

**ABSTRACTS: 29<sup>TH</sup> ANNUAL MEETING OF THE WATERBIRD SOCIETY**

**JEKYLL ISLAND, GEORGIA, 12-18 OCTOBER 2005**

**1. SUBLETHAL EFFECTS OF CHRONIC METHYLMERCURY DOSING ON THE DEVELOPMENTAL AND REPRODUCTIVE ECOLOGY OF WHITE IBISES (*EUDOCIMUS ALBUS*) (Poster)**

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Methylmercury contamination in the Everglades has been high, and field studies have suggested that it acts as an endocrine disruptor and possibly interrupts breeding in wading birds at ambient levels. Recently, industrial regulation has caused an 80-90% reduction in methylmercury in the Everglades and wading birds have responded with a three-fold increase in numbers over a five year period, implying that methylmercury consumption is affecting the breeding ecology of wading birds. Our study, using the White Ibis (*Eudocimus albus*), is designed to quantify the developmental and reproductive effects of methylmercury over a three year time period. Pre-fledgling birds (10-25 days old) were collected from the Everglades and a breeding colony in northern Florida and raised in a 13,000 sq. ft. free-flight aviary in Gainesville, FL, USA. Currently there are 168 total birds divided into four separate enclosures, each enclosure corresponding to a dosing regime (control, 0.05 ppm/day, 0.1 ppm/day, 0.3 ppm/day). Though in its early stages, methylmercury has already been associated with a reduction in food consumption. We are monitoring the fecal hormone levels of individuals for estradiol, testosterone and corticosterone over the course of their development. An experiment designed to test a dose group's foraging per unit time with varied habitat complexity is currently being implemented.

**2. DOUBLE-CRESTED CORMORANT GUANO IMPACTS ON THE NITROGEN CHEMISTRY AND FOREST COMPOSITION OF TWO ISLAND ECOSYSTEMS IN THE GREAT LAKES (Poster)**

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Half of the trees are standing dead on Epoufette Island (northern Lake Michigan) while the trees on the other half of the island are still alive. According to landowners, tree mortality occurred during a 12-15 year time period when Double-crested Cormorants, Great Blue Herons, and Black-crowned Night-Herons were nesting on the island. The objectives of this study were to determine the levels of the <sup>15</sup>N signal and C:N ratio on Epoufette Island. We use <sup>15</sup>N and C:N ratio analyses as a way to help determine if excess N was deposited by cormorants and if plants are taking it up. In addition a partial comparison was made with Green Island, a current cormorant-nesting colony. Soil as

well as foliage samples from three plant species were collected from each half of the island. All samples were returned to the lab, freeze dried, ground and analyzed. Data indicate that cormorants have increased percent N and  $^{15}\text{N}$  in the soil and plant material via deposition of guano. C:N ratios were lowered in former and current nesting locations with increased N inputs. The opposite trend was observed in an undisturbed region of Epoufette. Research conducted at another temperate forest site previously demonstrated that exposure to excessive amounts of N over fertilizes trees and increases growth decline or mortality. The degree of elevation of  $^{15}\text{N}$  at Epoufette is an indication of similar excessive N input. Therefore, cormorant and wader guano may be causing mortality to vegetation by similar over fertilization mechanisms. However, further analyses are needed to thoroughly understand this phenomenon before management or restoration can be considered at this or similar sites in the Great Lakes region.

### **3. WHY OLDER BIRDS PERFORM BETTER: A MARK-RECAPTURE MODEL FOR THE COMMON TERN (Oral)**

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A major prediction of life history theory is that reproductive effort should increase with age because of decreased future expected reproductive success. This is validated by observations that older birds have higher reproductive success than younger birds and the prediction that survival rate decreases with age. Recent work, however, provides limited support for this age-based approach to life history. An alternative "state-based" approach suggests that reproductive effort and survival are influenced by the state/quality of the individual rather than age. We use an 8-year mark-recapture data set to discriminate between these two theories using survival and breeding propensity. Quality is indexed by mean mass derived for each individual in every year from repeated mass measurements throughout the breeding season, using an automated system. Mark-recapture models illustrate higher survival and breeding propensity for better quality common terns, and no evidence of age-specific survival or breeding propensity, except among the oldest birds (18-23 years, ~3 % of study population). We suggest that the higher reproductive success of older birds commonly observed in some populations is therefore a direct result of only high quality phenotypes surviving to old age. The mean survival rate for common terns in this study was 0.92 and in most years breeding propensity was 0.95. No variation between sexes was observed.

### **4. STATUS OF THE LEAST BITTERN (*IXOBRYCUS EXILIS*) IN CANADA (Oral)**

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The Least Bittern is a secretive marshbird that nests in freshwater marshes with dense tall aquatic vegetation (generally *Typha*) interspersed with clumps of woody vegetation and open water. In Canada, this species is found from Manitoba to the Atlantic provinces with the majority of the population in southern Ontario. Information on the distribution and abundance of Least Bitterns in Canada is scarce but would appear to indicate that the breeding population has declined over several decades. The primary reason for this decline is loss of breeding habitats due to the destruction or drainage of wetlands for urbanization, industrialisation and agriculture. The total breeding population in Canada is estimated to be less than 1000 pairs. The Least Bittern is listed as a threatened species in Canada under the federal Species at Risk Act and a National Least Bittern Recovery Team has recently been formed to develop a recovery strategy and to implement recovery actions nationwide. Because most records are only presence data at selected sites, one objective of the recovery team is to augment knowledge of the species distribution and abundance in Canada and to better understand factors influencing habitat selection. Research on the breeding ecology of the Least Bittern will also be initiated in the near future along with key research questions dealing with detection probability and identification of critical habitat.

## **5. TRACKING MOVEMENTS OF AN ADULT MALE WOOD STORK (*MYCTERIA AMERICANA*) DURING THE BREEDING SEASON AT THE JACKSONVILLE ZOO AND GARDENS (Poster)**

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In June 2004, a solar-powered GPS satellite tag was mounted on a wild, adult male wood stork from a colony at the Jacksonville Zoo and Gardens (JZG). This colony has been the most productive colony in Florida for the last 3 years. Tracking the movements of this adult stork during the 2005 breeding season has helped to identify core foraging habitat used to support a nesting wood stork. GPS locations show that the stork primarily used estuarine habitat early in the breeding season, remained at the colony during nest building, and predominantly used fresh water habitat throughout the chick-rearing period. The adult returned to estuarine habitat use after chicks fledged. Satellite tracking movements show heavier use of freshwater habitat during the chick-rearing period of the breeding season. Stable isotope analysis on feathers of banded chicks at the colony indicates strong use of freshwater habitat while rearing chicks. We conclude that freshwater foraging habitat provides an important component of the resources needed to produce young in the coastal environment. Future studies involving this colony will provide better understanding of wood stork productivity and foraging activity in estuarine and freshwater habitats in natural and urban landscapes.

## **6. MARCO INLET, AN IMPORTANT COASTAL WATERBIRD SITE (Oral)**

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For 32 years coastal waterbirds have been monitored in the Marco Inlet as a part of a larger project to assess the impact of human activity. The inlet is at the confluence of three coastal passes that drain much of the local estuaries. Marco Inlet, Southwest Florida is situated north of Marco Island, Collier County, Florida and has changed considerably. Bi-weekly censuses have been conducted along a 30 km. transect that includes the inlet. During the study, birds have used five sites in the inlet for roosting, feeding and nesting; today due mostly to human factors, only one site is active. The last site to evolve; Sand Dollar Island has become one of the most important coastal waterbird locations on the west coast of Florida. Sand Dollar was designated as the Big Marco Pass Critical Wildlife Area by the State of Florida in 1988. Seventy bird species have been recorded using Sand Dollar; of these, 39 species use the island in analyzable numbers. One to two percent of the worlds Piping Plovers (from all of the five major breeding populations) winter here. Sixteen species are listed by government as needing special attention. To date 894 census have yielded a mean of 2702; range 695 - 1944, birds both wintering, summering and resident.

## **7. NOCTURNAL FORAGING ECOLOGY OF BLACK-CROWNED NIGHT HERONS IN AN URBAN ESTUARY 2002-2004 (Oral)**

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Over 1,700 pairs of colonial wading birds (e.g. herons, egrets, and ibis) breed and forage in the industrialized ecosystem of metropolitan New York City. The Black-crowned Night-Heron (*Nycticorax nycticorax*), a mainly nocturnal forager, is the numerically dominant breeding wader in these colonies, and has been undergoing population declines both locally and region-wide. My objective was to determine how Black-crowned Night-Herons (BCNH) use marine, freshwater, and terrestrial environments in this highly urbanized setting. From 2002-2004, I conducted weekly surveys on Staten Island, NY, to describe: (1) BCNH night-time abundance and foraging success in four habitat types (shoreline, salt marsh, freshwater, terrestrial); and (2) BCNH foraging flight patterns from an active breeding colony. I observed a mean of 54 BCNHs per week foraging at 35 sites on Staten Island. I found that: (1) a tradeoff existed between habitat type and foraging success; (2) individuals used different foraging techniques in different habitats; (3) activity level remained constant over the entire night cycle; and (4) the most abundant prey items available at foraging sites also made up the largest proportion of food provisioned to nestlings. Additionally, aggressive interactions between Great Black-backed Gulls and adult BCNHs during foraging flights from colonies were observed. By describing BCNH habitat use and foraging success, and developing techniques to establish a direct link between individuals and their shifting use of foraging habitats, comprehensive conservation and management plans for local wader populations can be developed.

## **8. COMPARISON OF REPRODUCTIVE SUCCESS AMONG THREE COMMON TERN COLONIES IN NORTHERN LAKE MICHIGAN, GREAT LAKES, USA (Poster)**

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Currently under special status as a threatened species in the Great Lakes Region, Common Terns (*Sterna hirundo*) are prime candidates for conservation and management programs. Threats to the population include fluctuating lake levels, predation, human activity and competition with Ring-Billed Gulls (*Larus delawarensis*). Variable colony site fidelity exhibited by terns in the Great Lakes is unlike most colonial waterbirds and is poorly understood in relationship to the selective pressures that make it an adaptable behavior. This study investigated the relationship between colony site age (fidelity) and nesting success in relation to the evolution of variable site fidelity. Based on a body of existing literature, we hypothesized that older, well-established colonies will have higher mean productivity than younger, newly established colonies. To test this, we selected three sites of different age (1, ~3, 25+ yrs), and monitored 50 randomly selected nests throughout each colony every three to five days from June 23 to July 18, 2005. During this time, we recorded clutch size, hatching success, and estimated fledging success. We analyzed the data using non-parametric tests to look for correlations between reproductive success (clutch size/ hatching rate) and colony age, as well as significant effects of presence or absence of Ring-Billed Gulls (RBGUs). Calculation of approximate initiation date indicated older colony sites are occupied earlier, but clutch size and hatching success are not higher in older colonies. Our results suggest that the presence of RBGUs has a greater impact on nesting success than colony age. We concluded that by changing nest sites frequently (variable site fidelity), Common Terns may increase their reproductive success by avoiding local threats (eg. RBGUs). While older, artificial sites may experience lower reproductive success due to higher pressure from RBGUs and predators, they offer safe refuge from changing lake levels. This study demonstrates the importance of monitoring and managing these important breeding sites for conservation of Common Terns in the Great Lakes.

## **9. FORAGING HABITAT CHARACTERISTICS OF ARCTIC AND COMMON TERNS BREEDING ON MACHIAS SEAL ISLAND, NB, CANADA. (Oral)**

**Amie L. Black\*** ([a.black@unb.ca](mailto:a.black@unb.ca)) and **Antony W. Diamond** ([diamond@unb.ca](mailto:diamond@unb.ca)), Atlantic Cooperative Wildlife Ecology Research Network, University of New Brunswick. We radio-tracked 18 Arctic Terns and 18 Common Terns nesting on Machias Seal Island (MSI) in 2005 between 29 June and 16 July to compare foraging area characteristics. Bathymetry, sea surface temperature (SST), and chlorophyll concentrations ([chl]) at feeding sites were evaluated to determine differences in Arctic and Common Tern foraging habitat. Where terns were found foraging, the mean distance from MSI and mean distance from the closest mainland point were calculated for the incubation, chick rearing and no nest stages of the breeding cycle. Both Arctic and Common Terns were

found to travel the same distance from the nesting colony to find food during all 3 stages. Between species there appears to be variation in direction traveled with respect to the nesting colony. Common Terns were tracked more often feeding inshore, closer to the mainland, and both species were found offshore. The next step is to compare the types of prey found on the feeding grounds with prey fed to chicks at the nest site.

#### **10. PRELIMINARY INVESTIGATION OF POST-BREEDING DISPERSAL PATTERNS OF AMERICAN OYSTERCATCHERS IN COASTAL VIRGINIA (Poster)**

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We color-banded 128 American Oystercatcher chicks and adults during the 2004 (n=65) and 2005 (n=63) breeding seasons on the Eastern Shore of Virginia. Ninety-seven (92 juveniles, 5 adults) individuals were banded on barrier island breeding territories while 31 (26 juveniles, 5 adults) were banded on breeding territories in the seaside and Chesapeake Bay marshes. We conducted post-breeding resighting surveys at 38 high tide roost sites within the seaside lagoon system south of Chincoteague Bay. Surveys covered 55% and 100% of these roost sites in 2004 and 2005 respectively. Of the 128 individuals banded, 33% (36 juveniles, 6 adults) were resighted at least once. Of the 65 birds banded in 2004, 17% (9 juveniles, 2 adults) were observed after mid-October indicating that a portion of the state's breeding adults and young overwinter in Virginia. Of the 36 juveniles resighted, 58% were never observed more than 5km from their natal sites while 83% of the six resighted adults were never seen more than 1.5km from their breeding territories. This suggests that for some oystercatchers post-breeding roost site selection may be influenced in part by its proximity to the individual's natal site or breeding territory. Continued and expanded oystercatcher banding and resighting efforts will further clarify post-breeding dispersal patterns and address other key issues such as juvenile survivorship and natal site fidelity.

#### **11. A PRELIMINARY MODEL OF WOOD STORK POPULATION DYNAMICS IN THE SOUTHEASTERN UNITED STATES (Oral)**

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We modeled population dynamics and extinction probabilities for the endangered wood stork using count data from synoptic aerial surveys, annual measures of productivity from throughout the southeastern U.S., and survival data from satellite-tagged juveniles. Using a simple, count-based diffusion approximation approach we were able to quantify an increasing population trend since 1976. High inter-year variability resulted in wide confidence intervals and we could not eliminate the possibility of long-term population decline in spite of recently measured population increases. We also used a stage-based population matrix model to incorporate observed differences in survival rates among age classes. Fledging success, and survival of fledglings, one, and two year-old birds were

estimated using data from the satellite telemetry study. Because the survival rates of 3-year olds and adults are presently unknown, we analyzed population dynamics over a range of these values. Long-term population growth was most sensitive to changes in adult survivorship, followed by fledgling survival and fecundity of adults. Our initial deterministic matrix model indicated that adult survival rates  $> 0.925$  were necessary to maintain a growing population. When we incorporated environmental stochasticity into our population projections, we saw a low cumulative probability ( $< 16\%$ ) of quasi-extinction ( $< 800$  breeding pairs over 100 yr) when adult survival was 0.925. When adult survival was decreased to 0.90, however, the cumulative probability of quasi-extinction within 100 years was high ( $> 60\%$ ).

