

South Carolina Cooperative Fish and Wildlife Research Unit

*Report of Activities
2005-2006*

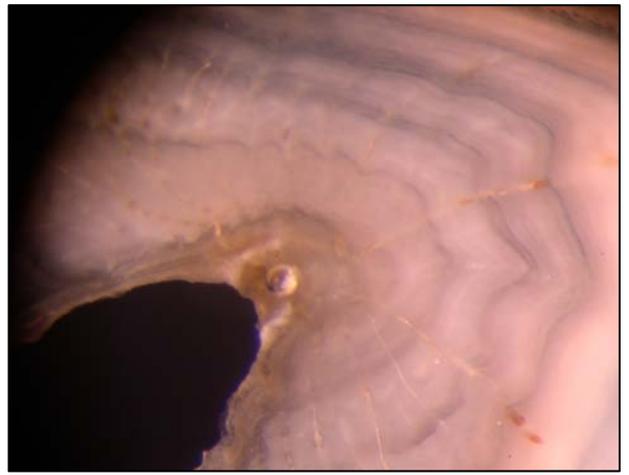
*Cooperating Agencies
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South Carolina Department of
Natural Resources
Clemson University
Wildlife Management Institute*

*South Carolina Cooperative Fish
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American Oystercatcher chick and egg, Cape Romain NWR (see P 26)



Annuli on a carp spine (see P 13)



Quilback from Apalachicola River, FL (see P 9)



Brown Pelican attending chicks at Crab Bank, Charleston Harbor, SC (see pp 23,27, & 29)



Rafinesque Big-eared bat, Congaree NP (see P 25)



Nuptial tubercles on a spotted sucker (see P. 9)

Front Cover (top to bottom): Kate Manry, Ph.D. student, surveying for Carolina bogmint in the Congaree National Park. Jeff Isely, Asst Unit Leader, with a Gulf Sturgeon on the Apalachicola River. Ben Harris, Student Conservation Assoc. Intern, banding American Oystercatchers.

*USGS South Carolina
Cooperative Fish and Wildlife Research Unit*

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Cooperating Agencies

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US Fish and Wildlife Service*

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South Carolina State Ports Authority
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Shawn Young (Isely)

Projects in Fisheries Science



Jeff Isely implanting a sonic transmitter in an Alabama Shad

Behavior of adult striped bass in relation to hydroelectric operations

Principle Investigators: J. Jeffery Isely, SCCFWRU
Shawn P. Young, Ph.D. candidate
Duration: May 2002 - December 2005
Funding Source: S.C. Cooperative Fish and Wildlife Research Unit
US Army Corps of Engineers
Project Location: J. Strom Thurman Reservoir, Calhoun Falls, SC
Status: Completed

We conducted telemetry studies of adult striped bass during the summer of 2003 and 2004 to relate summer diel movement of adult striped bass to diel changes of water quality within the tailwater during normal power generation and during current pumped-storage operation at Richard B. Russell Dam, J. Strom Thurmond Reservoir, South Carolina-Georgia. We also monitored environmental conditions, temperature and dissolved oxygen, to evaluate the affect of current pumped storage on tailwater habitat. Preliminary results indicate no significant differences in movement or summer distribution, between the daily periods of no generation, hydro-electric generation, and pumped-storage. Overall daily activity was significantly greater during continuous 24-hr telemetry than daily activity reported for telemetry performed on a bi-monthly basis. There was no conditioned response to the daily flow-regime from hydroelectric discharge. A high proportion of striped bass utilized the tailwater as a summer seasonal refuge or made periodic excursions into the tailwater throughout the summer, showing no apparent avoidance of pumped-storage operations. The use of pumped storage raised minimum water temperatures 2-3°C in the tailwater during summer compared to previous summers with no pumped-storage. However, the temperature increase did not raise water temperatures outside the range considered optimal for striped bass habitat.

Spatial and temporal habitat segregation by spawning fishes in the Savannah River, South Carolina and Georgia

Principle Investigators: J. Jeffery Isely, SCCFWRU
Tim Grabowski, Ph.D. candidate
Duration: May 2002 - December 2005
Funding Source: S.C. Cooperative Fish and Wildlife Research Unit
U.S. Fish and Wildlife Service
US Army Corps of Engineers
Project Location: Savannah River, North Augusta, SC
Status: Completed

Six catostomid species including the imperiled robust redhorse inhabit the lower Savannah River. Each of these species is dependent to differing degrees upon main channel gravel bars for spawning substrate. Catostomids in the lower Savannah River have ready access to only two main channel gravel bars. Despite the importance of these features, little is known about how the different species utilize gravel bars. We used visual observation, prepositioned grid electrofishers, and drift nets to determine the degree of spatial and temporal segregation in the use of this habitat. We were able to evaluate spawning activity in three species: spotted sucker, notchlip redhorse, and robust redhorse. No temporal overlap was observed in habitat use by adult fishes. Adults of a given species were present on the bar for discrete periods of time (approx. 15-21 days) followed by a lapse of 14-20 days with no spawning individuals observed. Different species showed a high degree of spatial overlap on the gravel bar with similar requirements of substrate and flow. Our preliminary conclusion is that no interference occurs among species and other factors such as habitat availability and density dependent effects, such as egg predation and intraspecific nest superimposition, may be effecting catostomid populations.

Behavior of post-tournament released striped bass

Principle Investigators: J. Jeffery Isely, SCCFWRU
Shawn P. Young, Ph.D. candidate
Duration: May 2004 - December 2005
Funding Source: S.C. Cooperative Fish and Wildlife Research Unit
Project Location: J. Strom Thurman Reservoir, Calhoun Falls, SC.
Status: Completed

Recently, new opportunities to study post-tournament dispersal and post-tournament live-release behavior of striped bass have come about due to a shift from harvest-oriented to live-release fishing tournaments. We initiated a telemetry study in November 2004 at J. Strom Thurmond Reservoir, SC-GA, to quantify striped bass dispersal from tournament weigh-in sites; striped bass dispersal to original capture sites; and long-term post-tournament survival (> 120 d). Preliminary results indicate that 80% of live-released striped bass survive capture, transport, and transmitter implantation. Striped bass disperse from post-tournament release sites within 7d. However, none of the study fish has returned to their original capture site.

