The American Oystercatcher appears to be experiencing declines in nesting numbers throughout the southern portion of its range. The purpose of this study is to assess techniques that might enhance reproductive success or oystercatchers and identify factors that affect nest survival in oystercatchers.

We monitored 134 nests of American Oystercatchers within three study areas; Lighthouse Island, Southwest Bulls Bay (SWBB), and along the Atlantic Intracoastal Waterway (AICW). Nests were monitored from 5 April through 31 July 2010. Nest status was checked every three days in SWBB and the AICW and 2x/week at Lighthouse Island. Nests were monitored until they failed or until chicks fledged and we attempted to determine causes of failure. These data will be comparable to those collected by Thibault et al. from 2006-2008 in the same region. We also conducted behavior and attendance surveys at nests during the incubation and chick rearing stage along the AICW and in SWBB. These surveys were typically one hour in duration and occurred during the low tide period. During the 2010 field season, 52 incubation and 18 chick rearing surveys were conducted between SWBB and along the AICW.

A primary goal of this study was to assess the feasibility of using artificial incubators to hatch oystercatcher eggs and essentially ‘head-start’ chicks. This method is being tested because previous data have demonstrated substantial loss of productivity during incubation to predation and flooding. We assigned nests in SWBB and the AICW to either a ‘headstarting group’ or ‘control group’. For headstart nests, eggs were removed for artificial incubation and replaced with wooden decoy eggs. Upon hatching, chicks were returned to the nest. Control nests were not manipulated. We located 61 nests on the AICW and collected 34 eggs from 30 of these nests for headstarting. In SWBB we located 36 nests and collected 19 eggs from 18 of these nests for headstarting. No nests were headstarted at the Lighthouse Island study site. Preliminary analyses are being conducted and an annual report is being prepared.

Double-crested Cormorants as agents of change in ecosystems

Principle Investigators:	Patrick Jodice, SCCFWRU, Principal Investigator William Bowerman, Clemson University, Co-Principal Investigator Kate Sheehan, Ph. D student
Duration:	June 2009 to December 2013
Funding Source:	Seeking funding
Project Location:	Voyageurs National Park, MN Chippewa National Forest, Walker, MN Waconia Lake, Waconia, MN Lake Guntersville State Park, AL Santee State Park, SC Clemson University Aquaculture Facility, Clemson, SC Others
Status:	Ongoing

Colonies of migratory birds can influence the function, health, and quality of ecosystems. The redirection of cycling nutrients coupled with the high metabolic turnover of endothermic apex predators can result in restructuring of aquatic ecosystems. An avian migrant of particular concern in northern nesting locations and southern wintering colonies is the double-crested cormorant. Large and dense colonies of cormorants have been shown to affect natural aquatic ecosystems by deforesting waterfronts, preying upon commercially important fishes, and impacting water quality where they roost and forage. In synthetic ecosystems (aquaculture fisheries), cormorants have been shown to prey upon commercial fish stocks and perhaps contribute to disease transmission.

This project seeks to examine the effects of cormorants on natural aquatic ecosystems across trophic levels. To do this, we are conducting field surveys that monitor environmental variables, community composition, nutrient concentration, and trophic food web interactions. Additionally, we are examining changes in the prevalence of diseases and parasites within the community as changes in parasite communities can indicate deviations in food web stability and/or act as biomarkers of environmental change. We are thus implementing a novel, yet broad-scale study to evaluate the impact of double crested cormorants on the ecosystems where they nest (sites in MN) and winter (sites in the southeastern US).

To complement the field surveys being completed on a seasonal basis, we will also be implementing a synthetic ecosystem study at the aquaculture facility on the Clemson University campus. In this experiment we will simulate trophic alterations through the removal of specific size classes of fish and duplicate effects of nutrient reallocation through the use of fertilized treatments. This semi-controlled environment will be sampled more frequently (monthly) than the field sites, and thus, will allow us to more clearly establish the dynamics of community change effected by colonial birds like the double-crested cormorant. To complete this experiment, a Creative Inquiry class will be assembled. This will allow undergraduate students the opportunity to learn the theories and techniques used in community ecology, while providing personnel support and funding for this research.