## **12. FLEDGING DYNAMICS OF JUVENILE WOOD STORKS: ARE AGRICULTURAL SETTINGS ECOLOGICAL TRAPS? (Oral)**

**Rena R. Borkhataria\*** ([rrbork@ifas.ufl.edu](mailto:rrbork@ifas.ufl.edu)) and **Peter C. Frederick** ([pcf@mail.ifas.ufl.edu](mailto:pcf@mail.ifas.ufl.edu)), Dept. of Wildlife Ecology and Conservation, U Florida.

We used GPS satellite transmitters to monitor the survival and movements of juvenile wood storks from colonies in south Florida (1) and Georgia (2) in 2005. Fledging success averaged 79.5% and was similar among colonies. The time between acquiring flight capabilities and fledging (dispersing permanently from the colony) ranged from approximately 5 to 69 days and averaged 23 days. Prior to dispersal, maximum recorded flight distances from the nest ranged from 0.18 to 50.6 km ( $x = 5.7$  km). In the week following dispersal, individuals attained distances ranging from 23 to 517 km from their natal colony. Mortality during the first week of dispersal was 20%. Post-dispersal mortality for south Florida birds was particularly high. Of the 18 birds that fledged successfully, 12 died within the first 30 days and of those 12, 7 died within the first week. High mortality during this time may have been related to the use of novel and/or unsuitable habitats: prior to fledging, 81% of locations occurred in wetlands, followed by forests (10%) and open water (4%) but during the week following fledging, the proportional use of wetlands declined to 64% while the use of cultivated areas and forests increased to approximately 13% each. Cultivated areas seemed especially unsuitable for use by juvenile birds—of 9 tags recovered, 7 were found in intensively cultivated agricultural settings. These well-drained settings may have attracted birds when regional water levels were high, potentially subjecting young birds to elevated risks of starvation, predation, or exposure to toxic chemicals.

## **13. THE EFFECTS OF DISTURBANCE ON HERRING GULLS (*LARUS ARGENTATUS*) AND GREAT BLACK-BACKED GULLS (*L. MARINUS*) (Oral)**

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The effects of researchers on their study species is of increasing concern. It is important to determine whether anthropogenic effects are greater than those encountered by study species as part of their overall environment. In this study, human disturbance was studied in contrast to disturbances caused by Bald Eagles (*Haliaeetus leucocephalus*). Herring

Gulls (HERG) and Great Black-backed Gulls (GBBG) were studied on the southeastern end of Great Duck Island, Hancock County, Maine and were observed from June through July, 2005, for a total of 70 observation hours over 36 days. Behaviors were observed and recorded quantitatively before, during, and after disturbances. Indicators of disturbance included: grass pulling, fighting, and choking, calling, feeding, and brooding. Distances between the disturbance and subjects were recorded. An 8 meter radius of disturbance for HERG and a 10 meter radius of disturbance for GBBG were observed. Gull reactions to Eagle disturbances were more organized and affected the entire colony for the duration of the Eagles presence, human disturbances caused more localized and aggressive responses. Reactions to human disturbances increased the amount of time parents spent away from the nest by 60% in contrast to Eagle disturbance. Frequency of grass pulling and choking was lower during human disturbance while frequencies of fighting and strikes during flight increased during human disturbance.

#### **14. WHERE CAN A PAIR NEST AROUND HERE? HABITAT SELECTION IN THE BLACK GUILLEMOT (*CEPPHUS GRYLLE*) ON GREAT DUCK ISLAND, ME (Oral)**

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Few studies have examined habitat selection in alcids quantitatively, especially in relation to potential predators or competition. A colony of roughly 400 pairs of Black Guillemots nest on Great Duck Island in eastern Maine at the southern edge of the species' distribution. Increasing numbers of Great Black-backed Gulls *Larus marinus* have recently invaded breeding areas. All nests on the island were located and mapped using GPS and incorporated into a GIS database. Shoreline was classified into 16 categories according to rock structure and added as a GIS layer. iButton stand-alone temperature recorders were deployed in 20 nests. Multivariate statistics showed that the density of nesting burrows was negatively correlated with crevice size and positively correlated with the proportion of the shore type, boulder-slab. This shore type, although comprising less than 2% of the island, contained 37% of nesting guillemots and was also most abundant in sub-colonies of Herring Gulls *Larus argentatus* and Great Black-backed Gulls where kleptoparasitism and direct predation on guillemots occurred; preferred nesting habitat type apparently brings them into direct contact with potential threat. Sample nests in the boulder-slab shore type were significantly warmer than the outside environment and fledged more young per unit area, which may compensate for the high amount of kleptoparasitism and predation by gulls on guillemots in this shore type.

#### **15. NON-LETHAL SAMPLES PREDICT SOFT TISSUE MERCURY CONCENTRATIONS FOR TWO WADING BIRD SPECIES (Poster)**

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Mercury has been recognized as a serious threat to piscivorous birds, including endangered species such as the wood stork (*Mycteria americana*). Because of their protected status, assessments of mercury accumulation in wading birds would be facilitated by use of an easily-collected, non-invasive tissue sample (e.g., feathers). In order to be effective, this form of biomonitoring must be evaluated for its sensitivity to temporal and spatial changes in exposure and resulting accumulation. While studies comparing mercury concentrations in keratinized structures with those of soft tissues have been conducted on seabirds and waterfowl, the strength of these associations in wading birds has as yet received little attention. As part of on-going studies, we obtained 49 carcasses of juvenile and nestling wood storks and compared total mercury concentrations in the claws and breast/primary feathers to those of breast and leg muscles, liver, heart, kidney, and brain. We also compared total mercury concentrations in tissues and feathers from captive snowy egret (*Egretta thula*) nestlings fed diets containing 50 or 120 µg mercury kg<sup>-1</sup> for a period of 60 days. In both species, mercury concentrations were well correlated between soft tissues and keratinized structures. Tissue concentrations in captive juvenile snowy egrets were similar to those of the free-ranging juvenile wood storks, suggesting that the dietary doses in this experiment were environmentally realistic. Our results show that non-lethal tissue samples can be used to predict total mercury accumulation within the soft tissues of these wading birds.

## **16. LARGE-SCALE MOVEMENTS OF WOOD STORKS IN THE POST-BREEDING SEASON (Oral)**

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Early studies utilized radio and satellite telemetry to document large-scale movements of sub-adult and adult Wood Storks during the non-breeding season. Radio tracking storks breeding in east-central Georgia found these storks to move to coastal areas before moving south into central and southern Florida for the late fall/early winter months. Early satellite telemetry studies determined that storks from coastal Georgia also traveled to Florida for the cooler winter months. More recently, satellite transmitters were deployed

on Wood Storks in the Gulf Coast states to determine countries of origin of these birds. This study suggests that storks observed in eastern Mississippi originated from the southeastern U.S. and most birds observed in western Mississippi and Louisiana originated from Mexico and Guatemala. However, one stork captured in Louisiana traveled to Florida, suggesting that population mixing is occurring at some level. Wood Storks are capable of lengthy inter-regional movements in the non-breeding season with these movements presumably due to the search for quality foraging habitat.

#### **17. RECOVERY STATUS OF THE SOUTHEAST U.S. BREEDING POPULATION OF WOOD STORKS (*MYCTERIA AMERICANA*) (Oral)**

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In 1984, the U.S. Fish and Wildlife Service listed the U.S. breeding population of wood storks in Florida, Georgia, South Carolina, and Alabama as “endangered” under the ESA, due to population declines of 75 percent from the 1930s to the 1980s. In 1997, an updated recovery plan established two metrics for determining status: numbers of nesting pairs and regional productivity measured over time. Five-year averages of nesting pairs from annual aerial surveys suggest a slight increasing trend. The average number of active colonies has almost doubled and colony size has decreased. Current productivity estimates appear similar to those recorded in the 1970s and 1980s. Monitoring continues to document nesting numbers and productivity rates that are variable within and among years and within and among colonies. Variability is likely related to factors affecting the quality of local and regional nesting and foraging habitats. In 2006, the USFWS will conduct a status review to assess wood stork biology and threats to recovery. Loss of natural foraging habitat continues to be a major threat, while the effects of the increasing number of constructed wetlands and their use as foraging areas is unknown. Habitat Management Guidelines are being updated and will address: managing colony sites, controlling predation and human disturbance, and core foraging habitat issues. One of the most important recovery initiatives is the Comprehensive Everglades Restoration Plan (CERP), which has established the restoration of healthy wading bird populations as an expected benefit. It is anticipated that CERP will be a large contributing factor toward the recovery of this species.

#### **18. RED-NECKED PHALAROPES (*PHALAROPUS LOBATUS*) IN THE NORTHEAST: REPORT FROM A WORKSHOP ON POPULATION STATUS AND RESEARCH/MONITORING NEEDS (Oral)**

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Estimates of up to 2 million red-necked phalaropes once congregated in a small part of the Bay of Fundy during post-breeding migration, foraging on massive concentrations of

copepods brought to the surface by tidal upwellings. Failure of these birds to reappear after a precipitous population decline in the late 1980s has now left the status of the eastern North American population of the species in doubt. At least superficially, the situation is reminiscent of the apparent recent decline of eastern red knots, *Calidris canutus rufa*, in the Western Hemisphere. In October 2004 a workshop was convened in St. Andrews, New Brunswick, to review the evidence for population change in both phalaropes and their food resources and to chart a course for further investigation. The workshop concluded that, although small groups of red-necked phalaropes appear elsewhere in the Bay of Fundy, no concentrations comparable to those of the 1980s are known anywhere; and that the preferred copepod species has also declined dramatically between the 1980s and the present, possibly because of rising ocean temperatures. A program of bird monitoring, radio-tracking, turnover rate assessment, stable isotope analysis, and copepod monitoring in surface waters is recommended.

#### **19. BREEDING SUCCESS OF WOOD STORKS NESTING IN GEORGIA AND SOUTH CAROLINA IN 2004 AND 2005 (Oral)**

**Larry Bryan<sup>1</sup> and John Robinette<sup>2</sup>** (bryan@srel.edu), Savannah River Ecology Laboratory and <sup>2</sup> (john\_robinette@fws.gov), US Fish & Wildlife Service-Savannah Coastal Refuges.

Wood Stork breeding success was monitored during ground observations in 6 Georgia and 3 South Carolina colonies in 2004 and 2005 to examine annual variation in stork productivity. Nesting storks throughout both states were very successful in 2004, averaging  $2.3 \pm 1.0$  (SD) fledged young per nest. Storks from inland colonies produced significantly more nestlings than those in coastal colonies that year. In 2005, overall breeding success dropped significantly to an average of  $1.6 \pm 1.0$  (SD) fledged young per nest and, unlike 2004, coastal colonies were more productive than inland colonies. Success at three coastal colonies did not differ between years. Overall breeding success was likely determined by amounts and timing of rainfall and its effects on freshwater prey availability.

#### **20. AN UNEXPLORED COMPONENT OF WADING BIRD PREY AVAILABILITY: THE DISPERSAL RESPONSE OF THE SLOUGH CRAYFISH TO WATER RECESSSION (Oral)**

**Erynn M. Call<sup>1</sup> and Mark I. Cook<sup>2</sup>** (ecall@sfwmd.gov), South Florida Water Management District, <sup>2</sup> (mcook@sfwmd.gov), South Florida Water Management District

Prey availability is a critical factor limiting wading bird breeding success in the Everglades, but the mechanisms governing prey availability are poorly understood. Mounting evidence suggests that as water levels decline, fish follow water off densely vegetated ridges to adjacent sloughs where they become increasingly concentrated and vulnerable to avian predation. However, little is known of how another important prey animal, the crayfish, becomes available to wading birds. To explore this, we experimentally examined the dispersal of the slough crayfish, *Procambarus fallax*, across

the ridge and slough landscape in response to declining water levels. On the ridges, crayfish density tended to increase as water levels declined, then significantly decreased once the ridge dried. This decrease on the ridges was reflected by a dramatic increase in density in the sloughs and gator holes. Mark-recapture data reveal a similar pattern: no movement was evident when water was above the ridge, but when the ridge dried 83% of recaptured crayfish moved from ridge to slough and gator holes, only 8% moved in the opposite direction, and the remaining recaptures remained in situ. These data suggest crayfish respond to the seasonal drawdown by following water from the ridges to sloughs where they subsequently become available to foraging wading birds.

## **21. WADING BIRD FORAGING ECOLOGY IN A DISTURBED MANGROVE ESTUARY IN NORTHWEST ECUADOR: ARE COMMERCIAL SHRIMP PONDS AN ADEQUATE SUBSTITUTE FOR NATURAL MANGROVE ESTUARIES AS FORAGING HABITAT FOR EGRETS AND HERONS? (Poster)**

**Michael Cheek\*** (mchee001@fiu.edu), Biology Dept., Florida International University.

I examined the foraging ecology of a wading bird community in a disturbed mangrove estuary in northwest Ecuador, where over 21% of former mangrove habitat has been destroyed, 40% of which has been attributed to the construction of commercial shrimp ponds (CLIRSEN 1999). During the local non-breeding (October-November 2004) and breeding season (February-March 2005), I compared the suitability of commercial shrimp ponds and natural mangrove mudflats as wading bird foraging grounds by examining foraging efficiency, diet, density, prey availability, and colony flight-line directions. Over 56 hours of focal observations of foraging great (*Ardea alba*) and snowy (*Egretta thula*) egrets revealed that great egrets had greater foraging efficiency in shrimp ponds than in natural estuarine habitats, while snowy egrets exhibited greater foraging efficiency in natural mudflats. Over 85% of the prey items found in 50 snowy egret boluses were species originating exclusively from shrimp ponds. Wading bird densities were consistently greater in shrimp ponds and most birds leaving the breeding colony in the morning flew towards areas with higher concentrations of shrimp farms. Prey-base data collected from over 300 throw traps indicate that wading bird prey availability is greater in shrimp ponds. Despite the known negative environmental impacts of shrimp farming on a variety of estuarine species, several wading bird species appear to utilize shrimp ponds as the primary food source during the breeding season, indicating that these species have readily adapted to the extensive conversion of mangrove habitat within the Muisne River Estuary.

## **22. COMPARISON OF THE BREEDING OF EIDERS AT TWO NEARBY "COLONIES" (Oral)**

**John Coulson** (JohnCoulson1@compuserve.com) and **Becky Coulson**, Durham, UK. The Common Eider shows some characteristics in common with seabirds, such as longevity and a distribution restricted to a marine habitat. However, they can nest at very different densities. In one study colony, eiders nested in close proximity, and at densities comparable to some colonial seabirds. Elsewhere, they nested at low

density. This presentation compares the breeding biology on two islands where the density of breeding birds differed markedly.

### **23. WORLD CONSERVATION STATUS OF STORKS (Oral)**

**Malcolm C Coulter** (CoulterMC@aol.com) IUCN Specialist Group on Storks, Ibises and Spoonbills, Chocorua, NH.

Among 18 species of storks (plus Shoebill and Hamerkop), eight are species of conservation concern: three are near threatened (Painted Stork, Black-necked Stork and Shoebill), two are vulnerable (Milky Stork and Lesser Adjutant) and three are endangered (Storm's Stork, Oriental White Stork and Greater Adjutant). Among these eight species, seven are in Asia and one in Africa. I will present the status and threats to each of these species and put the American Wood Stork in the larger international perspective.

### **24. MERCURY CONTAMINATION IN CAVITY NESTING BIRDS ON THE CARSON RIVER, NV (Oral)**

**Christine Custer** (ccuster@usgs.gov), **Thomas Custer** (tcuster@usgs.gov), USGS, La Crosse, WI and **E.F.Hill** (ehill@nanosecond.com), Gardnerville, NV.