Spawning chronology of native and introduced striped bass in two Gulf of Mexico drainages

Principle Investigators: J. Jeffery Isely, SCCFWRU
Matthew Noad, M.S. student
Duration: December 2004 - May 2007
Funding Source: Georgia Department of Natural Resources
U.S. Fish and Wildlife Service
Project Location: Apalachicola and Ochlockonee Rivers
Status: Ongoing

We investigate the potential for temperature to serve as a mechanism for maintenance of reproductive isolation in a sympatric population of Atlantic and Gulf striped bass in the Apalachicola and Ochlockonee rivers, Florida. Adult striped bass ($n=66$, mean weight = 8.3 kg, mean total length = 780.6 mm) were collected from February to May below JWLD, on the Apalachicola River, and below JBL on the Ochlockonee River, Florida. Ancestry (Gulf or Atlantic) of specimens was determined using three diagnostic microsatellite loci: *SB 20*, *SB 1021* and *SB 111*. There was no difference between mean dates of arrival for female striped bass between strains within years. The mean date of first arrival for either strain of striped bass differed between 2003 and 2005. A comparison of the mean arrival temperature for Atlantic and Gulf striped bass also showed no difference within years. It is possible that the genetic introgression of Atlantic alleles has been so great that any difference in spawning temperature preference between strains that might have existed historically has been lost. Additional genetic material will be collected to increase sample size and evaluate year-class effects.

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

Principle Investigators: J. Jeffery Isely, SCCFWRU
Travis Ingram, M.S. student
Duration: January 2006 - May 2007
Funding Source: Georgia Department of Natural Resources
Project Location: Apalachicola River, FL
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 was adjusted for tag loss, emigration and mortality. The population size of migrating Alabama shad near JWLD was estimated at 26,029 (95% C.I. = 15,174 - 49,040) in 2005 and as 972 (95% C.I. = 270 - 9,720) in 2006. Due to the small sample size, a relative abundance method was used to independently estimate a population size of migrating Alabama shad near JWLD in 2006 at 7,757 (95% C.I. = 5,987 – 11,012). 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 and fecundity of Alabama shad in the Apalachicola River, Florida

Principle Investigators: J. Jeffery Isely, SCCFWRU
Travis Ingram, M.S. student
Duration: January 2006 - May 2007
Funding Source: Georgia Department of Natural Resources
Project Location: Apalachicola River, FL
Status: Ongoing

Age and growth of Alabama shad *Alosa alabamae* were estimated by examining scales and otoliths from 203 adult fish collected on their spawning run in the upper Apalachicola River from 2005 and 2006. Ages of Alabama shad ranged from 1 – 4 years. All sampled spawning males were between 1 and 3 years old, whereas females were 2 - 4 years of age. Scales and otoliths both gave similar age estimates. Although otoliths are the preferred aging structure, scales can be removed in the field without sacrificing the specimen. Age distributions from this study differed from those of previous studies for both males and females. Female Alabama shad, on average, were found to be larger than males at age 2 and age 3. Growth of male and female Alabama shad is best described by the equations: $L_t = 359.6 [1 - e^{-2.1712(t-0.3757)}]$ and $L_t = 389.5 [1 - e^{-2.3193(t-0.6424)}]$. Mean back-calculated lengths were similar to those of observed values for males and females. Alabama shad demonstrated a positive correlation of length to fecundity, with fecundity estimates ranging from 26,095 to 208,494 eggs per female. Fecundity estimates appeared similar to other studies from the Apalachicola River. Variations in fecundity estimates may be contributed to partial spawning. Gonosomatic indices of female shad ranged from 3.6 – 24.0. In contrast to earlier studies, no spawning marks were found on scales.

High-resolution stratigraphy at a coastal drillhole determined from a continuous core profile and a borehole geophysical log

Principle Investigators: J. Jeffery Isely, SCCFWRU
Beth M. Wrege, Ph.D. student
Duration: August 2006 - December 2009
Funding Source: Department of Defense
U.S. Geological Survey
Project Location: Cherry Point Marine Corps Air Station
Status: Ongoing

Lithologic descriptions of continuous core interpreted in conjunction with borehole geophysical logs were used to establish high-resolution hydro- and geostratigraphic profiles and to determine thicknesses of hydrologic and geologic units at CR-622 in the coastal plain of North Carolina. Borehole geophysics was used to adjust the position of core loss within each cored interval, and to supplement lithology to determine the stratigraphy of missing segments of core. The normal section with generalized depths has been translated to a stratigraphic profile which includes the hydrologic units, the apparent geologic formations and photographs of the core representing the principle component found at that depth. The surficial aquifer has some small inclusion of clay, and is thinner here than anticipated. The Yorktown confining unit rests on an unconformity, distinguishing the aquifer from the aquitard and corresponding to the geologic units. Borehole geophysics identified this anomaly which might have otherwise been missed. The Pungo River aquifer immediately overlies the upper Castle Hayne confining unit. The Castle Hayne confining unit is comprised of the Pungo River Formation. In other areas of the Coastal Plain, the lower part of the Pungo River Formation is a confining unit on top of the River Bend Formation and separates the Pungo River aquifer from the upper Castle Hayne aquifer. The interpretation of borehole geophysical logs in conjunction with lithology developed from continuous core can be used to produce high-resolution hydro- and geostratigraphic profiles. A resulting hydrologic and stratigraphic column of the upper Cretaceous, Tertiary and Quaternary, showing a generalized relation between geologic and hydrologic units beneath Cherry Point Air Station is presented. Present are the Yorktown, Pungo River and Castle Hayne aquifers. The geologic units are Eocene – Castle Hayne, Miocene – Pungo River, Pliocene – Yorktown, Pleistocene – James City and Flanner Beach, and the topsoil is Holocene- undifferentiated. The Oligocene – River Bend Formation is absent, and unconformity exists between the Pungo River Formation and the Castle Hayne formation. Although some geophysical logs produce non-unique lithologic solutions, a complete normal stratigraphic profile may be obtained with the addition of continuous core. Curve characteristics within geophysical logs provide precise identification of transitional sequences and can be used to calibrate lithostratigraphy.

Movement and passage of anadromous fishes at New Savannah Bluff Lock and Dam

Principle Investigators: J. Jeffery Isely, SCCFWRU
Daniel Hanks, Ph.D. student
Duration: January 2007 – August 2010
Funding Source: U.S. Fish and Wildlife Service
The Nature Conservancy
Project Location: Savannah River, Augusta, GA
Status: Initiated

Dams have served as substantial obstacles to anadromous fish migrations. However, the effectiveness of locks in facilitating up-stream passage has not been fully evaluated. Adult fishes within the vicinity of New Savannah Bluff Lock and Dam (NSBLD) low-head regulator facility on the Savannah River, will be implanted with sonic transmitters a. Movement and passage during the period of annual upstream spawning migration will be monitored. In order to facilitate fish passage, the lock will be operated at least three times per week during the spring migratory season. Lock cycles will be evaluated with and without attraction flow. Additionally, a proposed submerged fishway within the lock will be evaluated.