Projects in Fisheries Science

Jim Woodruff Dam, Apalachicola, River, FL

Population size and passage efficiency of Alabama shad reaching Jim Woodruff Lock and Dam, Florida

Investigators:	J. Jeffery Isely, SCCFWRU, Principal Investigator Shawn Young, Post-Doctoral Research Assoc.
Duration:	January 2009 – July 2010
Funding Source:	Georgia Department of Natural Resources
Project Location:	Apalachicola River, Florida
Status:	Ongoing

Historically, the Apalachicola River supported large runs of anadromous fish. The creation of Lake Seminole and subsequent flow alterations to the system significantly altered population characteristics and species distributions. Currently, it is believed that Jim Woodruff Lock and Dam on the Apalachicola River serves as a significant barrier to migration of anadromous fishes. Researchers have documented the failure of the navigation lock to pass some fish, as well as spawning activity by Gulf sturgeon in the tailrace of the dam. In this study, we estimated the population size of migrating Alabama shad below JWLD in the Apalachicola River located in the central panhandle of Northwest Florida near the Georgia border using mark recapture and relative abundance techniques. The number of marked fish will be was adjusted for tag loss, emigration and mortality. The population size of migrating Alabama shad near JWLD was estimated at 5,286 (95% C.I. = 1,674 - 10,428) in 2009. The current population size of Alabama shad reaching Jim Woodruff Lock and Dam is relatively small when compared to both current and historic estimates of American shad population size along the Atlantic coast. We also evaluated the effectiveness of the navigational lock at JWLD for upstream passage of Alabama shad using fixed-station telemetry. About 18% of Alabama shad implanted with sonic transmitters abandoned their spawning migration. Passage efficiency of the remaining study fish was 59%. We conclude that the navigational lock at JWLD can be effective in passing migrating Alabama shad.

Age, growth, mortality and abundance of Lake Sturgeon in the Grasse River, New York

Investigators:	J. Jeffery Isely, SCCFWRU, Principal Investigator Drew Trested, Ph.D. student
Duration:	January 2007 - May 2010
Funding Source:	Unfunded
Project Location:	Massena, New York
Status:	Ongoing

The Grasse River population of lake sturgeon *Acipenser fulvescens* is one of a few populations in New York State where recruitment has been documented. Little is known about the current condition of the Grasse River lake sturgeon population. The purpose of our study was to assess the current status of lake sturgeon in the Grasse River system, specifically age, growth, mortality and abundance. We determined age for 196 of 211 lake sturgeon captured from the Grasse River, New York, by examination of sectioned pectoral fin rays. Ages ranged from 0 to 32 years and the annual mortality rate for fish between ages 7 and 17 was 9.9%. The weight (W, g) to total length (TL, mm) relationship was $W = 1.281 \times 10^{-6} TL^{3.202}$. The von Bertalanffy growth equation for total length was $TL = 2{,}049(1 - e^{-0.0258(t+10.3103)})$. While the range of observed ages was similar to that of nearby St. Lawrence River populations, mean weight at age for an individual at 1,000 mm TL was lower than that observed for lake sturgeon within Lake Saint Francis of the St. Lawrence River. Predicted growth based on von Bertalanffy parameters for the Grasse River yielded similar values to those observed for Lake Saint Francis lake sturgeon. An open population estimator using the POPAN sub-module in Program MARK produced an abundance estimate of 793 lake sturgeon (95% CI = 337 to 1,249). Based on our current abundance estimate, range of year classes and mortality rate, the Grasse River lake sturgeon population appears to be sustainable under current system conditions.

Peer Reviewed Publications *(* denotes graduate student advisee)*:

Eggert, L.M.F. *, P.G.R. Jodice, K.M. O'Reilly. 2009. Stress response of Brown Pelican nestlings to ectoparasite infestation. General and Comparative Endocrinology. 166: 33-38.

