CAHA # 2192

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Subject: American Oystercatcher Research at CAHA and CALO - 2005 Annual Report

Dear Superintendents Murray and Vogel,

I have attached a copy of our 2005 Annual Report summarizing findings to date on the distribution, abundance, survival, and reproductive success of American Oystercatchers on the Outer Banks of North Carolina. This research is the product a cooperative partnership involving North Carolina State University, the National Park Service, the USFWS, the North Carolina Wildlife Resources Commission, the National Audubon Society, and the USGS NC Cooperative Fish and Wildlife Research Unit at NCSU. Together we have sought to understand the relationship between oystercatcher nesting success and survival, and issues of management concern such as human disturbance, habitat alteration, and introduced predators. The enclosed report summarizes findings since the research began in 1997, and new results from 2005.

In 2005 we initiated a radio telemetry and behavior study to track oystercatcher chicks from hatching to fledging. Over the past several years a number of dead oystercatcher chicks have been found that were apparently hit or run over by vehicles, and many more disappeared for unknown reasons. After oystercatcher chicks hatch, there is a period of approximately five weeks where they are flightless and highly mobile, placing them at considerable risk from beach traffic and other sources of mortality. The extent to which these different factors (predators, ORVs, weather, etc.) affect chick survival was unknown prior to this study. Chicks are very hard to locate when they are small because they are very well camouflaged and they can move hundreds of meters on a daily basis. By attaching small radio transmitters to the chicks shortly after they hatched we were able to track and observe them throughout the nestling period.

The 2005 pilot study documented a range of predators from great horned owls to feral cats, but also revealed additional connections between ORV use and chick mortality. Shortly after the study was initiated, two radio-tagged chicks were killed by an ORV on Cape Lookout National Seashore. Radio tracking revealed how vulnerable oystercatcher chicks are to ORV traffic, especially during their first few weeks of life. The NPS responded quickly to these findings by closing sections of beach with oystercatcher broods to vehicles, and diverting traffic via the inter-dune road. As a result of this management policy, no more chicks were killed by vehicles in the Park in 2005, and we observed more broods using the beach and inter-tidal zone than we had prior to the closures. In 2005, for the first time since intensive monitoring began, no chicks were killed by ORVs on Cape Hatteras National Seashore, despite higher than average hatching success. This may have resulted from the policy (initiated in 2005) of posting full beach closures around all oystercatcher broods.

We plan to continue our research in 2006 and would welcome your comments on these findings and suggestions for the upcoming field season. This research would not have been possible without the generous housing, staff, and logistical support provided by both Cape Hatteras and Cape Lookout National Seashores. We are very grateful for the support from the National Park Service and look forward to working with you and your staff in 2006.

Sincerely,

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American Oystercatcher (*Haematopus palliatus*) research and monitoring in North Carolina

2005 Annual report

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Table of Contents:

Tables and Figures

Tables

Figures

American Oystercatcher Biology and Population Status

American Oystercatchers are large, conspicuous shorebirds that are strictly tied to the coastal zone throughout the year. Unlike many shorebirds that breed in the Arctic and migrate to coastal regions in the winter, oystercatchers breed along the Atlantic Coast from Cape Cod to Florida, and along the Gulf Coast from Florida to Mexico. The winter range extends from central New Jersey south. The US Shorebird Conservation Plan lists American Oystercatchers as a high priority species (Brown et al. 2001), in part because of significant threats from development and heavy recreational use of coastal breeding habitats.

Patterns of land use in the coastal zone are changing. Population growth is widespread along the Atlantic seaboard, and is expected to increase significantly, particularly in the southeastern states (Crossett et al. 2004). At the same time, recreational use of the coastal zone is on the rise. Many visitors to the coast seek out undeveloped beaches. As coastal islands and beaches are developed, more visitors are concentrated onto the remaining undeveloped areas. Coastal development, recreational activity, and altered predator communities have seriously reduced the amount of suitable nesting habitat for oystercatchers in North Carolina. Shoreline development affects the availability of foraging habitat as well. Oystercatchers nest at higher densities and fledge more chicks when they have direct access to foraging areas (Nol 1989; Ens

et al. 1992). Roads and artificial dunes along nesting beaches can limit access to soundside marshes and flats that are important foraging habitats for oystercatchers. Nesting and roosting sites can also be lost when jetties and revetments alter the normal process of longshore transport of sand and accelerate erosion of adjacent beaches.