Projects in Wildlife & Ecological Science



Black Skimmers on Deveaux Bank, South Carolina

Cross-scale structure and scale breaks in complex systems

Principle Investigators: Craig R. Allen, SCCFWRU
Ahjond Garmestani, Ph.D. Candidate
Duration: January 1999 –December 2005
Funding Source: James S. McDonnell Foundation – 21st Research Award, Studying
Complex Systems
The Resilience Alliance
Project Location: Clemson University
Status: Completed

The representation of complex systems has focused upon their hierarchical organization and the scaling of physical, biological, ecological and social phenomena. Much attention has focused on discovering universal laws, which have provided powerful heuristics and the formalization of scaling laws. Our research has been motivated by the discovery of regular patterns of deviation from scaling laws and the continuous distributions of attributes of complex systems. These suggest that systems organize over discrete ranges of scale, and that organization abruptly shifts with changes in scale. If this is so, scaling laws serve only as the baseline from which to measure those departures, and those departures indicate 'scale breaks' (transitions) between scales of structure in complex systems. Patterns of scale breaks from a scaling law baseline may provide clues of the processes that lead to the emergence of the scaling relationships themselves.

Complex systems, such as ecosystems, urban systems, and regional economic systems, emerge unpredictably without the influence of central control but as a result of adaptive behavior by their component, interacting agents. Urban systems exhibit spatial patchiness in their social and economic infrastructure. Thus, urban systems, much like ecosystems, are subject to a hierarchy of structure and processes that govern the function and growth of cities at a variety of scales. Urban size distributions have been described by Zipf's law or the rank-size rule, which imply invariant growth processes across scales. Zipf's law predicts that city-size distributions will have a continuous distribution, and conform to the restraints of a power law. The desire to fit data to linear models obscures deviations from the broad strokes of power laws. Departures from linear relationships are indicative of important pattern that may reveal information about the organization and resilience of complex systems.

Growth and adrenocortical response of Brown Pelican nestlings in relation to ectoparasite infestation in South Carolina

Principle Investigators: Patrick Jodice, SCCFWRU
Lisa Ferguson, M.S. student
Duration: January 2004 - May 2006
Funding Source: Start-up Funds, State Base Funds
Project Location: Cape Romain National Wildlife Refuge, SC
Crab Bank, SC
Status: Completed

Coloniality is relatively common among breeding birds, occurring in 13% of avian species and over 95% of seabirds. Ectoparasite infestation is a main disadvantage of coloniality that may affect growth, survival, and condition of nestling, particularly those of altricial species. We investigated the effect of the soft tick, *Ornithodoros capensis*, on the growth rates and adrenocortical stress response of altricial Brown Pelican (*Pelecanus occidentalis*) nestlings during early development. This research was conducted over two years at three colonies in South Carolina, and also considered the effect of insecticide treatment and select ecological variables. Tick infestation levels differed between colonies but not between years. We found a positive relationship between tick infestation and growth rates and hatching success at the more infested colony. Insecticide treatment reduced tick numbers on chicks but did not have a consistent effect on growth rates. The magnitude of the adrenocortical stress response, as measured by the release of corticosterone in reaction to an acute stress regime, was greater for tick-free nestlings than for those with a moderate tick load. The average number of ticks per nestling and the distribution of parasitized nestlings differed between insecticide treated and untreated nests, though results were not consistent between colonies or years. Other variables including nest effect, hatch order, and body condition index significantly affected growth rates and corticosterone levels, and colony differences were apparent in both studies. Together, these results suggest that soft ticks are not likely the major contributor to the observed declines in nesting effort of Brown Pelicans in South Carolina. However, a slight negative impact of ectoparasites over time, especially in conjunction with other ecological stressors, could affect long-term population dynamics of Brown Pelicans. A more detailed investigation of growth, survival, and physiological condition of pelican nestlings during the extended developmental period may provide additional insight into the role of ectoparasites in this system and potential impacts to the long-term health and condition of Brown Pelicans in South Carolina.

Assessing the conservation value of golf courses for fox squirrels in coastal South Carolina

Principle Investigators: Patrick Jodice, SCCFWRU
Kristin Meehan, M.S. student
Duration: June 2004 to December 2006
Funding Source: US Golf Association via National Fish & Wildlife Foundation
Project Location: Coastal South Carolina
Status: Completed

Although declining throughout the southeast, fox squirrel (*Sciurus niger*) populations are found on some golf courses in rapidly developing coastal South Carolina. This study used 2001 National Landcover Database data to investigate the relationship between fox squirrel presence on golf courses and landscape-scale habitat features. The study was conducted within the coastal zone and coastal plain ecoregions of South Carolina. We conducted surveys for fox squirrel surveys on ca. 50 golf courses along the coast and conducted interviews with golf course staff from ca. 100 courses to determine presence or absence of fox squirrels on courses. Results indicated that the best predictor of fox squirrel presence on a course was the presence of a fox squirrel population on the nearest neighbor course, regardless of distance. Course age and the total area of undeveloped features on the course were the best predictors of fox squirrel presence on golf courses without a fox squirrel population on their nearest neighbor. This suggests that regional fox squirrel populations may be stabilized by multi-patch population dynamics. Golf course managers and other large landowners in the region are encouraged to cooperate to preserve movement corridors between habitat patches in order to allow continued fox squirrel dispersal.

Contaminant loads in eggs of Brown Pelicans from two colonies in South Carolina

Principle Investigators: Margie Peden-Adams, Medical University South Carolina
Patrick Jodice, SCCFWRU
Joyce Stuckey, M.S. student (College of Charleston)

Duration: May 2005 to August 2006

Funding Source: NOAA

Project Location: Cape Romain NWR, Crab Bank

Status: Completed

Polybrominated diphenyl ethers (PBDEs) are naturally produced by biological and chemical processes in sponges, corals, seaweed, fungi, algae and bacteria. However, in the late 1950s and early 1960s, mass synthetic production of these compounds began for inclusion in commercial products as flame retardants. Release of PBDEs may occur when waste containing PBDEs is burned, during accidental fires, during blending of PBDEs with polymers and through recycling of plastics. Once released, PBDEs are transported in the atmosphere before entering the aquatic realm where they are known to persist, bioaccumulate and biomagnify. Most of the previous studies of PBDEs in birds have used species resident in the higher latitudes, but the Brown Pelican, *Pelecanus occidentalis*, is one seabird that may serve as a useful bioindicator of PBDEs in the temperate and tropical latitudes of the Americas. Recently, concern has heightened over the South Carolina population of brown pelicans. New research has documented declines in nest counts statewide beginning in the late 1980s and continuing through 2005. Interestingly, the declines correlate with increasing usage trends in the United States of PBDEs and other contaminants of emerging concern such as perfluorinated compounds.