The Carson River Basin in Nevada is the location of the famous Comstock Lode, a gold- and silver-rich ore body near Virginia City, NV. Between 1860 and 1880, intensive ore processing resulted in about 7,500 tons of elemental mercury being lost into the Carson River. Mercury was used to recover gold and silver from the bulk ore. Swallows and other cavity nesting birds have been used to assess local contaminant exposure and effects because nest boxes can be placed in areas of concern and the birds feed near ( $\pm$  500 m) their nest boxes on aquatic insects. Nest boxes were erected in 2002 and 2003 at three sites on the Carson River, at and below the historic ore smelting areas, and at one upstream reference area. Boxes were checked weekly and the numbers of eggs and nestlings in each box were documented. Egg samples were collected during mid-incubation and nestling samples were collected when they reached 10- to 12-days of age. Mercury was elevated in egg and liver tissues along the Carson River compared to the upstream reference area. Average mercury concentrations on the Carson River ranged between 2.9 and 9.2  $\mu\text{g/g}$  dry wgt. in eggs and between 2.9 and 4.2  $\mu\text{g/g}$  in livers. Other trace elements did not differ among sites or species.

### **25. ROYAL TERN WORKING GROUP: FORMING A PARTNERSHIP FOR CONSERVATION AND MANAGEMENT OF A ROYAL TERN METAPOPULATION ON THE ATLANTIC COAST (Poster).**

**Pamela P. Denmon** (pamela\_denmon@fws.gov), U.S. Fish and Wildlife Service, Eastern Shore of Virginia National Wildlife Refuge and **Patrick Jodice** (pjodice@clemson.edu), U.S. Geological Survey, South Carolina Cooperative Fish & Wildlife Research Unit, Clemson University.

Breeding population estimates of royal terns (*Sterna maxima*) in Virginia, North Carolina and South Carolina have shown a declining trend since the 1980's. Various groups concerned with the status, conservation and management of royal terns nesting on the Atlantic Coast met in 2004. Consequently a Royal Tern Working Group was formed. Participants included biologists from the states of Maryland, Virginia, North Carolina, and South Carolina, North Carolina Audubon, The Nature Conservancy, University of North Carolina at Wilmington, Clemson University, U.S. Geological Survey and U.S. Fish and Wildlife Service. The group defined preliminary metapopulation boundaries for royal terns breeding from Maryland to South Carolina. Group objectives include coordinated monitoring, consistent banding efforts, habitat assessment, identifying research needs and obtaining funding. Prior to 2004, methods used to obtain breeding population estimates varied and were inconsistent between states. The Group's first effort resulted in a 2004 standardized nest count conducted in MD, NC, VA, SC and GA in all royal tern colonies; a total of 31,022 nests were counted. Products will include a publication on royal tern nesting demographics from Maryland, Virginia, North Carolina and South Carolina and a Royal Tern Working Group website.

## **26. MICROHABITAT SELECTION IN LEACH'S STORM PETREL (Oral)**

**Jamus Drury\*** (jdrury@coa.edu), College of the Atlantic, Bar Harbor ME.

Leach's Storm Petrel (*Oceanodroma leucorhoa*) is one of the most common of all procellariiformes nesting in the Northern Hemisphere, with numerous active colonies on all four major ocean coasts. Storm petrels nest on our Atlantic coast from Southern Labrador to Massachusetts. Like most other members of the order procellariiformes they nest in burrows or crevices in the ground, only entering or exiting the burrow at night. During June and July 2005 I surveyed a 100 x 100 m gridded area of Great Duck Island, Maine, searching for active petrel burrows. The grid was set up in an area with a range of habitats—from open meadow with scattered boulders, to dense spruce forest with minimal ground cover. Petrels chose sites with soft soil under dead branches, roots, or around/under rocks. The densest clusters of nests consisted of areas approx. 2m sq. with 4-7 breeding pairs. In a few instances two burrows were separated by less than 2 cm. Burrows in the dense woods tended to be similar in construction (0.5 –0.75 m. deep, slightly convoluted around roots and only 15-17 cm below the surface). Burrows in more open areas seemed to be slightly deeper or more convoluted. Temperature and humidity within burrows was monitored using a combination of micro sensors, and stayed constant at 98% R.H. and +/- 2 degrees C.

## **27. NEW YORK CITY AUDUBON'S HARBOR HERON SURVEYS: A SUMMARY OF TWENTY YEARS OF NESTING IN THE NEW YORK/NEW JERSEY HARBOR (Poster)**

**Susan B. Elbin<sup>1</sup>, Andrew Bernick<sup>2</sup>, Katharine Parsons<sup>3</sup>, Paul Kerlinger<sup>4</sup>, Yigal Gelb<sup>5</sup>, and Ariana Harari<sup>6</sup>** (elbin@wildlifetrust.org), NY Bioscape Initiative, Wildlife Trust; <sup>2</sup> (bernick@mail.csi.cuny.edu), CUNY-Graduate Center and NYC Audubon; <sup>3</sup> (parsonsk@manomet.org), Manomet Center for Conservation Sciences;

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New York City Audubon coordinated annual nesting surveys of colonial waterbirds on up to 17 islands in the New York/New Jersey Harbor for 20 years (1986-2005). Since 1986, nine wading bird species have bred there: Black-crowned Night-Heron (BCNH), Great Egret (GREG), Snowy Egret (SNEG), Glossy Ibis (GLIB), Cattle Egret (CAEG), Yellow-crowned Night-Heron (YCNH), Little Blue Heron (LBHE), Green Heron (GRHE), and Tricolored Heron (TRHE). BCNHs typically predominated the nesting colonies harbor, with a high count of 1343 nests in 1993 (59% of the population). Total wader breeding population ranged from 876 pairs on 3 islands (1986) to 2360 pairs on 6 islands (1991). During 2001-2005, the maximum total of waders for the harbor was 1580 pairs. The maximum species totals were: BCNHs (1024), GLIBs (329), SNEGs (217), and GREGs (214). Three islands in the Arthur Kill and Kill Van Kull supported the highest diversity of breeding species (8 species) but have virtually been abandoned since 2001. Double-crested Cormorants (DCCOs) nested in low numbers in 1986 (97 pair) on two islands, increasing and expanding their nesting to a maximum of 1203 pairs on six islands (in 2002).

## **28. VARIABLE REPRODUCTIVE SUCCESS AMONG COASTAL LEAST TERN COLONIES (Oral)**

**Greg H. Farley** (gfarley@fhsu.edu), Department of Biological Sciences, Fort Hays State University, Hays, KS and **Joseph M. O'Connell**, Long Beach, NY.

We studied Least Tern nesting ecology at four eastern Long Island, NY colonies during 2004. For comparisons, sites were paired as “small” (n=9 and 13 nests) or “large” (n=65 and 109 nests). Reproductive success varied significantly across sites due to abiotic and biotic effects. Nest scrapes contained significantly more shell and rock as compared to random sites, but these data did not correlate with success. Hatching rate ranged from 77-92% among the four sites, and a total of 211 chicks were color-banded and observed after leaving nests. Chick survivorship was estimated at various age intervals and indicated significant variation among colonies. The only island site in the study exhibited significant loss due to Great Black-backed Gull predation, with 2% of hatched chicks observed > 7 days post-hatch. The remaining sites had estimated chick survivorship for the same age of 37%, 58% and 69%, with the highest levels from the smallest colonies. Colony locations appeared similar at a large scale, but differences in site structure and size were related to overall success.

## **29. REDDISH EGRET EXTENDS ITS BREEDING RANGE ALONG THE NORTH AMERICAN ATLANTIC COAST INTO SOUTH CAROLINA (Poster)**

**Lisa Ferguson** ([lfergus@clemson.edu](mailto:lfergus@clemson.edu)), **Patrick Jodice** ([pjodice@clemson.edu](mailto:pjodice@clemson.edu)), USGS SC Cooperative Fish & Wildlife Research Unit, Clemson University, **William Post**, Charleston Museum, Charleston, SC, **Felicia Sanders** ([SandersF@dnr.sc.gov](mailto:SandersF@dnr.sc.gov)), South Carolina Department of Natural Resources.

We report the northernmost breeding record of the Reddish Egret (*Egretta rufescens*) along the North American Atlantic Coast, and the first confirmed nest of the species in South Carolina. A nest with two young chicks was discovered in early July 2004 on Marsh Island, a barrier island located within Cape Romain National Wildlife Refuge, South Carolina, USA. The nest was located on the ground within a mixed wading bird colony. Reddish Egret nestlings were last observed at approximately four weeks old. The nest represents a northward extension of ca. 450 km in the breeding range of this species and, for the U.S. Atlantic Coast, the only recorded instance of nesting north of Florida.

### **30. LANDSCAPE SUITABILITY MODELS FOR WADING BIRDS: COUPLING SMALL SCALE HABITAT MODELS WITH LANDSCAPE HYDROLOGIC MODELS (Oral)**

**Dale E. Gawlik<sup>1</sup>, Gaea E. Crozier<sup>2</sup>, and Kenneth C. Tarboton<sup>3</sup>**<sup>1</sup> Department of Biological Sciences, Florida Atlantic University, [dgawlik@fau.edu](mailto:dgawlik@fau.edu); <sup>2</sup> Division of Ecological Services, Minnesota Department of Natural Resources, [gaea.crozier@dnr.state.mn.us](mailto:gaea.crozier@dnr.state.mn.us); <sup>3</sup> Hydrologic Systems Modeling, South Florida Water Management District, [ktarbot@sfwmd.gov](mailto:ktarbot@sfwmd.gov).

Spatially-explicit hydrological and biological landscape models are powerful tools for evaluating wetland ecosystem restoration alternatives. We developed wood stork (*Mycteria americana*) and white ibis (*Eudocimus albus*) landscape suitability indices for the Everglades based on the physical processes that concentrate aquatic prey and make them vulnerable to capture by wading birds. Indices were calculated from output of a landscape hydrologic model for each 3.2 km by 3.2 km grid cell in the remnant Everglades. The wading bird suitability index for each grid cell had one function for water depth and one function for water recession rate. The index was then aggregated up to the landscape scale for each weekly time step to reflect a typical pattern of bird distributions in the landscape. The landscape suitability indices were validated by using logistic regression to relate annual summary variables from the indices to a wading bird nesting index (n = 19 years). The models classified wood stork and white ibis nesting effort correctly for 75% to 90% of the years. Prior to nesting, variability in weekly landscape suitability was more important than the absolute value. As the season progressed, nesting was positively related to the number of weeks landscape suitability was high.

### **31. ASSESSMENT AND COMPARISON OF AERIAL AND GROUND COUNT TECHNIQUES FOR CENSUSING WADING BIRD COLONIES (Oral)**

**M. Clay Green<sup>1</sup>, Margaret C. Luent<sup>2</sup>, Clinton W. Jeske<sup>3</sup>, Thomas Michot<sup>3</sup>, and Paul L. Leberg<sup>4</sup>**<sup>1</sup> Department of Biology, Texas State University - San Marcos; <sup>2</sup> Department of Biology, University of Louisiana – Lafayette; <sup>3</sup> USGS National Wetlands Research Center; <sup>4</sup> Department of Biology, University of Louisiana.



We conducted a census of wading bird colonies in southern Louisiana using aerial and ground counts in 2004-2005. Ground counts were conducted twice per season on 20-25 colonies using two observers and employing marked-subsample (Lincoln-Peterson estimator) to obtain estimated number of breeding pairs in each colony. Colony sizes ranged from less than 5 to over 500 breeding pairs with a mean estimated colony size of 176.6 (+/- 5.39) breeding pairs. Overall mean visibility bias, or the average number of breeding pairs missed, was approximately 0.18. Mean visibility bias varied with wading bird species and habitat type. We also compared colony estimates between ground counts and two aerial count methods (fixed-wing and rotary-wing aircraft). Fixed-wing counts estimated 185 percent (+/- 30.8 percent) of breeding pairs in colonies compared with rotary-wing counts. In comparison with ground counts, fixed-wing counts estimated 204 percent (+/- 31.1 percent) of breeding pairs in colonies. Variability of aerial estimates increased with colony size and with mixed-species colonies. We also presented results related to species visibility bias and its implications on precision and accuracy of wading bird colony censuses.

### **32. THE EFFECTS OF VEGETATION DENSITY ON THE VULNERABILITY OF PREY TO AVIAN PREDATION (Poster)**

**Rachael Harris\*** ([harris2@fau.edu](mailto:harris2@fau.edu)) and **Dale E. Gawlik** ([dgawlik@fau.edu](mailto:dgawlik@fau.edu)), Florida Atlantic University.

The vulnerability of prey to capture plays a fundamental role in determining overall prey availability for wading birds. Multiple environmental factors, such as structural complexity, can act to decrease prey vulnerability and thereby influence predator response. Currently, little data exist regarding how structural complexity within aquatic systems might: 1) reduce prey vulnerability to avian predation, or 2) how vegetation density might affect avian foraging success. To test the effects of vegetation density on prey vulnerability, we measured the time interval between prey captures for Snowy Egrets foraging within three prey-stocked 25m<sup>2</sup> enclosures in a shallow marsh. Vegetation densities were 0 L/m<sup>2</sup>, 2 L/m<sup>2</sup>, and 5 L/m<sup>2</sup> of submerged *Utricularia spp.* Results from a pilot study indicated that there was no significant difference in capture intervals among vegetation treatments. However, mean capture interval in treatments containing vegetation were nearly twice as long as in the open treatment, suggesting that the open treatment was a better foraging site. We also measured vegetation densities throughout the Everglades at random sites and at sites with foraging flocks of wading birds. Results confirmed that birds selected foraging sites with lower vegetation densities than random sites, again suggesting that birds viewed the open sites as higher quality. The experiment and field sampling will be replicated during a second year of study.

### **33. POPULATION TRENDS OF MARSHBIRDS OF CONSERVATION CONCERN IN MAINE (Oral).**

**Jed Hayden**<sup>1</sup>, **Frederick Servello**<sup>2</sup>, **Cynthia Loftin**<sup>3</sup>, and **Thomas P. Hodgman**<sup>4,1</sup>  
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There is concern about declines in marsh bird populations in Maine and the Northeast, but few data exist for these species. We are examining long and short-term trends of marsh bird occurrence in Maine by re-surveying 80 wetlands that were previously surveyed during 1989-1990 and 1998-2000. During May-July 2005 we conducted standardized call-response surveys for Least Bitterns (*Ixobrychus exilis*), Soras (*Porzana carolina*), Virginia Rails (*Rallus limicola*), American Bitterns (*Botaurus lentiginosus*), and Pied-billed Grebes (*Podilymbus podiceps*). In surveys of 38 sites originally surveyed in 1989-1990, we found an increase in the proportion of wetlands used by American Bitterns (26.0%,  $P = 0.005$ ) and Virginia Rails (11.4%,  $P = 0.100$ ), a decrease for Least Bitterns (37.0%,  $P = 0.001$ ), and no changes ( $P > 0.100$ ) for Soras and Pied-billed Grebes. Wetlands that had high use by Least Bitterns in 1989-1990 did not support any individuals in 2005. Use of 17 sites originally surveyed in 1998-2000 did not change for any species. Our data suggest that most of these marsh bird species have remained stable or increased over the last 15 years, except for the Least Bittern which may have declined considerably. We will be surveying additional sites in 2006 and further investigating the apparent decline of least bitterns.

#### **34. FACTORS AFFECTING PREDATION ON NESTS AND CHICKS OF BLACK TERNS (Oral)**

**Shane R. Heath** ([Shane.R.Heath.01@alum.dartmouth.edu](mailto:Shane.R.Heath.01@alum.dartmouth.edu)) and **Frederick A. Servello** ([Fred\\_Servello@umit.maine.edu](mailto:Fred_Servello@umit.maine.edu)), Department of Wildlife Ecology, University of Maine.