Hand, C.*, F. Sanders, P.G.R. Jodice. In Press. Foraging proficiency during the nonbreeding season in a specialized forager: Are juvenile American Oystercatchers (*Haematopus palliatus*) 'bumble-beaks'* compared to adults? Condor.

Jodice, P.G.R., and R.M. Suryan. In Press. The transboundary nature of seabird ecology. In Landscape Scale Conservation Planning (R. Baldwin and S. Trembulak, eds.). Springer Verlag.

Meehan, K.*, P.G.R. Jodice. 2010. Landscape scale correlates of fox squirrel (*Sciurus niger*) presence on golf courses in coastal South Carolina. Southeastern Naturalist 9: 573-586.

Peden-Adams, M.M., J.E. Stuckey, K. Gaworecki, J. Berger-Ritchie, K. Bryant, P.G.R. Jodice, T.R. Scott, S. Boone, W.D. McGuinn, J.C. DeWitt, D.E. Keil. 2009. Developmental toxicity in white leghorn chickens following i*n ovo* exposure of perfluorooctane sulfonate (PFOS). Reproductive Toxicology 27:307-318.

Sachs, E.*, P.G.R. Jodice. 2009. Behavior of parent and nestling Brown Pelicans during early brood-rearing. Waterbirds 32:276-281.

Thibault, J.*, F. Sanders, P.G.R. Jodice. In Press. Parental attendance and brood success in American Oystercatchers. Waterbirds.

Wickliffe, L.C.*, P.G.R. Jodice. 2010. Abundance of nearshore seabirds at shrimp trawlers in South Carolina. Marine Ornithology 38: 31-39.

Presentations at Scientific Meetings:

Invited Seminars

Jodice, P.G.R. 2010. South Carolina seabird colonies - longterm trends and recent explorations of reproductive and foraging ecology. Department of Wildlife Ecology, University of Maine, Orono, Maine.

Invited Presentations

Jodice, P.G.R., W. Mackin, J.A. Arnold, R. Phillips. 2009. Movement patterns of Audubon's Shearwaters breeding in the Bahamas. Atlantic Seabird Symposium, Waterbird Society Annual Meeting, Cape May, New Jersey.

Jodice, P.G.R., L.C. Wickliffe*, E.B. Sachs*. 2009. Investigating the relationship between breeding seabirds and commercial shrimp trawlers in nearshore waters of South Carolina, USA. Atlantic Seabird Symposium, Waterbird Society Annual Meeting, Cape May, New Jersey.

Contributed Papers / Presentations / Posters

Brooks, G.*, F. Sanders, P.G.R. Jodice. 2009. Preliminary investigation of factors influencing hatch success of beach-nesting birds within Cape Romain National Wildlife Refuge, South Carolina. Waterbird Society Annual Meeting, Cape May, New Jersey [Poster]

Eggert, L.M.F..*, P.G.R. Jodice. 2009. Intertidal habitat use by birds on a coastal island. Waterbird Society Annual Meeting, Cape May, New Jersey

Eggert, L.M.F..*, P.G.R. Jodice, J.R. Speakman, P. Redman. 2009. Energetics of Black Skimmer nestlings. Waterbird Society Annual Meeting, Cape May, New Jersey [Poster]

Eggert, L.M.F..*, P.G.R. Jodice, F. Sanders, G. Brooks. 2010. Conservation challenges and successes for seabirds in South Carolina, USA: Importance of longterm monitoring and research partnerships. First World Seabird Conference, Victoria, British Columbia, Canada.