We collected newly laid eggs from brown pelican from two colonies in South Carolina: Crab Bank in Charleston Harbor and Marsh Island in the Cape Romain National Wildlife Refuge. Results demonstrated that brown pelicans are bioaccumulating PBDEs. The sumPBDE measurements for Crab Bank and Marsh Island of 36.854 ± 5.013 $\mu\text{g}/\text{kg}$ wet weight and 38.108 ± 7.625 $\mu\text{g}/\text{kg}$ wet weight, respectively, were approximately in the middle of the range of concentrations measured for total PBDEs in other seabirds. As with most other avian species, BDE47 is the most abundant congener. BDE209 is measurable in some eggs, but even more interesting is the importance of BDE205 to the total PBDE concentration in this species, which may be attributed to the debromination of BDE209. Few differences in congener concentrations were measured between the two colonies although the foraging areas for the two colonies during the breeding season should only overlap slightly if at all indicating a more homogeneous PBDE contamination along the coast than hypothesized. Future studies assessing PBDE concentrations along the entire South Carolina coast and in organisms from each position of the food web will help to produce a more complete picture of PBDE distribution and accumulation rates in pelican eggs.

Longterm trends in nest counts of colonial nesting seabirds in South Carolina

Principle Investigators: Patrick Jodice, SCCFWRU
Felicia Sanders, SCDNR
Tom Murphy, SCDNR
Lisa Ferguson, Ph.D. Student
Duration: June 2005 to October 2006
Funding Source: SCFWRU
Project Location: Clemson University
Status: Completed

We analyzed temporal and spatial trends in annual nest counts of Brown Pelicans (*Pelecanus occidentalis*), Royal Terns (*Sterna maxima*), and Sandwich Terns (*Sterna sandvicensis*) throughout South Carolina from 1969 through 2005. There was an increase in the number of active pelican nests from 1969 through the mid 1980s, although this was followed by a steady decline that continued through 2005. Numbers of Royal Tern nests have declined during the study period, especially since 1990. In contrast, annual counts of active Sandwich Tern nests remained relatively stable through the mid 1980s, then increased substantially and have since remained stable. During the early years of the study, a greater proportion of nests from each species occurred on colonies within the Cape Romain region, although this distribution appears to have shifted with a greater proportion of nests now occurring along the southern coast. At the statewide level and at each of the primary colonies, we observed a positive correlation in counts of Brown Pelican and Royal Tern nests. Mechanisms underlying the observed trends are unclear. We suggest that priorities for research include (1) determination of diet and foraging locales for all three species, (2) impacts of ectoparasites on condition and survival of pelican chicks, and (3) metapopulation structure of all three species. Management activities should focus primarily on protection of colony sites.

Spatial ecology of feral hogs in the Congaree National Park

Principle Investigators: Patrick Jodice, SCCFWRU
Brad Freibel, M.S. student
Duration: January 2005 to May 2007
Funding Source: Congaree National Park
Project Location: Congaree National Park
Status: Ongoing

The introduction and expansion of exotic plants and animals to new regions has generated much concern among biologists. Feral hogs are now considered a dangerous exotic because of their high destruction capability of native organisms. The species possesses the highest reproductive potential of any North American large mammal with the ability to produce 2 litters of 10 young per year in high quality habitat. Intensive eradication efforts have generally been successful at only temporarily reducing feral hog numbers. This project examines home range and habitat use of hogs in the Congaree National Park (CNP). The CNP encompasses 8,984 ha of old-growth bottomland hardwood forest and is the largest such tract remaining in the United States. The CNP is best described as a floodplain forest that experiences wet and dry periods.

Field work was conducted between April 2005 and October 2006. Feral hogs were captured in live traps located along the Congaree River and also in upland sections of the Park. A total of 115 trap nights occurred between April 2005 and April 2006 and resulted in the capture and radio collaring of 12 female and 11 male hogs. Trap success was 21% (11 out of 52 trap-nights) along the river and 19% (12 out of 63 trap nights) in the uplands. We obtained 512 relocations of radio collared individuals between April 2005 and November 2006. Preliminary analysis of home range data suggest that most individuals had relatively small ranges, typically < 200 ha. These relatively small home ranges indicate that habitat quality for feral hogs may be quite high in the CNP. Our telemetry data also demonstrated that hogs move readily between Park land and adjacent private land, and that mortality from hunting was not uncommon. Results will be considered as control programs for feral hogs are developed for the CNP.

Provisioning and attendance behavior in Brown Pelicans

Principle Investigators: Patrick Jodice, SCCFWRU
Elena Sachs, M.S. student
Duration: May 2006 to August 2007
Funding Source: SCDNR
SCCFWRU
Project Location: Crab Bank and Deveaux Bank, South Carolina
Status: Ongoing

Colonial seabirds were first surveyed intermittently along the South Carolina coast in the 1940s and select species have been monitored annually since 1969. These surveys revealed a declining trend in nest counts of Brown Pelicans (*Pelecanus occidentalis*) and Royal Terns (*Sterna maxima*) within ca. the last decade. In 2006, the South Carolina Department of Natural Resources (SCDNR) limited public access to several offshore islands that have historically provided nesting grounds for Brown Pelicans. This afforded us the opportunity to collect data on provisioning behavior for this species in the absence of human disturbance.

This project examines provisioning, chick-feeding, and attendance behavior of Brown Pelicans at two colonies. To date, research pertaining to the breeding biology of Brown Pelicans is limited. Our goal was to examine the relationship between parental effort (i.e. chick feeding and nest attendance) and the growth and survival of chicks. Field work was initiated in late May 2006. A total of 52 nests were studied during the 2006 field season on Crab Bank and Deveaux Bank. Behavioral observations began in early June and ceased in late July, once chicks were no longer able to be identified at a specific nest. We recorded frequency of feeding, nestling behavior (i.e. begging, brooding, preening, sibling aggression), adult behavior (i.e. feeding, brooding, preening, defense behavior), and adult attendance during three-hour-long observation periods.

Preliminary analysis suggests that the frequency of feeding events for both adults and chicks increases initially until chicks are approximately 24 days old, and then gradually decreases as the chicks get older. Attendance rates of adults were normal and in accordance with the natural history of the birds, but showed a significant decreasing trend with the age of the chick. We are continuing to investigate other trends in feeding, attendance, begging, and aggression rates and potential causes and effects of these results. Results will be considered in light of changing levels of human disturbance in and around colonies.

Carolina Bogmint at Congaree National Park: distribution mapping and population status assessment

Principle Investigators: Craig R. Allen, NCFWRU, University of Nebraska, Lincoln, NE
(formerly Unit Leader of the SCCFWRU)
Joan Walker, USFS
Kate Manry, Ph.D. Student

Duration: January 2004 - December 2007

Funding Source: National Park Service

Project Location: Congaree National Park

Status: Ongoing

Carolina bogmint (*Macbridea caroliniana*) is a globally imperiled plant species and federal species of concern found in the seepage forest wetland community at Congaree National Park. There are only about 30 extant occurrences of *M. caroliniana* documented world-wide with one of the largest at the Congaree National Park. Potential threats to the *M. caroliniana* population at Congaree include disturbance by wild hogs and invasion of non-native plant species. In addition, it is possible that some management activities at the park, such as boardwalk construction or maintenance, recreational use, and research activities could locally impact *M. caroliniana* occurrences.