As with wetland-nesting waterfowl, predation is likely an important influence on nest success and chick survival in Black Terns. We identified factors affecting nest predation and determined the relative importance of predation and food provisioning on chick survival of Black Terns in Maine in 1998-2002. We measured variables related to wetland features and nest aggregation for 231 successful and 124 depredated nests at six breeding colonies. We used Akaike's Information Criterion to select among candidate logistic regression models for predicting nest predation. We constructed predator exclosures around 27 nests at three colonies and monitored chick growth and survival through fledging. We hypothesized that chick survival would be near 100% if predation was the only factor substantially limiting survival. Variables related to proximity to depredated nests consistently had the greatest influence on nest predation. Variables related to colonial nest defense, nest concealment and proximity to upland habitats had little affect on predation. Chick survival in the absence of predation was 0.92-0.94 in contrast to low estimates for unexclosed nests. Growth rates were high, and there was no evidence of differential growth with hatch order. Nest predation in these colonies appears to be primarily influenced by predator activity patterns; nest losses were highly localized and predators appeared to exhibit area-restricted search behavior. Predation was the primary influence on chick survival during 2001-2002.

### **35. CONSTRAINTS OF LANDSCAPE LEVEL PREY AVAILABILITY ON PHYSIOLOGICAL CONDITION AND PRODUCTIVITY OF GREAT EGRETS AND WHITE IBISES IN THE FLORIDA EVERGLADES ((Oral))**

**Garth Herring\*** ([gherrin1@fau.edu](mailto:gherrin1@fau.edu)) and **Dale E. Gawlik** ([dgawlik@fau.edu](mailto:dgawlik@fau.edu)), Biological Sciences, Florida Atlantic University.

Declines in breeding success and populations of wading birds in the Florida Everglades may be linked to reduced prey availability as result of historic water management practices. Understanding the linkage between prey availability and physiological condition of adults may be the key to understanding how hydrology affects nesting and population patterns in the Florida Everglades. We studied the Great Egret and White Ibis, as they represent searcher and exploiter foraging strategies and exhibit different population trends. We present results from a 2005 pilot study, focused on nesting success and chick physiological condition in response to system-wide levels of prey availability. Time to nest failure for Great Egret and White Ibis differed, averaging 44.5 days  $\pm$  5.4 SE and 30.9 days  $\pm$  0.8 SE, respectively. Chick masses increased similarly among species, while pectoral scores were significantly higher for Great Egret chicks, averaging 3.3  $\pm$  0.2 SE (Great Egret) and 2.8  $\pm$  0.1 SE (White Ibis). Physiological parameters suggested some fundamental differences between species for both mass gain (albeit non-significant) and physiological condition. Great Egret chicks tended to increase mass more acutely than White Ibis, and had higher pectoral scores. Differences were consistent with the pattern of nesting success and likely stem from the same reason, suggesting Great Egret chicks were buffered against prey availability changes.

### **36. USING MULTIPLE TISSUE STABLE ISOTOPE ANALYSES TO INFER LONG-TERM TROPHIC PATTERNS IN HIGH ARCTIC SEABIRDS (Poster)**

**Keith A. Hobson** ([Keith.Hobson@ec.gc.ca](mailto:Keith.Hobson@ec.gc.ca)), Canadian Wildlife Service, Saskatoon, Canada.

The isotopic measurement of several tissues from the same individual provides dietary and foraging location information integrated over various time periods. This approach was used to provide a year-round picture of trophic ( $\delta^{15}\text{N}$ ) and positional ( $\delta^{13}\text{C}$ ) patterns in Black Guillemot, Dovekie, Thick-billed Murre, Northern Fulmar, Ivory Gull and Glaucous gull breeding in the vicinity of the Northwater Polynya, northern Baffin Bay, in 1998. Long-term integrations were provided by bone collagen, winter diet by flight feathers, summer diet by muscle, and immediate diet during chick rearing by liver tissues. By applying the appropriate diet-tissue isotopic fractionation factors for each tissue, directly comparable isotopic data were possible. Seabirds tended to decrease their trophic level in winter and during early summer when they could use ice-associated invertebrates. Chick-rearing corresponded to the highest trophic level period. Both Glaucous Gull and Ivory Gull showed the highest trophic level as expected and are species most vulnerable to bioaccumulation of contaminants. Dovekie showed the lowest overall trophic level but this increased over the summer as they switched from *Calanus finmarchicus* to *Calanus hyperboreus*.

### **37. LONG TERM TRENDS IN RECOVERY OF COASTAL WATERBIRDS IN MASSACHUSETTS: CONSERVATION, MANAGEMENT AND STEWARDSHIP ON A LOCAL SCALE (Poster)**

**Ellen Jedrey** (ejedrey@massaudubon.org) and **Andrea Jones** ([ajones@massaudubon.org](mailto:ajones@massaudubon.org)), Coastal Waterbird Program, Mass Audubon  
Coastal Waterbird Program, Mass Audubon.

The Atlantic Coast Population of the Piping Plover (*Charadrius melodus*) was listed as threatened under the federal and Massachusetts Endangered Species Act in 1986, and the Least Tern (*Sterna antillarum*) is state listed as a species of Special Concern. In Massachusetts, both species have rebounded due to intense management and habitat protection on a local scale. For twenty years, Mass Audubon's Coastal Waterbird Program has monitored and managed populations of both plovers and terns. In 2005, we monitored approximately 45% of the Massachusetts population of Piping Plovers (228 pairs) and 45% of MA Least Terns (1200 pairs) at 91 coastal sites in mainland southeastern Massachusetts, Martha's Vineyard and Nantucket. Sites were monitored on a daily basis to document total numbers and productivity levels, and were adaptively managed through a variety of techniques, including recent successful experimentation with electric fencing around Least Tern colonies. Long-term population trends suggest numbers of plovers are currently stable, however Least Tern trends are more difficult to interpret. The Coastal Waterbird Program will be implementing future studies to more accurately determine Least Tern productivity at managed sites. We suggest that without management, research and conservation efforts on a local scale, these populations would decline.

### **38. LONGTERM TRENDS IN NESTING NUMBERS OF SEABIRDS IN SOUTH CAROLINA**

**Patrick Jodice**<sup>1</sup>, **Lisa Ferguson**<sup>2</sup>, **Thomas Murphy**<sup>3</sup>, and **Felicia Sanders**<sup>4</sup><sup>1</sup> (pjodice@clemson.edu), USGS SC Cooperative Fish & Wildlife Research Unit, Clemson University;<sup>2</sup> (lfergus@clemson.edu), USGS SC Cooperative Fish & Wildlife Research Unit, Clemson University; <sup>3</sup> (murphyt@scdnr.state.sc.us), South Carolina Dept. Natural Resources; <sup>4</sup> (SandersF@dnr.sc.gov), South Carolina Dept. of Natural Resources.

We examined nest count data for Brown Pelicans, Royal Terns, and Sandwich Terns in South Carolina from 1969 to 2005. Each of the focal species experienced a substantial trend or change in nesting numbers during the study period. Nest counts of Brown Pelicans increased ca. six-fold from 1969 to 1989, but have declined steadily since that time. Nest counts of Royal Terns were highly variable between 1975 and 1990, but, like Brown Pelicans, have declined during the past decade. Sandwich Terns have experienced a substantial increase in nest numbers since 1975 and now are almost as numerous as pelicans in the state. Moderate to strong correlations in nest counts of Brown Pelicans and Royal Terns at the individual colony and statewide level compared to weak correlations between nest counts of Sandwich Terns and these two species suggest that the factors underlying nesting population trends are acting differentially among the three

focal species. We reviewed a suite of hypotheses that may explain the differing trends we observed among species. It appears that erosion of a key nesting island, ectoparasitism, and changes in food availability are the most likely mechanisms underlying the trends we observed. Future research should focus on diet, foraging ecology, and metapopulation structure. Management should focus on enhancing nesting habitat protection.

### **39. MIGRATION PATTERNS OF DOUBLE-CRESTED CORMORANTS CAPTURED NEAR SOUTHEASTERN AQUACULTURE (Oral).**

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The number of Double-crested Cormorants wintering near aquaculture facilities in the southeastern United States has nearly tripled in the past 15 years. Cormorants come in conflict with aquaculture producers by taking advantage of these abundant and readily accessible food sources. Information about cormorant movements is needed to properly implement and monitor management activities. We developed a study to determine the spring and fall migration patterns of Double-crested Cormorants captured in the southeastern United States. To better understand the timing, routes, and duration of migration, we monitored 30 cormorants (18 adults, 12 immature) using satellite telemetry and recorded their movements for  $\leq 546$  days. Twenty percent of these birds did not migrate and remained in the southeastern U.S. The average departure dates for spring and fall migration were 23 April and 1 October, respectively. The average daily movement of cormorants during spring migration was 70 km (SD = 46). Mean daily distance traveled during migration did not differ between immature and adult cormorants ( $W = 99$ ;  $P = 0.98$ ). During migration these birds typically followed the Mississippi and Central Flyways.

### **40. THE LINKAGE BETWEEN WOOD STORK PARENTAL ACTIVITIES AND POTENTIAL PREY AVAILABILITY IN EVERGLADES NATIONAL PARK (Poster)**

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Low numbers of nesting Wood Storks in Everglades National Park (ENP) during the 2005 nesting season suggest that breeding conditions were poor. A leading hypothesis for poor breeding conditions in the Everglades is that prey availability was reduced because of rainfall driven reversals in the dry season water recession. Parental activities, such as nest attendance and food provisioning rates, are thought to reflect the availability of prey in the landscape and this project seeks to identify relationships between the two. We examined parental activities of Storks at the Paurotis Pond colony during the 2005 breeding season. Provisioning rates and parental nest attendance information were recorded for five nests during early, mid, and late nest stages, and before and after rain

events. There was a general increase in provisioning rates throughout the season until approximately two weeks before fledging. However, there were temporary decreases in provisioning rate following water level increases. Nest attendance showed a steady decrease throughout the breeding season. Attendance rates of successful and failed nests were not statistically different; however there was a tendency for failed nests to have lower attendance rates during the early nest stage. Our data suggest that even when wood stork nests do not fail following water level reversals, there may be other negative effects, particularly when chicks are less than three weeks old.

#### **41. THE DISTRIBUTION OF A POTENTIALLY LETHAL PARASITE IN NATURAL AND AGRICULTURAL WETLANDS IN SOUTH LOUISIANA (Poster)**

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*Eustrongylides ignotus* has been reported to be fatal to juvenile wading birds in Florida (Coyner, et al., 2002). *E. ignotus* is known to infect *Gambusia holbrooki* in Florida (Coyner, et al., 2002), therefore it is possible that *E. ignotus* could infect *Gambusia affinis* in Louisiana and possibly impact Louisiana's wading bird populations. To determine the distribution and prevalence of in south Louisiana, I sampled twelve natural wetland sites (six marsh sites and six forested sites), six agricultural wetland sites and two wading bird colonies. Sampling was conducted when fledgling concentrations of wading birds were highest (May through July). Four hundred *G. affinis* were collected from each site via dip net then dissected to collect *E. ignotus* specimens. Relative abundance of *G. affinis* at each site was determined using a catch per unit effort index. Water samples were also collected to measure the productivity of each wetland site. *E. ignotus* has been found in *G. affinis* from both natural wetland and agricultural sites. Mean occurrence of *G. affinis* infected with *E. ignotus* was approximately 0.2%.

#### **42. GROWTH AND DEVELOPMENT OF CAPTIVE-REARED CASPIAN TERN CHICKS FED AD LIBITUM AND RESTRICTED DIETS (Oral)**

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We captive-reared 10 Caspian tern (*Sterna caspia*) chicks on an *ad libitum* (ad lib) diet and 10 on a restricted diet (69% of the ad lib diet) to investigate chick energy requirements and the effects of energy restriction on growth and development. Chicks fed the ad lib diet consumed 4.7 kg (SD = 0.27 kg) of fish (23.5 MJ) through day 35, the typical fledging age. Total metabolizable energy requirements of ad lib chicks to fledging age were 7% greater than allometric predictions (Weathers 1992). Mass growth rates of ad lib chicks were similar to those documented in wild Caspian terns (Schew et al. 1994), although average asymptotic mass was lower in the captive-reared chicks (535 vs. 570 g), suggesting energy requirements of wild chicks nearing fledging age may be

higher than we documented. Chicks fed restricted diets exhibited lower body mass (409 g at 35 days) and shorter wing chord, tarsus, head-bill length, culmen, and length of the outermost primary. In a subset of chicks (n = 4 for each group), total lipid content was also significantly lower in restricted diet birds, however masses of digestive tract components were not. Apparent metabolizable energy coefficients did not differ between ad lib and restricted birds.

#### **43. DIFFERENCES IN ENERGY EXPENDITURE BY GREAT EGRETS AND SNOWY EGRETS AT FRESHWATER WEIRS AND RIVERS (Oral)**

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We observed Snowy and Great egrets foraging Kansas rivers and New Jersey salt marshes. Kansas birds foraged below weirs and in unaltered channels. New Jersey birds foraged on tidal mud flats adjacent to salt marshes. In Kansas, Snowy Egrets reduced their step rate from 40.8 steps/min in rivers to 8.1 steps/min at weirs. Great Egrets reduced their step rate from 21.6 in rivers to 6.7 at weirs. Snowy Egrets stepped more slowly in salt marshes (30.8 steps/min) than in rivers. Step rates for Great Egrets were similar in estuaries and rivers. A computer program recorded the times of all steps and prey strikes. We used algorithms to estimate velocity (m/s) and energy expenditure (Watts) for ambulation and striking. Snowy Egrets used less power to strike at prey at weirs (0.228 W) than in rivers (0.988 W) or salt marshes (0.932 W). Great Egrets expended similar power while striking at prey in rivers (0.243 W) and at weirs (0.237 W), but used 0.606 W in salt marshes. At all locations, power expenditure increased with ambulation velocity. Since birds at weirs moved more slowly than birds in rivers or estuaries, they used fewer watts for ambulation in that habitat. Strike rates, capture rates, and capture efficiencies were lower for Great Egrets at weirs than in rivers, but fish caught at weirs were significantly larger. Snowy Egrets also showed reduced strike and capture rates at weirs; however, their capture efficiency was greater at weirs. Snowy Egrets also captured larger fish at weirs.

#### **44. TIME ACTIVITY BUDGETS OF WOOD STORKS IN MOIST SOIL MANAGED WETLANDS IN EAST TEXAS (Oral)**

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Although wood storks (*Mycteria americana*) are regularly documented in wetlands of coastal and inland Texas during the breeding season, they are not known to nest. However, as they are of management concern, their occurrence on moist soil managed

wetlands during the breeding season prompted closer behavioral evaluation. Specifically, our objective was to develop wood stork time-activity budgets during the breeding season. We measured behaviors using focal sampling techniques during three diurnal periods, from 15 April- 31 August, 2004 and 15 March – 31 August, 2005 at the Richland Creek Wildlife Management Area in Texas. Approximately 300 diurnal focal samples were collected during 2004 and 2005, and 31 storks were observed at night. Preliminary results indicate few differences between years, where wood storks spent between (62-70%) of their time resting, and very little time feeding (5–8 %) in either year during diurnal periods. Some storks were observed pulling and carrying branches at night. In sum, these data suggest that wood storks primarily use these moist soil managed wetlands for resting during diurnal periods, possibly during post breeding movements, although future studies may focus upon nocturnal behaviors, specifically as related to nest construction and agonistic behaviors.