American Oystercatchers are listed in both Georgia and Florida as "threatened", and proposed as a "species of special concern" in North Carolina (J. Gerwin, pers. comm.). A recent aerial survey of the species' winter range resulted in a population estimate of 10971 individuals (+/-298), with 7500-8000 wintering on the Atlantic Coast (Brown et al. 2005). The survey estimated a winter population of Oystercatchers in North Carolina at 647 birds. A 2004 breeding season survey estimated North Carolina's summer population at 701 individuals, with 327 breeding pairs (Cameron and Allen 2004).

Like many long-lived species, oystercatcher reproductive rates tend to be highly variable but generally low (Evans 1991). This prevents rapid population swings, but reduces the ability of the species to recover quickly to the population declines. This variability also makes it difficult to assess the status of a population. Recent surveys indicate that populations in the Mid-Atlantic states are declining (Mawhinney and Bennedict 1999, Nol et al. 2000, Davis et al. 2001). The breeding population of Virginia's barrier islands, a historical stronghold for oystercatchers, fell from 619 breeding pairs in 1979 to 255 breeding pairs in 1998 (Davis et al. 2001). A 2004 survey that covered the same region estimated the population at 302 breeding pairs (Wilke and Watts 2004). This survey also covered lagoon and marsh habitat and found an additional 223 pairs. These results highlight the need for documenting use of alternative habitats. During the period of apparent decline in the mid-Atlantic, the species expanded its breeding range into the northeastern U. S. (Davis 1999, Mawhinney and Bennedict 1999, Nol et

al. 2000, Davis et al. 2001). Understanding the causes of local, regional, and continental population trends will require region-wide studies of the species' population structure and demographics.

The objectives of our research are to evaluate the status and viability of North Carolina's Oystercatcher population and to understand the relationship of this population to other populations along the east coast of the United States. We are currently focused on obtaining reliable estimates of survival, recruitment, and other key demographic parameters through a large scale mark-recapture study. In addition, we have recently initiated a radio telemetry study to investigate factors affecting pre-fledging chick survival.

Study Sites

We are currently monitoring American Oystercatcher productivity at several locations in North Carolina with the assistance of staff from the National Park Service and the National Audubon Society. Cape Lookout and Cape Hatteras National Seashores (Figure 1) comprise over 160 km of barrier island habitats that support a population of approximately 90 breeding pairs. The National Audubon Society manages several islands in the Cape Fear region (Figure 1) that provide habitat for an additional 32 pairs of breeding oystercatchers. Ferry Slip and South Pelican Islands are dredge spoil islands at the mouth of the Cape Fear River where large colonies of Royal Terns (*Sterna maxima*), Sandwich Terns (*Sterna sandvicensis*) and Laughing Gulls (*Larus atricilla*) nest. A third island, Battery, is a natural island that has been armored with large sand bags to prevent erosion and over wash. Battery Island is the site of a large wading bird colony comprised of White Ibis (*Eudocimus albus*), Great Egrets (*Ardea alba*), Snowy Egrets (*Egretta thula*) and Great Blue Herons (*Ardea herodius*). It is also host to substantial population of breeding fish crows (*Corvus ossifragus*). Oystercatcher nesting densities on these islands are

much higher than those found on the barrier islands of the Outer Banks. In 2003 the Audubon Society began monitoring nesting success on Lea and Hutaff Islands in Pender County North Carolina. Lea and Hutaff are barrier islands similar to the islands in the national seashores, but they are privately owned and public recreation is limited. The islands recently joined when Topsail Inlet closed to form one island 8 km long (McGowan et al. 2005).