The objectives of this research are to: 1) Develop a distribution map of *M. caroliniana* for Congaree National Park, 2) Estimate the size of the *M. caroliniana* population at the park, 3) Determine the reproductive status of the population, 4) Document specific habitat conditions in areas that contain *M. caroliniana*, 5) Identify the native and non-native plants most frequently co-occurring with *M. caroliniana*, 6) Examine the frequency, abundance, and severity of hog disturbance in *M. caroliniana* areas and the effects of hog activity on *M. caroliniana* populations, and 7) Monitor the above parameters over a three-year period.

We have completed monitoring for 2003-2005. We have created maps of *M. caroliniana* stems, hog disturbance and invasive plants for the seepage forest areas of the Park. We estimate the population to be much larger (8000-98000 stems) at one of the two forest seepage areas than at the other (150-2100 stems), although there were large fluctuations between years. Fruit sets from hand pollination treatments applied to bagged flowers at two subpopulations in the Park and on potted plants were compared with untreated bagged flowers and open pollinated flowers. We found that *M. caroliniana* has a mixed mating system; fruit was set after self pollination and outcrossing. No untreated bagged flowers set fruit; therefore *M. caroliniana* is pollinator limited. We also sampled the habitat at sites with and without *M. caroliniana* and are in the process of developing a habitat model to predict presence of this rare species. Preliminary analysis suggests that *Sphagnum* spp., *Woodwardia areolata*, *Saururus cernuus* and *Triadenum walteri* are the most common co-occurring native species and that *Murdannia keisak* is the most common co-occurring exotic species. Hogs appear to be a growing problem as more evidence of hog disturbance was recorded over the course of the three year monitoring period.

Roosting and foraging requirements of Rafinesque's big-eared bats in Congaree National Park

Principle Investigators: Susan Loeb, USFS
Patrick Jodice, SCCFWRU
Jessica Lucas, M.S. student
Duration: January 2006 to May 2008
Funding Source: National Park Service, USFS
Project Location: Congaree National Park
Status: Ongoing

Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) are considered rare throughout their range, and have a Rounded Global Status of G3, meaning they are vulnerable to extirpation or extinction. In each state of its range, Rafinesque's big eared bat is considered a species of special concern, and is possibly extirpated in Indiana and Ohio. In South Carolina, the species is considered endangered by the South Carolina Department of Natural Resources. Because roost structures are one of the most critical resources for bats, knowledge and understanding of roost requirements are critical for developing effective bat management and conservation policies. In the Coastal Plains, Rafinesque's big-eared bats use large hollow trees in bottomland hardwood forests, but much of this habitat has been destroyed through agricultural activities and urban development. Conservation of habitat that supports roost trees is important, but is difficult due to lack of knowledge regarding roosting habits and cavity requirements of this species.

The objectives for this project were to determine roost tree characteristics of Rafinesque's big-eared bats in the Congaree National Park and to determine foraging habitat requirements. In the summer of 2006 (May-August), Rafinesque's big-eared bats were tagged with radiotransmitters, and tracked to 22 roost trees, 15 male and 7 maternity. Maternity groups used trees with upper bole cavities (87.7%) significantly more often than they did basal cavities. Males used trees with basal cavities (93.3%) over trees with only upper bole cavities. Earlier studies on Rafinesque's big-eared bats found that they use both basal and upper bole cavities, but we found that maternity roosts were primarily in upper cavities whereas males predominantly used basal cavities. This suggests that the conservation of upper bole cavities may be important for this species.

Foraging data were also collected and the results are currently being analyzed. Further data collection will occur in summer 2007.

Reproductive success of American Oystercatchers in South Carolina

Principle Investigators: Patrick Jodice, SCCFWRU
Felicia Sanders, SCDNR
Janet Thibault, M.S. student

Duration: August 2005 to December 2007

Funding Source: National Fish & Wildlife Foundation, Savannah Santee PeeDee Restoration Fund
U.S. Geological Survey Cooperative Research Units
South Carolina Department of Natural Resources
Clemson University Department of Forestry and Natural Resources
USFWS Cape Romain National Wildlife Refuge

Project Location: Cape Romain National Wildlife Refuge, SC

Status: Ongoing

South Carolina supports a substantial proportion of the eastern race of American Oystercatchers, and over half of the breeding population of oystercatchers in South Carolina nest within the Cape Romain Region. The majority of oystercatchers nest on shell rakes along the Atlantic Intracoastal Waterway (AICW). Disturbance from boat traffic, storm overwash and predation of nests by mammals from the mainland are suspected causes of nest failure along the AICW. In contrast, Oystercatchers that nest in Bulls Bay, which is farther from the mainland and relatively devoid of boat traffic during the nesting season, appear to achieve higher rates of reproductive success. To date, however, quantitative data for reproductive success and reasons for failure are not available, but are needed to ascertain how the Cape Romain Region is contributing to the larger Atlantic population.

The goal of this project is to compare reproductive success of American Oystercatchers among several nesting sites. The objectives are: (1) To compare rates of hatching and fledging success along the AICW and in Bulls Bay, (2) Identify causes of egg and chick mortality within each nesting site and compare these between the AICW and Bulls Bay, and (3) Compare the percentage of time parents forage away from the nesting territory and relate that time to reproductive success. These data will allow managers to focus habitat protection in these areas. During the 2006 field season, 122 oystercatcher nests were monitored within the Cape Romain Region. Reproductive success and nest loss were recorded for each nesting attempt at each site. Additionally, 64 hour long foraging observations were conducted on breeding adults this season. Nest survival and foraging data from the 2006 season are currently being analyzed. Preliminary results suggest that reproductive success was greater within the Bulls Bay area than along the AICW, although reproductive success in both habitat types appears to be greater compared to values from NC and GA. Similar protocols will be implemented for the 2007 field season.