#### **45. NONLINEAR POPULATION DYNAMICS OF METROPOLITAN NEW YORK WATERBIRDS (Oral)**

**Donald A. McCrimmon, Jr.**, (damccrimmon@cazenovia.edu), Cazenovia College.

I analyzed 39 years of Breeding Bird Survey (BBS) data (41 routes) for waterbird (Anseriformes, Charadriiformes, Ciconiiformes, Falconiformes) populations in metropolitan New York (Metro NYC - defined as the 28 counties in the tri-state [CT, NJ, NY] region) through time-series analyses of mean birds counted per route and the first differences of successive annual counts ( $\Delta x_{year} = x_{year} - x_{year-1}$ , where  $x$  is the mean annual count). The Metro NYC American Black Duck population declined throughout the study period, while that of the Canada Goose increased. The Great Blue Heron population increased, while that of the Green Heron decreased. Both Least and Common Tern populations fluctuated erratically at low population numbers. The Osprey population increased dramatically. These and other waterbirds about which I report are important, often conspicuous components of wetland ecosystems in Metro NYC and are the focus of diverse, fragmentarily coordinated management and conservation efforts among local/regional private organizations and state/federal agencies. While BBS data are sub-optimal for certain species (e.g., those with limited foraging ranges nesting in small numbers of colonies characterized by high turnover rates), they have been collected for enough years to enable effective, sophisticated time series analyses. Routes can also be combined to allow analysis of populations transcending typical geopolitical boundaries. As such, BBS data provide inexpensive, accessible foundations of high value as indices of population dynamics for many species of waterbirds.

#### **46. FREQUENCY OF OCCURRENCE OF KING AND CLAPPER RAILS IN MANAGED AND UNMANAGED MARSHES (Oral)**

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Studying King (*Rallus elegans*) and Clapper (*R. longirostris*) Rails is challenging because of their elusive nature, secretive behavior, and remote wetland environment; hence, there are few data on the abundance of King and Clapper Rails in managed impoundments and open marshes in the Southeast. We estimated frequency of occurrence of rails within managed impoundments and open marshes near Beaufort, South Carolina, during summer 2005. Call-playback count stations were placed in six managed impoundments and six open marshes. Responses were recorded using a parabolic dish and microphone. Rail responses were detected in ten of twelve marshes. In total, there were 189 rail responses in open marshes and 15 rail responses in managed impoundments. Within a 50-m radius of each count station, we detected 70 rails in open marsh and 8 rails in managed impoundments. Our results indicate that rails preferentially select characteristics of open marsh during the breeding season. We will continue monitoring frequency of occurrence of King and Clapper Rails during winter 2005-2006 and spring–summer 2006. Sonographs will be created and analyzed for accuracy of detection of species, and we will create multiple linear regression models with characteristics of open and managed marsh, and frequency of occurrence data to understand selection processes of rails.

#### **47. BREEDING ECOLOGY OF BROWN AND BLUE-FOOTED BOOBIES IN THE NORTHERN AND SOUTH- CENTRAL GULF OF CALIFORNIA, MX (Oral)**

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To explore coupling of seabirds with oceanographic conditions, we studied Brown Boobies (*Sula leucogaster*) and Blue-footed Boobies (*Sula nebouxii*) at Isla San Jorge, in the northernmost part of the Gulf of California (México), and Farallón de San Ignacio and Isla El Rancho, in the south-central part of the Gulf during 2003 and 2004. The 2003 ENSO event caused the colonies of both species to cease breeding at Farallón, but only partial reductions in breeding at San Jorge and El Rancho. During this year the diet of Brown Boobie at San Jorge was notably different from that in 1998-2000. Also in 2003, in response to food shortage, boobies dove deeper, and apparently foraged farther from the colony than in 2004, a “normal” year. In both species, females, which are larger than males, foraged at a wider array of depths and farther from the colony, as inferred from nest tending. Conditions at coastal El Rancho promoted a more productive Blue-footed Booby colony than at Farallón, both in normal and poor years. Clear differences in foraging ecology of Brown Boobies at San Jorge and Farallón did not cause differences in its breeding success. Overall, the response of the boobies to the characteristics of the year and colony location varied with species, and represent fine-tuning to local conditions.

#### **48. POPULATION TRENDS AND COLONY TURNOVER IN STATEWIDE SURVEYS OF WOOD STORKS IN FLORIDA (Oral)**

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Between 1991 and 2004, aerial and ground surveys of Wood Storks (*Mycteria americana*) were conducted across Florida. At 10 colonies in 2004, different observers counted from air and ground. Aerial counts estimated 8.1% more nests, probably due to better visibility or by mistakenly including other species. Analyses for eight years (best coverage) produced statewide totals of 2,211-6,449 nests. Excluding 2001 (very dry), numbers showed an increasing trend. Annual modal colony size fluctuated from 65-144 nests, with significantly smaller modal size in 2001 – 2004. In south Florida, where we systematically surveyed all potential colony sites, turnover (proportion of colony sites different in two surveys) increased rapidly with time since initial survey. Aerial transects across suitable habitat revealed 1 novel colony/525 sq. km. Within 10 yrs, >80% of colony sites differed. Thus, abandonment and formation of new colonies is a typical and rapid process even in this philopatric species. Larger colonies were more persistent and were surveyed more often than small colonies, suggesting that statewide counts were robust to missing novel colonies. However, even large colonies became inactive during the study; turnover rates suggest that most colonies will be novel within 15 yr. We strongly recommend that surveys be geographically systematic, even if this reduces statewide coverage, and focused in large blocks (thousands of km<sup>2</sup>) in areas with suitable habitat and historically high colony densities.

#### **49. EFFECTS OF CULLING CORMORANTS ON SYMPATRICALLY NESTING HERONS AND EGRETS ON LAKE ONTARIO (Poster)**

**Dave Moore<sup>1</sup>, D. V. Chip Weseloh<sup>2</sup>, Philip Careless<sup>3</sup>, and Don Tyerman<sup>4</sup>**

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In 2005, we assessed the impact of culling tree-nesting cormorants on sympatrically nesting Great Blue Herons (*Ardea herodias*) and Great Egrets (*Ardea alba*). Behavioral data were collected weekly (over 5 weeks) at the culling site (High Bluff Island, HBI, N= 38 heron + 17 egret pairs) and a similar control site (Chantry Island, CI, N= 31 heron + 30 egret pairs). For both species, nest attendance did not differ between CI and HBI control samples during: (1) the pre-cull period (>95%), (2) non-cull days in the cull period (>96%) and (3) the post-cull period (herons, 64%; egrets, >90%). Culling occurred alternately in two HBI woodlots. During culls (35±20 min), nest attendance was reduced for both species in the cull woodlot (herons=20%, egrets=74%). Post-cull, herons returned to the nest in 11±14 min (longest unattended=50±30 min); all egrets returned before the cull ended (longest unattended=6±4 min). Culling had no effect on the nest attendance of herons in the non-cull woodlot. Nesting success did not differ between managed and control sites for herons (failed nests=25%, successful broods=2.3 chicks, age=45±9 d) or egrets (failed nests=28%, successful broods=3.0 chicks, age=35±9 d).

The effects of the cormorant cull on nesting herons and egrets appeared to be short-term and minimal.

## **50. WEATHER OR KNOT? THE CHALLENGE OF COUNTING SEABIRDS (Poster)**

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Tasker et al. (1984) identified five interrelated categories of factors that ensure reduced seabird detectability during surveys at sea: bird size, colour, and behaviour; observational conditions and observer ability. Weather conditions affect bird behaviour, as well as their detectability. Here we examine the relationships between survey conditions (rain, fog, cloud-cover, wind-speed, swell); time of observation (since sunrise or before sunset); and species' visibility (plumage colour, wingspan, flight characteristics). Between 1996 and 2003, MB conducted >6,000 transects (5-min observation-periods) during 9 cruises spanning June through September. All cruises were from coastal BC to Ocean Station Papa (50° 00.0' N x 145° 00.0' W); however, there was considerable variation in the cruise track. We correlate densities of 15 seabird species observed on the water and in flight with survey conditions. Analyses showed that wind speed was most strongly associated (negatively) with detecting birds on the water; whereas, there was a positive relationship between the occurrence of rain/fog and detection of birds on the water. Detecting birds in flight was strongly associated (negatively) with wind speed and cloud cover. The results suggest that at-sea observing should be restricted to specific environmental conditions to maximize detection rates.

## **51. THE IDAHO BIRD INVENTORY AND SURVEY (IBIS) - COORDINATED WATERBIRD MONITORING IN IDAHO (Oral)**

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With the exception of waterfowl surveys for setting harvest limits, waterbird monitoring in Idaho has generally lacked coordination and agreement on protocols. To remedy this situation, we launched an all-bird monitoring program in 2004 called the Idaho Bird Inventory and Survey (IBIS). Phase I of IBIS emphasizes aquatic species and habitats, and focuses on determining the distribution and abundance of waterbirds at Idaho's wetland Important Bird Areas (IBAs) and Idaho Department of Fish and Game Wildlife Management Areas (WMAs). In our pilot year, 2004, we visited 44 sites throughout Idaho to determine monitoring and logistical needs and to conduct preliminary surveys. In 2005, we initiated general waterbird, secretive marshbird, and/or colonial waterbird surveys at more than 20 of these sites. These data have already provided important information to land managers and conservation planners in Idaho. Ultimately, IBIS will generate much-needed inventories of WMAs, initiate permanent surveys at globally-recognized IBAs, yield baseline data for statewide population trend monitoring, and

address high priority management issues using short-term species assessments. Our paper will review existing information about waterbirds in Idaho, identify key management issues, present findings of the 2004 and 2005 field seasons, and summarize overall program objectives. We also will provide examples of sampling designs, recommended protocols, descriptions of monitoring sites, and priority waterbird species.

## **52. A TWENTY-FIVE YEAR HISTORY OF WOOD STORKS IN SOUTH CAROLINA (Oral)**

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Since the first documented successful nesting of storks in South Carolina in 1981, a total of 16,642 nesting attempts have been documented. During the past 25 years nesting has increased from 11 nests to a high of 2,057 nests in 2004. A total of 27 colony sites have been used by nesting storks, however, five sites have supported > 76% of the nesting. The mean colony size is 118 nests (range 1-547). Colony site fidelity has been high, particularly on sites where more than 50 nesting attempts have been documented in any one-year. Only 3 of 27 sites are in public ownership and most sites are in wetlands altered or maintained by man. Production of young has been generally high each year and colony abandonment has been rare. This may be a result of the varied habitats used for feeding by nesting storks. Palustrine habitats associated with rivers, inter-tidal wetlands, isolated wetlands and marsh impoundments that are maintained for waterfowl are all habitats used by nesting storks. The variety of habitats used combined with the topographic relief of our coastal plain combine to provide adequate foraging habitat under a variety of rainfall conditions.

## **53. CRITICAL WINTERING SITE FOR GREAT LAKES PIPING PLOVERS (Oral)**

**Brandon L. Noel<sup>\*1</sup>, C. Ray Chandler<sup>2</sup>, and Bradford Winn<sup>3</sup>**

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The Piping Plover, *Charadrius melodus*, is a federally listed species with distinct breeding populations in the northern Great Plains, the Great Lakes region, and along the northeastern Atlantic coast as far south as North Carolina. Most of the conservation-related research has focused on the breeding season despite the fact that Piping Plovers spend only 3-4 months out of the year on the breeding grounds. We report significant findings from two years of winter distribution surveys on Little St. Simons Island (2003-2005), an important wintering site for Piping Plovers in the Altamaha River estuary of coastal Georgia. During these two seasons, an average of 53 plovers were found on LSSI (Jul to Apr), with 53 confirmed individuals from the Great Lakes population documented migrating or wintering on LSSI. Between Jul 2004 and May 2005, approximately 20% of the entire Great Lakes breeding population migrated or wintered on LSSI. During the

height of migration (Sep), 27 and 26 individuals from the Great Lakes population were documented on LSSI, in the 2003-2004 and 2005-2005 seasons, respectively. Based on wintering color-banded individuals, plovers occupied restricted home ranges on LSSI during wintering months. Individuals from the Great Lakes population that wintered both seasons exhibited a mean home range size (95% adaptive kernel) of 1.10 km<sup>2</sup>. Our results suggest Little St. Simons Island to be one of the most important wintering sites on the Atlantic Coast for the Piping Plover, especially the endangered Great Lakes breeding population.

#### **54. THE AMERICAN OYSTERCATCHER (*Haematopus palliatus*)-A BIOINDICATOR SPECIES FOR ASSESSING ECOSYSTEM HEALTH ALONG THE GEORGIA AND SOUTH CAROLINA COASTS AND BARRIER ISLANDS (Oral)**

**Terry M. Norton<sup>1\*</sup>, Brad Winn<sup>2</sup>, Felicia Sanders<sup>3</sup>, Mark Spinks<sup>3</sup>, Maria S. Sepulveda<sup>4</sup>, Tim Gross<sup>4</sup>, Greg Masson<sup>5</sup>, Nancy Denslow<sup>6</sup>, Carolyn Cray<sup>7</sup>, Marcie Oliva<sup>8</sup>, and Ellen Dierenfeld<sup>9</sup>**<sup>1</sup>St. Catherines Island WSC, [tmynahvet@aol.com](mailto:tmynahvet@aol.com); <sup>2</sup>Georgia DNR, [brad\\_winn@dnr.state.ga.us](mailto:brad_winn@dnr.state.ga.us); <sup>3</sup>South Carolina DNR, [SandersF@dnr.sc.gov](mailto:SandersF@dnr.sc.gov), <sup>4</sup>USGS-BRD Florida Caribbean Science Center, [Tim\\_S\\_Gross@usgs.gov](mailto:Tim_S_Gross@usgs.gov); <sup>5</sup>USFWS, [greg\\_masson@fws.gov](mailto:greg_masson@fws.gov); <sup>6</sup>BEECS Molecular Biomarkers and Protein Chemistry Core Laboratories, University of Florida, [denslow@biotech.ufl.edu](mailto:denslow@biotech.ufl.edu); <sup>7</sup>University of Miami, Department of Pathology, [CCray@med.miami.edu](mailto:CCray@med.miami.edu); <sup>8</sup>White Oak Conservation Center, [MarcieO@wogilman.com](mailto:MarcieO@wogilman.com); <sup>9</sup>St. Louis Zoological Park, [Dierenfeld@stlzoo.org](mailto:Dierenfeld@stlzoo.org)

The American oystercatcher (AMOY), *Haematopus palliatus*, is considered to be rare in both Georgia and South Carolina. It is one of the few birds to be specialized feeders on bivalve mollusks living in saltwater. Due to these unique dietary preferences, this species has the potential to act as a bioindicator of the marine ecosystem in the southeastern US. The objectives of this study were to establish baseline data for physical examination, morphometric measurements, clinical pathology, toxicology, reproductive physiology, microbiology, external and internal parasites, infectious diseases, nutritional parameters, and confirmation of sex with DNA technology in the AMOY in Georgia and South Carolina. Several capture techniques were used in this study, including cannon netting, box traps, and a decoy/noose trap. Samples collected and evaluated, included blood, feathers, feces, cloacal swabs, tissues from necropsy cases, and eggs.

#### **55. STATUS OF CLAPPER RAILS IN BAJA CALIFORNIA, MÉXICO (Oral)**

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Very little is known about the current distribution and population status of the clapper rail (*Rallus longirostris*) in the peninsula of Baja California. We conducted marsh birds surveys in all major coastal wetlands of the Baja California peninsula during the breeding

seasons (March-June) of 2002 to 2004, following the Standardized North American Marsh Bird Monitoring Protocols. We surveyed the two subspecies known for the peninsula of Baja California, *R. l. levipes* in the state of Baja California (in salt marsh wetlands) and *R. l. beldingi* in Baja California Sur (in mangrove wetlands). For Baja California we estimated a population of 220 individuals (1.5 individuals/ha). For Baja California Sur we estimated a population of 260 individuals (1.2 individuals/ha). Low population numbers of *levipes* (< 100) in comparison with historical numbers (500 in 1981) showed a severe population decline of this subspecies in Bahía San Quintín, which is the largest wetland in its range. The population of *beldingi* (< 10) has also decreased in Scammon's Lagoon (< 20 individuals) where it used to be very common in 1926. Clapper rail habitats are in good conditions, however their populations have decreased from historical records and could be indicating other sort of conservation problems such as increased human disturbance in the wetlands.