Eggert, L.M.F..*, P.G.R. Jodice. 2010. Intertidal habitat use and management of seabirds on a coastal island in South Carolina. Pacific Seabird Group Annual Meeting, Long Beach, California

Jodice, P.G.R., L.C. Wickliffe*, E.B. Sachs*. 2009. Seabird use of discarded bycatch from shrimp trawlers: what's on the menu and who's buying? International Marine Conservation Congress, Fairfax, Virginia

Jodice, P.G.R., W. Mackin, J.A. Arnold, R. Phillips. 2010. Movement patterns of Audubon's Shearwaters and White-tailed Tropicbirds as determined by geolocators. First World Seabird Conference, Victoria, British Columbia, Canada

Sheehan, K.*, P.G.R. Jodice. 2009. Impacts of Avian Induced Eutrophication on Parasites. Waterbird Society Annual Meeting, Cape May, New Jersey

Graduate Theses and Dissertations, Clemson University:

Jessica Lucas, Dept. Forestry and Natural Resources, M.S. Wildlife and Fisheries Biology, 2009: *Roosting and Foraging Ecology of Rafinesque's Big-eared Bats in the Congaree National Park* (Advisor: Jodice, Co-advised w/ Dr. S Loeb USFS)

Drew Trested, Dept. Forestry and Natural Resources, Ph.D. Wildlife and Fisheries Biology, 2009: *Biology and Ecology of the Lake Sturgeon (Acipenser fulvescens) in the Grasse River, New York* (Advisor: Isely)

Beth Wrege, Dept. Forestry and Natural Resources, Ph.D. Wildlife and Fisheries Biology, 2009*: Characterization of Gulf Sturgeon Diel and Seasonal Activity in the Pensacola Bay System, Florida* (Advisor: Isely)

Teaching:

Patrick Jodice
WFB 861, Wildlife Energetics, Fall 2010, 2 credits
WFB 861, Foundations of Ecology, Fall 2009, 3 credits

Graduate Committee Service:

Patrick Jodice
7/09 – present: Lindsay Moore, Dept. Forestry & Natural Resources, Ph.D. Clemson University
3/09 – present: Sarah Latshaw, Environmental Studies Program, M.S., College of Charleston
1/09 – present: Cady Etheredge, Dept. Forestry & Natural Resources, Ph.D. Clemson University
9/07 – present: Michael Waller, Dept. Forestry & Natural Resources, M.S., Clemson University
7/09 – 4/10: Katie Snipes, Environmental Studies Program, M.S., College of Charleston
1/08 – 2/10: Amanda Hackney, Dept. Forestry & Natural Resources, M.S. Clemson University

Professional and Faculty Service:

Patrick Jodice
Chair, Scientific Program, First World Seabird Conference
Member, International Steering Committee, First World Seabird Conference
Executive Council, Waterbird Society (Elected)
Incoming Chair, Pacific Seabird Group (Elected)
Team Leader, Individual Tracking Studies, Atlantic Marine Bird Conservation Cooperative
Facilitator, Dept. Forestry and Natural Resources Seminar, Clemson University
Chair, Publication Committee, Pacific Seabird Group
Strategy Team Member, South Atlantic Regional Research Project
Co-chair, Atlantic Marine Bird Symposium, Waterbird Society Annual Meeting
Internal Reviewer, Promotion and Tenure Committee, Clemson Univ.

Jeff Isely
Member, Robust Redhorse Conservation Committee
Member, SACS Assessment Committee for the Ph.D. Degree Program in WFB
Faculty Advisor, Clemson Student Subunit of the American Fisheries Society
Member, Annual Meeting Oversight Committee, American Fisheries Society

22 Years of Service

South Carolina Cooperative Fish & Wildlife Research Unit
(Est.1988)

Leaders
Bob Trost, 1988-1990
David L. Otis, 1991-2001
Craig Allen, 2002-2004
Patrick G. Jodice, 2004-2007
(Acting Leader)
John Jeffery Isely, 2004-2007
(Acting Leader)
Patrick G. Jodice, 2007-present

Assistant Unit Leaders
Sue Haig, 1989-1994
John Jeffery Isely, 1992-2010
Craig R. Allen, 1998-2004
Patrick G. Jodice, 2002- 2007

Administrative Assistant
Betsy Clement, 1989-1997
Carolyn Wakefield, 1997-present