Foraging ecology of seabirds in relation to commercial shrimp trawler activity

Principle Investigators: Patrick Jodice, SCCFWRU
David Whittaker, SCDNR
Lisa Wickliffe, M.S. student

Duration: May 2006 to May 2008

Funding Source: SCDNR Cooperative Fisheries Program

Project Location: Nearshore waters of coastal SC

Status: Ongoing

The interactions between seabirds and commercial fisheries have received a great deal of management research attention during the past two decades. Primarily, research and management have focused on issues pertaining to bycatch related monitoring of seabirds and competition for foraged fish between seabirds and commercial fisheries. Recently, attention has been called to the potential positive impacts bycatch can have on ship-following seabirds, i.e. the role of discarded bycatch in seabird diets. Studies from Europe indicate that tens of thousands of seabirds each year may be supported by discards from a single regional shrimp fishery, and that discards from commercial fisheries may have contributed to the increase in seabird abundance and distribution in the North Sea and Northeast Atlantic. However, no evidence has surfaced stating that potentially beneficial seabird-fisheries interactions have been quantified in the southeastern United States. Off the coast of South Carolina, Brown Pelicans (*Pelecanus occidentalis*), Sandwich Terns (*Sterna sandvicensis*), Royal Terns (*Sterna maxima*), and Laughing Gulls (*Larus atricilla*) are four seabird species which nest in the area and may benefit from discarded bycatch via shrimp trawlers. However, Brown Pelicans and Royal Terns are in a period of apparent population decline for reasons which are currently unclear. Given that natural food levels are a limiting factor for reproductive success, bycatch may be providing a key food source for these declining species.

Our objectives were to (1) to determine the relative abundance and distribution of ship-following seabirds at shrimp trawlers during the late spring and summer seasons and (2) for each of the most common species collected as bycatch, determine rates of consumption by each of the most common seabird species observed foraging at trawlers.

During the 2006 field season we conducted 18 cruises on shrimp trawlers. Laughing gulls were recorded most frequently at trawlers in both regions and through all three months. Pelicans comprised ca. 9% of the seabirds counted behind trawlers with the highest number of pelicans observed in August in both Cape Romain and Charleston Harbor. Royal Terns comprised ca. 17% of the seabirds recorded and the highest numbers were observed in the month of August for both regions. Counts of sandwich terns were highly variable but accounted for the last number of seabirds counted behind trawlers. The species consistently found in the random sample of bycatch in both regions through all three months were Spot (*Leiostomus xanthurus*), Atlantic Croaker (*Micropogonias undulates*), Star Drum (*Stellifer Lanceolatus*), Ribbonfish (*Trichiurus lepturus*) and Hogchoaker (*Trinectes maculates*). The 2007 field season will provide the opportunity for a more substantial data set from both the Charleston Harbor and Cape Romain port locations.

Wintering ecology of American oystercatchers in the Cape Romain Region

Principle Investigators: Patrick Jodice, SCCFWRU
Felicia Sanders, SCDNR
Christy Hand, M.S. student
Duration: September 2006 to August 2008
Funding Source: The National Fish and Wildlife Foundation through the Savannah-Santee-Pee Dee Resource Protection Fund
Project Location: Cape Romain National Wildlife Refuge
Status: Ongoing

The Cape Romain region (CRR), which encompasses the coast of South Carolina from the northern boundaries of the Cape Romain National Wildlife Refuge to Dewees Inlet, is an important wintering area for both resident and non-resident American oystercatchers (*Haematopus palliatus*). South Carolina supports ca. 35% of the oystercatchers that winter on the east coast, and of these, ca. 50% winter in the CRR. Winter censuses suggest that the number of oystercatchers wintering in the CRR has declined by 21% over the past 14 years. The eastern race of the American oystercatcher was identified as a species of extremely high priority by the U.S. Shorebird Conservation Plan based on the small size of the population, which has been estimated to be less than 25,000 individuals, and the loss of nesting habitat. Along with poor nesting success in some areas of their range, winter mortality may be one of the causes of population decline. This study was initiated because little is known about oystercatcher foraging ecology during the non-breeding season. The identification of predominant prey items will allow agency biologists to improve management plans for oystercatchers in the CRR and throughout South Carolina.

During the 2006 field season, diet composition and foraging efficiency data was collected in Sewee Bay and in Southwest Bulls Bay. Observations were made during the period of the tidal cycle when oyster reefs were exposed on 44 days between 17 October and 18 December 2006. A spotting scope was used to observe foraging oystercatchers. Prey items were identified, and the size of the flesh that was consumed was approximated relative to bill length. Searching times, handling times, and band combinations were recorded whenever possible. Results from the 2006 field season will be analyzed during the summer of 2007. Preliminary analysis suggests that oysters made up the vast majority of prey items at both sites and during the entire study period.

Protection and management of seabird colonies in South Carolina in response to human disturbance

Principle Investigators: Patrick Jodice, SCCFWRU
Lisa Ferguson, Ph.D. student
Duration: May 2006 to May 2009
Funding Source: SCDNR
Project Location: Crab Bank, Deveaux Bank, Bird Key Stono South Carolina
Status: Ongoing

Seabirds nest in colonies on approximately nine islands along the coast of South Carolina. One of the main challenges faced by managers at these colonies is preventing disturbance to breeding seabirds caused by island visitors. Human disturbance can have numerous effects on breeding seabirds and their young. In response to disturbance in or near nesting areas entire colonies of seabirds may leave their nests and thereby expose their eggs or young to lethal temperatures and potential predators. Human disturbance is one of several factors that may be contributing to a recent statewide decline in reproductive effort of Brown Pelicans (*Pelecanus occidentalis*) and Royal Terns (*Sterna maxima*). Prior to the 2006 breeding season, SCDNR enacted new management regulations to limit public access at three nesting island and thereby reduce the impact of human disturbance. These new regulations provide additional protection of essential components of seabird breeding habitat including areas used for nesting, loafing, and feeding young. It is important to understand how habitat use and breeding performance is affected by these new conservation regulations.

The purpose of this study is to monitor seabird colonies on state lands and collect baseline measures of breeding parameters to better evaluate the health and condition of seabird populations in South Carolina in relation to new disturbance regulations and for future comparisons. This will be accomplished using the following objectives: (1) map habitat use by seabirds during the breeding season (2) measure reproductive and behavioral parameters of seabirds, and (3) determine condition and health of seabird populations. The main species of concern in this study are Brown Pelicans, Royal Terns, Sandwich Terns (*Sterna sandvicensis*), and Black Skimmers (*Rynchops niger*). Field work was initiated in 2006 (see description for Provisioning and attendance behavior in Brown Pelicans above). Efforts focused on developing survey techniques for loafing seabirds and foraging shorebirds in the intertidal zones of colony islands, testing methodologies for measuring attendance and behavior of nesting seabirds, and measuring basic reproductive parameters.

Peer Reviewed Publications:

Bettinger, J.M., J.R. Tomasso, and J.J. Isely. 2005. Hooking mortality and physiological responses of striped bass angled in freshwater and held in live-release tubes. *North American Journal of Fisheries Management* 25:1273-1280.

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Finney, S.T., J.J. Isely and, D.W. Cooke. 2006. Upstream migration of two pre-spawning shortnose sturgeon passed upstream of Pineopolis Dam, Cooper River, South Carolina. *Southeastern Naturalist* 5:369-375.