## **56. CHARACTERISTICS OF HERONRIES IN CENTRAL TEXAS (Poster)**

**Michael L. Parkes**<sup>1</sup> and **Miguel Mora**<sup>2</sup><sup>1</sup> Texas A&M University Department of Wildlife and Fisheries ([mlparkes@fastmail.fm](mailto:mlparkes@fastmail.fm)) <sup>2</sup> Texas A&M Department of Wildlife and Fisheries ([mmora@tamu.edu](mailto:mmora@tamu.edu)).

Mixed-species heronries have become a nuisance in some residential areas of central Texas and other areas of the United States, such as New Mexico, Oklahoma, and California. The concentration of thousands of nesting pairs can produce noise and odor problems, destroy nesting habitat via guano, and be perceived as a threat to human health due to the presence of guano and dead birds. Why some egrets and herons choose to nest within residential areas, when ample, seemingly suitable non-residential habitat is available, is largely unknown. This research compares 3 residential and 3 non-residential heronries in central Texas. Data were collected during the 2005 breeding season concerning reproductive success, predation, and breeding site characteristics of each heronry. Active nests by species were counted and totaled where practical, otherwise numbers of nesting pairs were estimated visually or using a density function. Subsamples of nests were marked on photographic printouts and data concerning nesting stage and brood size collected weekly. Nest survivorship was evaluated using Program MARK. Observations of potential predators and evidence of predation were noted on each visit. Preliminary results will be presented.

## **57. NOCTURNAL NEST ATTENTIVENESS AND NEST DEPREDATION IN LEAST TERNS (Poster)**

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Temporary nocturnal nest abandonment has been reported for terns and linked to predator activity, but rates and temporal aspects of adult absences from nests have not been well quantified. For Least Terns, high accessibility of coastal beaches may increase the potential for nocturnal disturbance and associated temporary nest abandonment. Our

objectives were to quantify the frequency, timing, and duration of adult nocturnal absences during incubation; examine temporal influences; and relate adult absences to nest depredation. We monitored temperatures in 119 nests with data loggers for 3-7-day periods to document the nocturnal activity of incubating adults at 1-4 breeding colonies in 2002-2003. We documented nest depredation every 1-4 days. Overall, adults were absent an average of 40% of nest-nights monitored and averaged 1.2 absences per nest-night for nights when absences occurred. Concurrent departures of adults from multiple nests were common. Proportions of nest-nights with absences and numbers of absences per nest-night differed among colonies. Proportion of nest-nights with absences did not differ by incubation stage. Adults either resumed nocturnal incubation within 1½ hr of departure or returned at dawn with absence lengths up to 4-8 hr. The frequency of absences appeared to be high, but it was not clear if total time absent during incubation would depress breeding success. Low nest attentiveness did not appear to be solely related to predator activity.

#### **58. USE OF THE BEAUFORT SEA BY KING EIDERS BREEDING ON THE NORTH SLOPE OF ALASKA (Oral)**

**Laura M. Phillips<sup>1</sup>, Abby N. Powell<sup>2</sup>, Eric J. Taylor<sup>3</sup>, and Eric A. Rexstad<sup>4</sup>**

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This study employed the use of satellite telemetry to estimate areas used by king eiders in the Alaskan Beaufort Sea, how distributions of used areas varied, and characteristics that explained variation in the number of days spent in the sea. Sixty king eiders were implanted with satellite transmitters at 2 locations on the North Slope of Alaska in 2002-2004. More than 80% of our transmitted eiders spent more than 2 weeks staging offshore prior to beginning molt migration, suggesting that the Beaufort Sea is an important migration flyway and staging area for this species. Distribution of locations did not vary by sex during spring migration. Shorter residence times of eiders and deeper water depths at locations during spring migration suggest the Alaskan Beaufort Sea may not be as critical a staging area for king eiders in spring as it is post-breeding. During post-breeding staging and migration, male king eiders had much broader distributions in the Alaskan Beaufort Sea than female eiders, which were concentrated in Harrison and Smith Bays. Significant variation in residence time in the Beaufort Sea was explained by sex with female king eiders spending more days within the sea than males in spring and during post-breeding. We recommend core use areas in Harrison and Smith Bays be protected from disturbance during post-breeding and future studies examine the importance of potential spring staging areas outside the Alaskan Beaufort Sea.

#### **59. A CLINICAL LOOK AT WATERBIRDS: SOME OBSERVATIONS ON THE NORMAL AND ABNORMAL (Oral)**

**Mark Pokras, Becky Harris and Florina Tseng;** [mark.pokras@tufts.edu](mailto:mark.pokras@tufts.edu); [becky.harris@tufts.edu](mailto:becky.harris@tufts.edu); [flo.tseng@tufts.edu](mailto:flo.tseng@tufts.edu); Wildlife Clinic & Center for Conservation Medicine, Tufts University, Cummings School of Veterinary Medicine, N. Grafton, MA. In studying the natural and anthropogenic causes of mortality in aquatic birds in New England we have had the opportunity to document a wide variety of interesting cases. Today's presentation will review some unusual points of normal anatomy and also discuss some necropsy findings that raise questions about threats to waterbirds. The audience will also be asked to participate in a brief game of "Name that dead beached bird!"

#### **60. INLAND PIPING PLOVER MIGRATION STOPOVER SITES: USING BIRDERS'REPORTS TO STUDY MIGRATION PATTERNS AND HABITAT USE (Oral)**

**Vanessa D. Pompei** ([pomp0012@umn.edu](mailto:pomp0012@umn.edu)) and **Francesca J. Cuthbert** ([cuthb001@umn.edu](mailto:cuthb001@umn.edu)). Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota.

The Great Lakes population of Piping Plovers (*Charadrius melodus*) has been extensively studied, but knowledge about migration ecology is limited; this information is needed for recovery. Because the population is small (~60 breeding pairs), tracking individual birds is not feasible. This study compiled records (e.g. state atlases, bird journals) of Piping Plover sightings from a "hypothetical migration pathway" used by Great Lakes birds between winter and breeding sites. Data were used to identify current and historic stopover sites and sites to visit to study habitat characteristics. Additionally, we examined chronology and spatial patterns of migration between the breeding and wintering grounds. We located > 1200 fall and spring stopover records and visited >15 sites to measure habitat characteristics. Results show that Piping Plovers use sites throughout the migration pathway during both fall and spring. Habitat used was shoreline of reservoirs, industrial ponds, natural lakes and rivers. Finally, reports indicate that plovers do not concentrate in large numbers at inland stopover sites and site use is highly influenced by local water levels and water management policy.

#### **61. SNOWY EGRET (*EGRETTA THULA*) EGG QUALITY AND CONTAMINANT BURDENS FROM FLORIDA ESTUARINE AND FRESHWATER HABITATS (Poster)**

**R. Heath Rauschenberger<sup>1</sup>, Jon M. Hemming<sup>1</sup>, Emily Boughner<sup>1</sup>, James Peterson<sup>2</sup>, and Karen Benjamin<sup>1</sup>**<sup>1</sup> U.S. Fish and Wildlife Service; <sup>2</sup> St. Johns River Water Management District.

Assessing contaminant exposure and effects in waterbirds is important in developing and prioritizing conservation activities for these species. Our study examined the relationship between egg quality, nest productivity, and organochlorine pesticide (OCP) and heavy metal burdens in eggs of snowy egrets from estuarine and freshwater habitats in Florida during 2004 and 2005. Snowy egret nests were monitored at St. Marks National Wildlife



Refuge (SM), an estuarine habitat, and along Lake Apopka's north shore (AP), which is proximal to a 1,214 ha wetland restoration area (reclaimed agricultural property). AP nests (n = 51) had larger clutch sizes ( $p > 0.0001$ ), and thinner eggshells ( $p > 0.0001$ ) compared to SM nests (n = 31). Hatch rates, egg mass, and dry eggshell mass did not differ between the sites, although AP nests showed greater variability. In 2004, AP eggs contained higher organochlorine pesticide burdens ( $p > 0.0001$  to 0.0016), higher Ba ( $p > 0.0002$ ) and Mn ( $p > 0.0036$ ) burdens, but lower Hg, Se, Cu, Zn and Sr ( $p > 0.0001$  to 0.0238) concentrations. No differences were detected between sites with respect to total PCBs or other heavy metals. We suggest that OCP exposure may be associated with eggshell thinning in AP eggs, but a connection to reduced hatch success or clutch size has not been demonstrated. Future studies should examine how foraging habits of birds relate to contaminant egg burdens, and egg quality for snowy egrets inhabiting Lake Apopka's North Shore Area. Support provided by a U.S. FWS Environmental Contaminants Program grant and in-kind service by St. Johns River Water Management District.

## **62. CONTRIBUTION OF CAPTIVE REARING TO RECOVERY OF GREAT LAKES PIPING PLOVERS (*CHARADRIUS MELODUS*) (Poster)**

**Erin A. Roche**\*<sup>1</sup> ([roche042@umn.edu](mailto:roche042@umn.edu)); **Francesca J. Cuthbert**<sup>2</sup> ([cuthb001@umn.edu](mailto:cuthb001@umn.edu)); and **Jennifer H. Stucker**<sup>2,3</sup> ([jstucker@umn.edu](mailto:jstucker@umn.edu))<sup>1</sup> Conservation Biology Program, University of Minnesota<sup>2</sup>, Department of Fisheries, Wildlife, & Conservation Biology, University of Minnesota; <sup>3</sup>USGS, Jamestown, ND.

Piping Plovers historically nested on shorelines throughout the Great Lakes region. In the early 1980s, the total number of breeding pairs dropped to 17 and the population was listed as federally endangered. Since 1994, the existing wild population has been supplemented with captive-reared piping plover juveniles raised from eggs salvaged from abandoned nests. This poster summarizes the contribution of captive rearing to recovery of the population. Abandoned eggs are removed from the wild following USFWS abandonment protocol and incubated at the University of Michigan Biological Station, Pellston, MI. Zookeepers from the Detroit Zoo and other participating U.S. zoos lend expert knowledge and equipment throughout the breeding season. Chicks are reared to fledging (approximately 23-25 days) using a combination of indoor pens and an outdoor enclosure to simulate the natural habitat. When chicks show exploratory flights and weights of 30g, they are banded and released to historic plover breeding habitats with similar aged broods. We continue to track captives using color band observations from breeding, migration and winter season reports. During 12 breeding seasons, a total of 108 eggs identified as potential candidates for captive rearing were salvaged and incubated; 90 hatched (83%). Of these 90 chicks, 82 (91%) survived to age of release; an additional 2 abandoned chicks were successfully released. Six captives returned to the Great Lakes in subsequent years as confirmed breeders. Currently (2005), captive reared birds represent < 2% of the total breeding Great Lakes piping plover population. Captive management may benefit recovery efforts by dampening environmentally derived stochastic effects on mortality rates. Additionally, involvement of zoos and associated media publicity increases stakeholder participation and public education regarding this critically endangered population.

### **63. PRODUCTIVITY OF WOOD STORKS IN NORTH AND CENTRAL FLORIDA (Oral)**

**James A. Rodgers, Jr.** (james.rodgers@MyFWC.com), Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Gainesville, FL.

One objective of the Wood Stork Recovery Plan identified productivity levels exceeding a minimum standard to ensure continued viability of the U.S. stork population. A reclassification from an endangered to threatened status could be accomplished when annual productivity among representative colonies in Florida is greater than 1.5 fledglings/nest averaged over three contiguous breeding seasons. Thus, the primary goal of this study is to gather productivity data for storks nesting in Florida in order to examine the variation and trends in fledging success within and among colonies and years. These data ultimately may be used to determine if the stork population in the U.S. meets recovery criteria for down-listing the species. The average fledging rate of wood storks at 19 colonies in North and Central Florida during 2004 was 1.53 fledglings/nest (n=1,574 nests). About 71.3% of monitored nests fledged at least one bird. Significant differences in the mean fledging rate existed among colonies (range=0.25 to 2.37 fledglings/nest). Differing rates among colonies were due to different frequencies of complete nest failures (no fledglings) and nests with 2-fledglings and/or 3-fledglings. While the mean fledging rate for all stork colonies was similar to 2003 (1.49 fledglings/nest), a comparison of the fledging rates for individual colonies monitored during both years indicates that 8 of 14 colonies exhibited greater fledging rates during the 2003 breeding season. Variable breeding success again characterized the 2005 nesting season but several stork colonies either did not initiate nesting or abandoned nesting during the 2005 season. These latter results are discussed in relation to the post-2004 hurricane season in Florida.

### **64. DISTRIBUTION OF CLAPPER RAILS IN MISSISSIPPI'S TIDAL MARSHES (Oral)**

**Scott A. Rush<sup>\*1</sup>, Mark S. Woodrey<sup>2</sup>, and Robert J. Cooper<sup>3</sup>**<sup>1</sup> D.B. Warnell School of Forest Resources, University of Georgia, Athens, GA, USA, [rushs@forestry.uga.edu](mailto:rushs@forestry.uga.edu); <sup>2</sup> Grand Bay National Estuarine Research Reserve, Moss Point, MS USA, [mark.woodrey@dmr.state.ms.us](mailto:mark.woodrey@dmr.state.ms.us); <sup>3</sup> Robert J. Cooper, D.B. Warnell School of Forest Resources, University of Georgia, Athens, GA, USA, [rcooper@smokey.forestry.uga.edu](mailto:rcooper@smokey.forestry.uga.edu).

Despite the rapid loss of tidal marsh, little is known about the birds that inhabit this ecotype. During the summer of 2005 we conducted call surveys, located and monitored nests and used GIS to identify factors that influence the distribution of clapper rails in Mississippi's tidal marshes. While this was the first year of a larger, long-term project, results indicate that clapper rails are more common in salt marshes experiencing greater salinity regimes; marshes often characterized by relatively low biotic diversity. Similar to studies along the Atlantic Coast, we found that clapper rails often nest closer to tidal guts or inflows than to contiguous patches of marsh habitat. While nest survival was high, the

dominant cause of nest-loss was tidal flooding. As such, nest height and the height of surrounding vegetation may be extremely important factors regulating nest success within this geographic context. Collectively these results support the importance of considering both marsh edge and tidal relationships during mitigation and conservation of salt marsh communities within the Gulf Coast of the United States.

#### **65. BEHAVIORAL RESPONSE OF WINTERING WATERFOWL TO WASTE RICE DEPLETION IN THE MISSISSIPPI ALLUVIAL VALLEY (Poster)**

**Danielle M. Rutka<sup>1</sup>, Bruce D. Dugger<sup>2</sup>, Kenneth J. Reinecke<sup>3</sup>, and Mark J. Petrie<sup>4</sup>** (daniellerutka@aol.com), Cooperative Wildlife Research Lab., Southern Illinois University, Carbondale, IL; <sup>2</sup> (bruce.dugger@oregonstate.edu), Cooperative Wildlife Research Lab., Southern Illinois University, Carbondale, IL; <sup>3</sup> (ken\_reinecke@usgs.gov), USGS, Patuxent Wildlife Research Center, Vicksburg, MS; <sup>4</sup> (mpetrie@ducks.org), Ducks Unlimited, Vancouver, WA.