Ferguson, L.M., P.G.R. Jodice, W. Post, F.I. Sanders. 2005. Reddish Egret extends its breeding range on the North American Atlantic Coast. *Waterbirds* 28:525-526.

Grabowski, T.B., and J.J. Isely. 2005. Use of prepositioned grid electrofishers for the collection of robust redhorse broodstock. *North American Journal of Aquaculture* 67:89-92.

Grabowski, T.B., and J.J. Isely. 2006. Seasonal and diel movements and habitat use of robust redhorses in the lower Savannah River, Georgia and South Carolina. *Transactions of the American Fisheries Society* 135: 1145-1155.

Grabowski, T.B. and J.J. Isely. 2007. Spatial and temporal segregation of spawning habitat by catostomids in the Savannah River, Georgia and South Carolina, U.S.A. *Journal of Fish Biology* 70:782-7.

Isely, J.J., and T.B. Grabowski. 2007 (In Press). Age and growth. *In* M. L. Brown and C. S. Guy, editors. *Analysis and interpretation of freshwater fisheries data*. American Fisheries Society, Bethesda, Maryland.

Jodice, P.G.R., T.M. Murphy, F. J. Sanders, L. Ferguson. (In Press) Longterm Trends in Nest Counts of Colonial Nesting Seabirds in South Carolina, USA. *Waterbirds*.

Jodice, P.G.R., D.D. Roby, K.R. Turco, R.M. Suryan, D.B. Irons, J.F. Piatt, M.T. Shultz, D.G. Roseneau, A.B. Kettle, J.A. Anthony. 2006. Assessing the nutritional stress hypothesis: the relative influence of diet quantity and quality on seabird productivity. *Marine Ecology Progress Series* 325:267-279.

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Paller, M.H., D.E. Fletcher, T.A. Jones, S.A. Dyer, J.J. Isely, and J.W. Littrell. 2005. Potential of largemouth bass as vectors of ¹³⁷Cs dispersal. *Journal of Environmental Radioactivity* 80:27-43.

Paller, M.F., D.E. Fletcher, M.M. Standora, T.B. Grabowski, T. Jones, S.A. Dyer and J.J. Isely. 2006. Emigration of fish from Two South Carolina Cooling Reservoirs. *North American Journal of Fisheries Management* 26:976-982.

Sowers, A.D., D.M. Gatlin, S.P. Young, J.J. Isely, C.L. Browdy, and J.R. Tomasso. 2005. Responses of *Litopenaeus vannamei* (Boone) in water containing low concentrations of total dissolved solids. *Aquaculture Research* 36:819-823.

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Presentations at Scientific Meetings:

Invited Seminars

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Jodice, P.G.R., L.M. Ferguson, F.I. Sanders, E. Sachs, J. Thibault, L. Wickliffe, and J. Stuckey. 2006. What factors are limiting seabirds and shorebirds in South Carolina? The role of physiological and behavioral ecology to investigate population trends. Fort Johnson Marine Science Center Seminar Series, Charleston, SC.

Invited Presentations

Roby, D.D., D.E. Lyons, P.G.R. Jodice, and A. M. Myers. 2006. Whither conservation physiology: providing relevant information to managers of marine ecosystems using indicators from seabirds. The Wildlife Society, Anchorage, AK.

Jodice, P.G.R., L.M. Ferguson, F.I. Sanders, and T. Murphy. 2006. The Value of Maintaining Longterm Monitoring Programs: Revealing Trends in South Carolina's Beach-Nesting Birds. South Carolina Chapter of the Wildlife Society, Edgefield, SC.

Contributed Papers / Presentations / Posters

Denmon, P., and P.G.R. Jodice. 2005. Royal Tern Working Group: Forming a Partnership for Conservation and Management of a Royal Tern Metapopulation on the Atlantic Coast. Waterbird Society Annual Meeting, Jekyll Island, GA.

Ely, P.C., and J.J. Isely. 2007. Population size and passage efficiency of Alabama shad reaching Jim Woodruff Lock and Dam. South Carolina Fisheries Workers and Georgia Chapter American Fisheries Society joint meeting, Tybee Island, GA.

Ely, P.C., and J.J. Isely. 2007. Population size and passage efficiency of Alabama shad reaching Jim Woodruff Lock and Dam. 25th Annual *Morone* Workshop, Albany, GA.

Ferguson, L.M., P.G.R. Jodice, W. Post, and F.I. Sanders. 2005. Reddish Egret extends its breeding range on the North American Atlantic Coast. Waterbird Society Annual Meeting, Jekyll Island, GA.

Ferguson, L.M., P.G.R. Jodice, and K. M. O'Reilly. 2005. Stress Response of Brown Pelican Nestlings to Tick Infestation. Clemson University Research Forum, Clemson, SC.

Ferguson, L.M., P.G.R. Jodice, and K. M. O'Reilly. 2005. Effect of ectoparasites on corticosterone levels of Brown Pelican nestlings. Joint Annual Meeting of the Pacific Seabird Group and The Waterbird Society, Portland, OR.

Ferguson, L.M., and P.G.R. Jodice. 2006. Ticks and Chicks: Is there an effect of soft ticks on physiological condition of pelican nestlings? South Carolina Chapter of the Wildlife Society, Edgefield, SC.

Ferguson, L.M., P.G.R. Jodice, K. M. O'Reilly. 2006. Adrenocortical response of Brown Pelican nestlings to ectoparasite infestation. Pacific Seabird Group Annual Meeting, Girdwood, AK.

Friebel, B.A., and P.G.R. Jodice. 2005. Determination of feral hog movement patterns in Congaree National Park, South Carolina. Cooperative Ecosystem Studies Unit Annual Meeting.

Friebel, B.A., P.G.R. Jodice. 2006. Movement patterns of feral hogs in the Congaree National Park, South Carolina. Cooperative Ecosystem Studies Unit Annual Meeting, Clemson, SC.

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Hand, C., P.G.R. Jodice, F.J. Sanders. 2006. Foraging ecology of American Oystercatchers during the nonbreeding season in the Cape Romain Region. American Oystercatcher Working Group, Cedar Key, FL.