Habitat conservation planning by the Lower Mississippi Valley Joint Venture is based on the assumption that carrying capacity of winter habitats for waterfowl is limited by food availability. If true, as food is depleted over winter, we would predict that waterfowl respond by changing their foraging patterns. We collected time-activity data from mallards and northern shovelers in 80 roadside rice fields during 2 winters (2000-2001 and 2001-2002) in Arkansas to test the hypothesis that foraging effort increases through winter as waste rice is depleted. Using explanatory variables year, date, daily minimum temperature, weekly cumulative precipitation, and field type (internal levees vs. no internal levees), we developed 37 candidate regression models and used an information theoretic approach (AICc) to select the model that best explained trends in foraging effort and changes in foraging mode during winter. The best models for both species included date, field type and date\*field type interaction ( $0.34 < R^2 < 0.37$  for mallards;  $0.23 < R^2 < 0.45$  for shovelers). Foraging effort changed with date for both species, but only in unleveed fields. Foraging patterns of mallards, a granivore, were consistent with rice depletion, whereas patterns of shovelers, feeding less on rice, were not.

#### **66. EFFECTS OF WINTER CRAB AVAILABILITY ON FORAGING BEHAVIOR AND REPRODUCTIVE SUCCESS OF WHOOPING CRANES (Oral)**

**Danielle M. Rutka\*<sup>1</sup> and R. Douglas Slack<sup>2</sup>**<sup>1</sup> (daniellerutka@aol.com), Department of Wildlife and Fisheries Sciences, Texas A&M University; <sup>2</sup> (d-slack@tamu.edu), Department of Wildlife and Fisheries Sciences, Texas A&M University.

The extent to which reproductive success of endangered whooping cranes (*Grus americana*) is related to or limited by food availability on the wintering grounds is unknown, but understanding this relationship is critical for evaluating conservation efforts. Field observations of whooping cranes wintering along the Texas Gulf Coast suggest blue crabs (*Callinectes spp.*) may be a principle item of cranes. Therefore, we investigated the effect of winter food availability on breeding success of cranes in Canada by testing 2 hypotheses: (1) foraging behavior of whooping cranes is not related to

availability of blue crabs during winter, and (2) breeding success of cranes is not related to blue crab abundance during the previous winter. We predicted cranes would alter their foraging behavior during winter in response to changes in their principle food source, and tested hypothesis #1 to ensure the most appropriate predictive variable (blue crab abundance) was being used to test hypothesis #2. Intensive focal observations of cranes were used to identify patterns in foraging behavior, and quantitative trapping methods were used to estimate crab abundance. We also utilized long-term crab abundance data collected by Texas Parks and Wildlife and crane breeding data collected by the Canadian Wildlife Service. Our findings suggest (1) blue crabs are a dominant food item of whooping cranes during winter, (2) changes in crab abundance affect the behavior and presumably body condition of cranes during winter, and (3) winter crab abundance is potentially a key factor determining reproductive success of cranes the following breeding season.

#### **67. EFFECTS OF HUMAN ACTIVITY ON BEHAVIOR OF BREEDING AMERICAN OYSTERCATCHERS, CUMBERLAND ISLAND NATIONAL SEASHORE, GEORGIA (Oral)**

**John B. Sabine<sup>1</sup>, J. Michael Meyers<sup>2</sup>, Sara H. Schweitzer<sup>3</sup>, and Clint T. Moore<sup>4</sup>**  
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Increased human use of coastal areas threatens the United States population of American Oystercatchers (*Haematopus palliatus*). Biologists attribute low reproductive success to human disturbance; however, the mechanism by which human presence reduces reproductive success is not well understood. In 2003 and 2004, we studied breeding American Oystercatchers at Cumberland Island National Seashore, Georgia. We recorded oystercatcher behavior in the presence and absence of ambient levels of human activity, and analyzed behavior using mixed models regression. Proportions of time human activities were present (<300 m of subjects) during observations averaged 0.14 ( $n = 32$ , 95% CI = 0.08–0.20). During incubation, pedestrian activity <137 m of pairs reduced reproductive behavior, but pedestrian activity 138–300 m had no effect. During brood rearing, effects of pedestrian activity <137 m were inconclusive, but pedestrian activity 138–300 m increased reproductive behavior. Vehicular activity decreased foraging during brood rearing, but boat activity had no effect. Two of twenty-three nest failures were due to humans, and these occurred in areas of greater human activity. We recommend that managers minimize pedestrian activity <137 m of nests during incubation, and increase this zone to >137 m during brood rearing. Vehicular activity should be minimized during brood rearing.

#### **68. NEST FATE AND PRODUCTIVITY OF AMERICAN OYSTERCATCHERS, CUMBERLAND ISLAND NATIONAL SEASHORE, GEORGIA (Oral)**

**John B. Sabine<sup>1</sup>, Sara H. Schweitzer<sup>2</sup>, and J. Michael Meyers<sup>1</sup>**

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The American Oystercatcher (*Haematopus palliatus*) is listed as a high priority species by the U.S. Shorebird Conservation Plan due to population decline. In 2003 and 2004, we video-monitored nests to document reproductive success of American Oystercatchers and identify causes of nest failure at Cumberland Island National Seashore, Georgia. Eleven pairs made 32 nest attempts during two seasons. Nine nest attempts were successful, fledging 15 chicks. Mayfield estimates of daily clutch survival were 0.973 (2003), 0.985 (2004), and 0.979 (2003 and 2004). Daily survival was greater on the north end, than on the south end of the island ( $\chi^2 = 7.211$ ,  $P = 0.007$ ) because rates of nest predation and human disturbance were lower. We documented 18 of 20 egg depredation events and one of eight chick losses. Predators included the raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), American Crow (*Corvus brachyrhynchos*), and ghost crab (*Ocypode quadata*). Other causes of nest failure were tidal overwash (1), trampling by horses (1), abandonment (2), and destruction of eggs by a child (1). Predator control may increase reproductive success on the south end of the island. Oystercatchers on the north end of the island had one of the highest reproductive rates for the Atlantic Coast.

## **69. DISTRIBUTION AND ABUNDANCE OF AMERICAN OYSTERCATCHERS IN SOUTH CAROLINA (Oral)**

**Felicia J. Sanders<sup>1</sup>, Thomas M. Murphy<sup>2</sup>, and Mark D. Spinks<sup>3</sup>** <sup>1</sup>South Carolina Department of Natural Resources, [SandersF@dnr.sc.gov](mailto:SandersF@dnr.sc.gov); <sup>2</sup>South Carolina Department of Natural Resources, [MurphyT@dnr.sc.gov](mailto:MurphyT@dnr.sc.gov); <sup>3</sup>South Carolina Department of Natural Resources, [tidalmark@juno.com](mailto:tidalmark@juno.com).

South Carolina winters a large proportion (over 1/3) of the eastern race of the American Oystercatcher (*Haematopus palliatus palliatus*), a declining species. During December of 1999-2002 ground surveys were conducted to provide baseline data on the abundance, age class partitioning and distribution of wintering American Oystercatchers in South Carolina. The number of oystercatchers in South Carolina was stable during this study (3,536, 95% CI: 3,030, 4,042). A single comprehensive survey can estimate the number of oystercatchers with enough precision to detect changes in the population of 13% and greater. Eighty-nine percent of the birds in 2002 roosted on washed shell rakes and 9% had immature bill coloration. Winter surveys of the proportion of immature oystercatchers may provide an index of regional reproductive success, an important parameter for conservation plans. To estimate the breeding population of South Carolina, potential nest sites were surveyed during April and May from 2001-2003. 400 pairs and large flocks of nonbreeding oystercatchers were counted during these months. The distribution of wintering and breeding oystercatchers was similar with the Cape Romain Region (comprising only 7% of the length of South Carolina's coastline) supporting over half the observed oystercatchers. Because South Carolina has a large number of

oystercatchers, future surveys can be used to verify suspected declines on a regional scale.

## **70. NESTING ACTIVITIES OF BROWN PELICANS AT COLONIES IN PUERTO RICO (Oral)**

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Between 2002-2003, we monitored Brown Pelican (*Pelecanus occidentalis*) reproductive efforts at one colony in Bahía Montalva, Guánica, off southwestern Puerto Rico, to document nesting activity, assess causes of nest failure, and compare earlier studies of pelican breeding success (1980-1983 and 2001-2002). We conducted aerial surveys around Puerto Rico and adjacent islands to estimate population numbers of juvenile, non-breeding, and breeding pelicans, and nesting colonies. Two historic nesting locations were consistently used, and an additional area showed nesting attempts. One new nesting area was reported, and one longtime-abandoned area showed nesting activity. Nesting success during the 2001-2002 nesting period was very poor, contrasting with 1980-1983 and 2002-2003. Nest failure is associated primarily with mortality of naked chicks due to human disturbance, exposure to high temperatures, poor movement coordination, windy conditions, deteriorated canopy, and possibly predation by rats, Yellow-crowned Night-Herons (*Nyctanassa violacea*), and hermit crabs. Dramatic changes in nesting success per nesting period may be tied to a combination of mortality factors and a cyclical periodicity of arrival, abundance, and availability of prey fish. Future breeding studies are expected at Conejo Cay, former United States Navy bombing range off the southeastern coast of Vieques Island, Puerto Rico, where nesting is currently undisturbed and we have evidenced of hermit crab predation. Reclassification of the Caribbean population of Brown Pelicans from its endangered status is not recommended at this time.

## **71. EVALUATION OF AN EGG SUBMERSION TECHNIQUE USED TO ESTIMATE INCUBATION STAGE OF SNOWY PLOVER EGGS (Poster)**

**Matthew G. Sexson\*** (mgsexson@scatcat.fhsu.edu), **Kyle Tutak** (katutak@scatcat.fhsu.edu), and **Greg H. Farley** (gfarley@fhsu.edu). Department of Biological Sciences, Fort Hays State University, Hays KS.

In 2005, we used egg submersion to estimate the incubation stage of Western Snowy Plover (*Charadrius alexandrinus nivosus*) eggs at Quivira National Wildlife Refuge and Cheyenne Bottoms Wildlife Management Area in Kansas. We adapted Hays' and LeCroy's technique for Common Tern (*Sterna hirundo*) to the incubation period of Snowy Plover in Kansas (approximately 25 days). Over 550 eggs were assessed using egg submersion; we will discuss the accuracy of our technique by comparing estimated hatch dates established by egg submersion to actual hatch dates. In addition, we will provide suggestions for producing reliable incubation stage estimates for Western Snowy Plover using egg submersion.

## **72. NEST-SITE SELECTION AND REPRODUCTIVE SUCCESS OF THE SNOWY PLOVER IN KANSAS (Oral)**

**Matthew G. Sexson\*** (mgsexson@scatcat.fhsu.edu), and **Greg H. Farley** (gfarley@fhsu.edu). Department of Biological Sciences, Fort Hays State University, Hays KS.

As a result of the detectable Western Snowy Plover (*Charadrius alexandrinus nivosus*) population decline throughout the United States, the species was listed as threatened in Kansas in 1987. As such, information regarding reproductive success and habitat requirements are valuable in guiding management and conservation activities at the state and regional scales. In 2005, we located and monitored 264 Snowy Plover nests at Quivira National Wildlife Refuge (n=233) and Cheyenne Bottoms Wildlife Management Area (n=31) in Kansas. Each nest was checked for an attending adult at least once per week during the (18 April – 10 August) breeding season, and estimated hatch date was established using egg flotation. In the event that eggs in a nest did not hatch, we attempted to determine the cause. Our preliminary analysis indicated that, of 264 nests, 31.1% had eggs that hatched, 28.8% were lost to flooding, 23.9% had an unknown fate, 8.0% were abandoned, 7.6% had eggs that were depredated, and 0.7% were lost to human disturbance. Post hatching, we attempted to monitor chicks through fledging. At the conclusion of the breeding season, nest characteristics such as nest substrate and surrounding vegetation were surveyed using a 1-m<sup>2</sup> quadrat centered on each nest, and compared to paired random sites. The results of reproductive success and habitat data analysis will be discussed.

## **73. EFFECTS OF HABITAT SUPPLEMENTATION ON BREEDING PERFORMANCE IN BLACK TERNS (Oral)**

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In 2003 and 2004, we placed 41 floating nest platforms on Grassy Lake in southeastern Wisconsin (USA) to test the hypothesis that reproductive success of Black Terns (*Chlidonias niger*) is limited by the quality of suitable nesting habitat. Extreme differences in water depth between these two years provided a natural experiment to evaluate the effectiveness of the nest platforms during a drought year (2003), when natural nesting substrate was abundant, and a flood year (2004), when natural substrate was severely limited during the peak nesting period. Terns nested on 27 of 41 (66%) of the platforms in 2003 and 26 of 41 (63%) in 2004, which represented about a third of all nest starts in each year. No difference in the occupancy rate of platforms and natural nests was evident in 2003, but in 2004 the pattern of clutch initiations early in the season indicated that platforms were preferred over natural substrates. In 2003, nest survival rates did not differ between nests placed on platforms and those placed on natural substrates, but in 2004, platform nests had significantly higher hatching success and nest

survival rates. Our experiment indicates that floating nest platforms can be an effective management tool to enhance nesting habitat for Black Terns and other aquatic birds that construct floating nests, primarily due to mitigation against catastrophic nest losses from flooding events. Nest platforms also may be useful for addressing questions pertaining to habitat selection and parental quality.

#### **74. A COMPARISON OF PASSIVE-LISTENING VERSUS BROADCAST-CALL SURVEYS FOR BREEDING MARSH BIRDS ALONG COASTAL ALABAMA (Poster)**

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We conducted point count surveys for Least Bittern (*Ixobrychus exilis*), King Rail (*Rallus elegans*), Clapper Rail (*Rallus longirostris*), Common Moorhen (*Gallinula chloropus*), and Purple Gallinule (*Porphyrio martinica*) along tidally-influenced marshes of coastal Alabama during the 2004 breeding season. We compared the number of individuals detected during an initial passive-listening period with additional individuals detected after broadcasting calls of each target species. Additionally, we examined responses of each species to conspecific and heterospecific calls. We conducted point counts at 195 sites in saline marshes and 146 sites in brackish marshes and detected 66 Least Bitterns, 45 King Rails, 775 Clapper Rails, 56 Common Moorhens, and 117 Purple Gallinules. Broadcast-call surveys greatly increased the number of detections for King Rail, Clapper Rail, and Purple Gallinule over passive listening, and marginally increased detections for Least Bittern. Broadcasting calls was less effective at increasing the number of Common Moorhens detected. Conspecific calls were more effective at eliciting responses than heterospecific calls for each of the species except Least Bittern. Least Bittern appeared as likely to respond to heterospecific calls as to conspecific calls.

#### **75. THE RECOLONIZATION BY ROSEATE TERNS OF PENIKESE ISLAND, MASSACHUSETTS IN 2005 (Poster)**

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In 2003 in Buzzards Bay, Massachusetts (BBMA), more than 250 pairs of Roseate Terns colonized Penikese Island (and a similar number of pairs moved to Bird Island) as a result of hazing done at Ram Island to try to prevent the terns from becoming oiled following the Bouchard Barge oil spill in April. About 350 adults were colorbanded at all three BBMA colony sites in 2004, but less than 10 pairs of Roseates nested at Penikese that year and most of the translocated adults that survived from 2003 were thought to have returned to Ram. More than 100 Roseate nests were found at Penikese in 2005 and a



preliminary analysis of just the 20 previously colorbanded adults trapped or resighted there suggests that our initial hypothesis as to the source of the birds that recolonized this site will not be supported as most of the colorbanded birds from 2004 appear to have come from Bird, rather than Ram Island. This poster will determine the extent to which the Roseate Terns that colonized Penikese in 2003 returned in 2005 and also will determine the degree to which the recolonization in 2005 was done by "new" birds that had not been part of the earlier colonization from Ram Island.