- Grabowski, T.B., and J.J. Isely. 2005. Savannah River robust redhorse research-final report. 11th Annual Meeting of the Robust Redhorse Conservation Committee. McCormick, SC.
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- Grabowski, T.B., and J.J. Isely. 2006. Spatial and temporal habitat segregation by spawning catostomids in the Savannah River, Georgia and South Carolina. Annual Meeting of the American Fisheries Society, Georgia Chapter.
- Ingram, T.R., and J.J. Isely. 2007. Age, growth and fecundity of Alabama shad in the Apalachicola River, Florida. 25th Annual *Morone* Workshop, Albany, GA.
- Ingram, T.R., and J.J. Isely. 2007. Age, growth and fecundity of Alabama shad in the Apalachicola River, Florida. South Carolina Fisheries Workers and Georgia Chapter American Fisheries Society joint meeting, Tybee Island, GA.
- Jodice, P.G.R, L.M. Ferguson, F.I. Sanders, and T. Murphy. 2006. Thirty years of nest count data reveal opposing trends in among pelicans and terns in South Carolina. Pacific Seabird Group Annual Meeting, Girdwood, AK.
- Jodice, P.G.R, L.M. Ferguson, F.I. Sanders, and T. Murphy. 2005. Long-term trends in nest counts of South Carolina seabirds. Waterbird Society Annual Meeting, Jekyll Island, GA.
- Lucas, J.S., S. Loeb, P.G.R. Jodice. 2006. Characteristics of Rafinesque's Big-eared Bats tree roosts in Congaree National Park. North American Symposium on Bat Research, Wilmington, NC.
- Lucas, J.S. Jodice. 2007. Natural history of Rafinesque's Big-eared Bat. Rafinesque's Big-eared Bat Working Group Meeting, Destin, FL.
- Lucas, J.S., S. Loeb, P.G.R. Jodice. 2007. Characteristics of Rafinesque's Big-eared Bats tree roosts in Congaree National Park. Southeastern Mammal Colloquium, Destin, FL.
- Meehan, K., and P.G.R. Jodice. 2006. Assessing the conservation value of golf courses for fox squirrels in South Carolina. South Carolina Chapter of the Wildlife Society, Edgefield, SC.
- Noad, M. A., and J. J. Isely. 2007. Spawning chronology of native and introduced striped bass in two Gulf of Mexico drainages. South Carolina Fisheries Workers and Georgia Chapter American Fisheries Society joint meeting, Tybee Island, GA.
- Noad, M. A., and J. J. Isely. 2007. Spawning chronology of native and introduced striped bass in two Gulf of Mexico drainages. 25th Annual *Morone* Workshop, Albany, GA.

Steinkamp, M., and P.G.R. Jodice. 2006. The Atlantic Marine Bird Conservation Cooperative: Developing Partnerships to Conserve Western Atlantic Seabirds. Pacific Seabird Group Annual Meeting, Girdwood, AK.

Thibault, J., and P.G.R. Jodice. 2006. Reproductive success of American Oystercatchers in South Carolina: Sources, sinks and traps. American Oystercatcher Working Group, Cedar Key, FL.

Weeks, K.F., J.L. Walker and C.R. Allen. Micro-habitat indicators for *Macbridea caroliniana*, a rare mint of floodplain communities. Ecological Society of America, Memphis TN

Graduate Theses and Dissertations:

Ferguson, L.M. 2006. Growth and Adrenocortical Response of Brown Pelican Nestlings in Relation to Ectoparasite Infestation in South Carolina. M.S. Degree Wildlife and Fisheries Biology, Department of Forestry and Natural Resources.

Grabowski, T.B. 2006. Spawning chronology of non-game fishes in the Savannah River. Ph.D. Degree Zoology, Department of Biological Sciences.

Meehan, K. 2006. Landscape Scale Correlates of Fox Squirrel Presence on Golf Courses in Coastal South Carolina. M.S. Degree Wildlife and Fisheries Biology, Department of Forestry and Natural Resources.

Young, S.P. 2006. Changes in habitat utilization by striped bass in J. Strom Thurmond Reservoir following artificial hypolimnetic oxygenation. Ph.D Degree Wildlife and Fisheries Biology, Department of Forestry and Natural Resources.

Teaching:

Jeff Isely

WFB840 Fish Management, Spring 2005, 3 credits

WFB861 Fish Ecology, Spring 2007, 3 credits

WFB863 Fish Age and Growth, Spring 2007, 2 credits

Patrick Jodice

WFB 861, Ecological Energetics, Fall 2005, 3 credits

WFB 861, Wildlife Health, Fall 2006, 3 credits

WFB863, Avian Survival Modeling, Spring 2007, 3 credits

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Jeff Isely

President, Early Life History Section, American Fisheries Society.

Member, Governing Board, American Fisheries Society.

Member, Management Committee, American Fisheries Society.

Member, Santee River and Coastal Drainage Liaison Committee. National Water Quality Assurance Board. 1994 - present.

Host, 28th Annual Larval Fish Conference

Member, Steering Committee, 27th Annual Larval Fish Conference.

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.

Faculty Advisor and Coach, Clemson Offshore Fishing Team.

Member, Annual Meeting Oversight Committee, American Fisheries Society.

Patrick Jodice

Founder and Facilitator, Natural Resources and Conservation Seminar, Clemson University

Facilitator, Ecology Reading Group, Clemson University

Founding Member, Atlantic Marine Bird Conservation Cooperative

Member and Webmaster, Royal Tern Working Group

Publication Committee Chair, Pacific Seabird Group

Session Leader, Marine Habitat Selection in Seabirds, Atlantic Marine Bird Conservation Workshop

Session Co-Leader, Seabird Distribution and Abundance, Atlantic Marine Bird Conservation Workshop

Student Paper Judge, Pacific Seabird Group Annual Meeting

Paper Selection Committee, Annual Meeting of The Wildlife Society

Student Paper Judge, Pacific Seabird Group Annual Meeting

Professional Awards:

Jeff Isely

Meritorious Service Award, U.S. Army Corps of Engineers, Galveston District, 2006

Clemson University Board of Directors Outstanding Achievement Award, 2006

Patrick Jodice

USGS Single Task Achievement (STAR) Award, 2006

Graduate Student Awards

Lisa Ferguson, Best Student Poster, Pacific Seabird Group & Waterbird Society, 2005

Lisa Ferguson, Graduate Student Travel Award, Clemson University, Graduate School, 2005

Lisa Ferguson, Rising Star Graduate Student Award, Clemson University, 2005

Lisa Ferguson, Bergstrom Award, Association of Field Ornithologists, 2005

Lisa Ferguson, Graduate Student Travel Award, Pacific Seabird Group, 2006

Lisa Ferguson, Wade Stackhouse Fellowship, 2006

Brad Friebel, Marion Bailey Assistantship for Research in National Parks, 2005-2006

Brad Friebel, Marion Bailey Assistantship for Research in National Parks, 2006-2007

Jessica Lucas, Marion Bailey Assistantship for Research in National Parks, 2006-2007

Kate Manry-Weeks, South Carolina Rural Rehabilitation Corp. Fellowship, 2005, 2006

Kate Manry-Weeks, Ecological Society of America Travel Award, 2006

Janet Thibault, Graduate Student Travel Award, Clemson University, Graduate School, 2005

Beth Wrege, University Fellowship recipient, Clemson University, Graduate School, 2006