#### **76. WINTER OBSERVATIONS OF GREAT LAKES PIPING PLOVERS 1995-2005: CONSERVATION AND MANAGEMENT IMPLICATIONS (Oral)**

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Banding of the endangered Great Lakes population of Piping Plovers began in 1993. Since 1993 efforts have been made to band all nesting adults and offspring during the breeding season. With the assistance of observers throughout their annual range, >430 sightings of banded Great Lakes birds have been reported from the wintering ground between 1995-2005. These records indicate Great Lakes Piping Plovers winter from North Carolina to Texas, including the Bahamas; 75% of Great Lakes individuals reported winter in Georgia and Florida. Between year winter site fidelity appears high, with sightings of 33 individuals at the same location in consecutive years. On average, pair members winter ~550 km apart; offspring winter ~500 km distant from their parents. Some females appear to use "winter" ground from July through April, indicating importance of habitat protection and survival at these locations. About 95% of sightings occur near or within federally designated winter critical habitat for Piping Plovers. Results emphasize the importance of protecting for plover winter habitat and tracking use and movement of individual birds among habitat units.

#### **77. MOVEMENT AND HABITAT USE OF SEMIPALMATED SANDPIPERS (CALIDRIS PUSILLA) MIGRATING THROUGH THE UPPER BAY OF FUNDY (Oral)**

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The upper Bay of Fundy is a critical fall migration stopover point for Semipalmated Sandpipers. The sandpipers forage on mudflats around the Bay to build fat reserves necessary to complete their trans-Atlantic flight to the South American wintering grounds. Distribution of birds among foraging and roost sites around the Bay has changed in recent years. We hypothesized that the main factors influencing sandpiper habitat selection and movements are: 1) prey abundance- particularly their main prey *Corophium volutator*, 2) predation threats by Peregrine Falcons and Merlins and 3) landscape. To

assess movements, sandpipers were radio-tracked in 2004 and 2005. Major differences in habitat use were observed between the two years. In 2004, very little movement was detected with the majority of birds using only one site to forage and roost. In 2005, the sandpipers were much more mobile, frequently moving among several sites. The differences may be due to a substantial decrease in *Corophium* densities on some sites, along with an increase of predator attacks.

#### **78. PREDATORS OF COMMON EIDER DUCKLINGS (SOMATERIA MOLLISSIMA) AND FLEDGING SUCCESS ON GREAT DUCK ISLAND, MAINE (Oral)**

**Sadie Spruce\***, College of the Atlantic, Bar Harbor ME (sspruce@coa.edu).

The Common Eider is a species of concern due to its popularity as a game bird throughout its range. In the eastern United States the Common Eider was hunted almost to extinction during the 19th century. Populations staged a significant come-back during the first half of the 20th century and are now hunted widely in coastal Maine. Previous studies have suggested high predation rates on Eider ducklings by Greater Black-backed Gulls (*Larus marinus*) resulting in mortality of up to 99% of young according to one estimate. Many of these studies have been highly intrusive, resulting in the probable separation of young eiders from adults. A nursery of eiders was studied on the southern end of Great Duck Island, Maine from June to August, 2005, for a total of 73 observation hours over 32 days. Use of a lighthouse tower overlooking the nursery area minimized the disturbance effects of the study. Mothers were individually recognized by their plumage and crèches of females and ducklings were tracked daily. Contrary to previously cited high predation rates, ducklings raised in the nursery near Great Duck Island experienced only seven observed predation attempts, resulting in the mortality of one duckling. Despite the fact that 2005 has been recorded as one of the worst summers for local eiders in recent history, six of 11 ducklings survived to fledging.

#### **79. CHALLENGES OF DETECTION AND MANAGEMENT OF PREDATION IN AN URBAN MINNESOTA HERON COLONY (Oral)**

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Peltier Island, located in the north metro region of Minneapolis, MN, was a large multi-species waterbird colony from 1989 to 2000. In recent years, colony-wide desertion occurred over 6 consecutive seasons at Peltier. Only Great Blue Herons (*Ardea herodias*) continue to nest, but their population has declined by > 90%. In 2004, in response to high public concern, the Minnesota DNR initiated a study to assess causes of colony desertion and potential management to protect the colony. This paper evaluates one method to detect and another method to deter predators. We remotely monitored 12 nests, 8 at Peltier and 4 at a separate control colonies, with tree-top video cameras. That

season, all 180 nests were deserted before fledging. Video evidence suggested that Raccoon (*Procyon lotor*) predation was important. Other data indicated Great Horned Owls (*Bubo virginianus*), American Crows (*Corvus brachyrhynchos*), sibling aggression, and stochastic events also contributed to GBHE nest failure. In March of 2005, we attempted to protect nests from mammalian predators by placing metal flashing around the trunks of all trees containing nests and any trees that could provide a route to the canopy. This method was only marginally effective. Of 25 active nests, only 3 produced 1 or more fledglings. Flashing prevented ground access to nests only under “ideal” conditions. Avian predation appeared more frequent in 2005, also suppressing productivity. We recommend the use of tree top video surveillance to detect predation but did not find flashing effective for the circumstances at the Peltier Island colony.

## **80. THE EMERGENCE OF GREAT BLACK-BACKED GULLS ON GREAT DUCK ISLAND, MAINE (Oral)**

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Great Black-backed Gulls (GBBG) (*Larus marinus*) began colonizing the northeastern United States in the early 1940's. Rising GBBG populations may impact the conservation of other seabird species. Great Duck Island (GDI), in the western Gulf of Maine, has historically supported large Herring Gull (*Larus argentatus*) (HERG) colonies with a few scattered GBBG nests. The GBBG population on GDI has recently expanded, usurping HERG territory and changing levels of aggression and competition between HERGs, Black Guillemots (*Cepphus grylle*), and Common Eiders (*Somateria mollissima*). Spatial and temporal changes in the composition of nesting gulls on the southern end of GDI were analyzed by obtaining GPS locations of all gull nests and habitat features, and comparing a detailed GIS map of the sub-colony of GBBG gulls with maps made from 2000 to 2005. Behavioral observations were conducted to reveal mechanisms of GBBG territoriality, and survivorship surveys were used to determine the ecological impacts that increasing GBBG numbers had on other seabirds. The GBBG sub-colony has expanded into optimal gull habitat and GBBGs have displaced HERGs from these areas. GBBGs exhibited high levels of both intra and interspecific aggression toward individuals invading nesting territories. A high degree of segregation occurred between GBBGs and HERGs, both within and outside of the nesting colony, enforced by aggressive behavior from both species. GBBG predation on HERGs, Common Eiders, and Black Guillemots increased during periods of inclement weather. These observations may impact future management and conservation strategies for island-nesting seabirds in areas where gull populations are expanding.

## **81. CONSERVATION GENETICS OF AN INTRODUCED MOTTLED DUCK POPULATION (Oral)**

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Mottled ducks (*Anas fulvigula*) are one of few non-migratory dabbling ducks in North America. The Florida mottled duck is considered a distinct subspecies (*A. f. fulvigula*). Mottled ducks were introduced to coastal South Carolina (SC) from Texas, Louisiana, and Florida during 1975-82. The introduced SC population has increased its range to include areas in Georgia (GA) and Florida, greatly concerning ornithologists because of efforts to maintain the Florida mottled duck as a distinct subspecies. We are estimating the possibility of gene flow from SC/GA to Florida populations and identifying the genotype of the SC/GA population for future reference. Also, we will compare the genetic composition of the new SC/GA population to its source populations, and investigate the population genetic structure and grouping of sub-populations of mottled ducks along the SC/GA coastal zone to reveal breeding units for management purposes. Microsatellite DNA will be used as the genetic marker. We have collected 736 samples from all the five states where mottled ducks occur. Sixteen primer sets have been screened and ten of them are scorable. At least sixteen primer sets will be used for our analysis. Results of this project will provide greater understanding of population dynamics and practical suggestions for management activities that affect the genetic integrity of mottled ducks.

## **82. THE THREAT TO BLACK-CROWNED NIGHT-HERON COLONIES FROM NESTING DOUBLE-CRESTED CORMORANTS ON THE GREAT LAKES: A PROTOCOL AND AN ASSESSMENT (Oral)**

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We obtained historical (since 1978) and current (2003-2004) data on 43 breeding colonies of Black-crowned Night-Herons (*Nycticorax nycticorax*, BCNHs) on Lakes Huron, Erie and Ontario and the Detroit, Niagara and St. Lawrence Rivers. Eleven of the sites also had nesting Great Egrets (*Ardea alba*, GREGs) and 8 also had nesting Great Blue Herons (*Ardea herodias*, GBHEs). Nesting Cattle Egrets (*Bubulcus ibis*) and Snowy Egrets (*Egretta thula*) were present at 2 and 1 colonies, respectively. We assessed the status of each species' nesting relative to possible encroachment from sympatrically nesting Double-crested Cormorants (*Phalacrocorax auritus*, DCCOs); DCCOs are known to take over heron nests. Status was evaluated according to 6 categories based, in part, on the proximity of nesting DCCOs: not applicable, no effect, potential conflict, probable conflict, nest take-over, and colony decline/abandonment. Thirty-eight percent of BCNH colonies were not affected, 23% showed potential or probable conflict and 39% showed nest take-overs or colony decline/abandonment. At least 9 BCNH colonies appear to have been abandoned after nest take-overs by DCCOs. More than half of GREG and GBHE colonies showed probable (or higher) threat from cormorants. All BCNH colonies under threat were located between Lake Erie and the St. Lawrence River. Managers should monitor DCCO nest placement when DCCOs nest with herons and assess if threats occur.

**83. AMERICAN OYSTERCATCHER PRODUCTIVITY ON FISHERMAN ISLAND NATIONAL WILDLIFE REFUGE, NORTHAMPTON COUNTY, VA (Poster)**

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The American Oystercatcher (*Haematopus palliatus*) is a shorebird of high priority and concern at both the national and regional levels. In response to identified research needs, researchers from the Center for Conservation Biology at the College of William and Mary (2002-2003) and Fisherman Island National Wildlife Refuge (2004) examined nesting success and productivity of oystercatchers on Fisherman Island. Number of breeding pairs ranged from 41 – 50, hatching success ranged from 33.3 – 69.6% and productivity ranged from 0.10 - 0.41 young per pair. Mayfield estimates of hatching probability ranged from 30.4 – 61.9%. Oystercatcher hatching success and hatching probability on Fisherman Island is relatively high when compared to other states (i.e., North Carolina, Georgia), but is low when compared to other nesting sites in Virginia. Factors limiting reproductive success on Fisherman Island remain unclear, but predation at the egg and chick stages is suspected. Nest cameras will be used in 2005 to detect predator impacts.

**84. ESTIMATION OF NEST FAILURE RATES AND BREEDING POPULATION SIZE IN COLONIAL WADING BIRDS (Poster)**

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We are developing several new procedures associated with surveys of colonially nesting wading birds, including the potential to measure nest turnover that remains undetected with current survey methods and an enhanced ability to monitor large numbers of individually marked nests from the air. Peak nest counts and similar methods measure the total number of nests present at each survey, but some unknown proportion of those nests are active on multiple surveys; additionally, some proportion of nests are initiated and fail between consecutive surveys, and thus are never counted. Nest turnover rates are highly variable, depending upon annual and seasonal factors, so regular measurement of nest turnover within seasons may be a required element for deriving useful estimates of numbers of nests. We report on 1) new methods to track the success of large numbers of individually identifiable nests through digital aerial photography and unique ground markers, and 2) the potential to use the superpopulation method (a variation of the Jolly-Seber model) to estimate numbers of nest starts using these turnover estimates. We also report on large aerial estimation errors (range of -46% to +10%, depending upon vegetative cover) by comparing aerial and ground counts of marked quadrats.

## **85. WOOD STORK NESTING IN GEORGIA: 1992-2005 (Oral)**

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The first Woodstorks were recorded nesting in Georgia in 1965 at Blackbeard Island National Wildlife Refuge. Since that discovery, stork nesting has occurred at least once in 43 locations across the Coastal Plain of the state, with an average of 14 active colonies per year since 1992. Aerial surveys of approximately 80 known wading bird rookery sites have been surveyed by state biologists every year to document Wood Stork distribution and estimate the total number of nesting pairs. Additionally, annual ground count data of several colonies have been contributed by personnel from the U.S Fish and Wildlife Service and Savannah River Ecology Laboratory. Productivity was estimated at colonies in Glynn and Camden counties in 2003, 2004, and 2005. Nesting effort for storks has increased from 4 pairs from one colony in 1965 to an estimated high count of 1,817 pairs from 19 colonies in 2005. A regression of log-transformed nest totals for the 14-year time-series (1992-2005) showed no trend in nesting pair numbers ( $P=0.84$ ) for that period. Thirty-three (77%) of stork nesting locations have been on private land, and 10 (23%) nesting locations have been on public lands.

## **86. VARIATION IN THE ABUNDANCE, DISTRIBUTION, AND HABITAT ASSOCIATIONS OF PASSERINES WINTERING IN SALT MARSHES IN MISSISSIPPI (Poster)**

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Little is known about wintering marsh bird communities along the northern coast of the Gulf of Mexico. Thus, our objectives were (1) to characterize winter marsh bird communities and (2) to collect data as baseline information for future research opportunities. To document the abundance, distribution and habitat associations of wintering marsh birds, we conducted weekly line-transect surveys along seventeen randomly selected transects ranging from 200 to 500 meters in length. Surveys were conducted January through March 2004 and 2005 at the Grand Bay National Estuarine Research Reserve and National Wildlife Refuge. Marsh Wren (*Cistothorus palustris*), Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*), and Seaside Sparrow (*Ammodramus maritimus*) were the three most commonly detected species. Preliminary analysis shows a positive relationship between vegetation diversity and species diversity. Sparrow densities and diversity were low in homogeneous stands of black needlerush (*Juncus roemerianus*), whereas Marsh Wrens were common across all habitat types. Relative abundance estimates decreased significantly for the three most common species in the second year of this study while species-specific habitat associations remained consistent across years. We do not have an explanation for the observed decline in

relative abundance. However, significant annual variation in site-specific abundance may be a feature of winter Gulf Coast marsh bird communities.

**87. MERCURY ACCUMULATION BY NESTLING WHITE IBISES RELATIVE TO HABITAT AND TROPHIC POSITION OF PREY (Poster)**

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White Ibis (*Eudocimus albus*) are tactile-foraging wading birds that typically feed on aquatic invertebrates in shallow fresh- and saltwater wetlands, although other prey types are consumed as well. Previous studies have indicated that nestling ibis cannot tolerate prey with high salt concentrations, forcing the parents in coastal areas to select appropriate prey and/or foraging habitats. As part of a study to examine mercury uptake in wading birds relative to their trophic position, we collected feathers during 2003-2005 from nestling ibis in two coastal and one inland colony. We analyzed these feathers for mercury and for the stable isotope ratios,  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ , as indicators of prey habitat and trophic position, respectively. As expected, preliminary analyses found the inland colony to be slightly higher in mercury with a different  $^{13}\text{C}$  signature than the coastal colonies. Mercury,  $^{13}\text{C}$ , and  $^{15}\text{N}$  varied between the two coastal colonies, where greater use of freshwater prey resulted in higher mercury concentrations. Stable isotope signatures indicated that nestling ibis were fed some saltwater prey, although they were likely fed marine/marsh fish which have lower salt concentrations than marine invertebrates.