Nesting success

Introduction

We have been monitoring the reproductive success of American Oystercatchers in North Carolina since 1995. Monitoring started on South Core Banks, Cape Lookout National Seashore in 1995, and on North Core Banks in 1998. Productivity monitoring began at Cape Hatteras National Seashore in 1999. Monitoring expanded in 2002 when the North Carolina Audubon Society initiated Oystercatcher monitoring on the dredge spoil islands it manages at the mouth of the Cape Fear River, and on Lea and Hutaff Islands in 2003. Although the undeveloped beaches of the barrier islands that comprise the National Seashores were thought to be ideal breeding habitat for American Oystercatchers, this has not been the case in most years. Novick (1996) found that oystercatcher reproductive success was very low in 1995 and she believed that human disturbance was an important cause of the high rates of nest failure she observed. Davis (1999) continued the monitoring in 1997 and used nest monitoring and predator tracking stations to determine the causes of nest failure. Davis determined that a majority of nests were lost to mammalian predators. Monitoring of American Oystercatcher nesting success on the Outer Banks has continued without interruption since 1997. In the fall of 2003 Hurricane Isabel struck the Outer Banks near Ocracoke Island as a category 2 hurricane with winds between 156 and 165 kph and a 2-3 meter storm surge. This storm dramatically altered parts of the Outer Banks,

knocking down dunes and opening up wide overwash fans. The following year we observed a sharp increase in nesting success on some Outer Banks islands. We hypothesize that the effects of Hurricane Isabel on nesting habitat and predator populations may account for the burst of productivity observed following the storm.

Methods

Nest Monitoring

In 2005, surveys for breeding Oystercatchers on the Outer Banks began in mid April. Nests were located by walking or slowly driving along the barrier beach and back road system. When an adult Oystercatcher was spotted, observers watched for behavioral cues indicating that the bird had a nest. Although nesting Oystercatchers do not usually employ "broken-wing" distraction displays like many smaller shorebirds, they do exhibit easily identifiable behaviors such as false incubating and alarm calling. When birds displaying breeding behavior were identified, scrapes were found by following the tracks of the adult birds or by systematic searches. Once located, nests were marked with a small wooden stick placed near the nest unless surrounding natural items such as driftwood, shells, etc could be used as a natural reference. The location of each nest was also recorded with a handheld Garmin GPS. Nests were checked every 2-4 days until hatching or failure. We made every effort to minimize site disturbance to reduce the effect of our observations on nesting success. If a bird was seen incubating from a distance, the nest was considered active and it was not inspected more closely unless we believed it was about to hatch. When visiting a nest, we never walked directly to the site, and spent a minimal amount of time in the vicinity of the nest. If a nest failed, we attempted to determine the cause by searching the area for predator tracks or other signs of the cause of nest failure. For example, when a storm event washed out a nest, the nest scrape was usually gone and the debris line was

higher than the nest's original location. Unfortunately, such evidence does not last long on the barrier beach, so it was not always possible to determine the causes of nest failure.

Data Analysis

Previous analyses compared estimates of apparent nesting success using the binomial proportion of successful nests to failed nests, with Mayfield nest survival estimates (Mayfield 1961, 1975, Davis, 1999, McGowan 2004). As expected, these results showed that apparent nest success overestimated survival because of nests that failed and were never found. In 2005 we recalculated nest survival for all years and locations using the nest survival module in Program Mark (White and Burnham 1999). This method is similar to the Mayfield method in that a daily survival rate is calculated from nest observation days and thus accounts for missed nests. Program Mark uses a maximum likelihood method to estimate the nest failure date when the time between nest checks is greater than 1 day, and it allows for modeling covariates to explain variations in nest success and the comparison of alternative models using Akaike's Information Criteria (AIC) (Akaike 1973). The average incubation period for oystercatcher nests is 27 days hatch (Nol and Humphreys 1994). To obtain nest survival probabilities we raised estimates of daily survival rates (DSR) to the 27^{th} power. For the purposes of these analyses we assumed no within-habitat heterogeneity in survival probabilities throughout the incubation period. In future work we may be able to test this assumption by calculating the age of nests when they are found, and modeling survival trends across the incubation and nesting periods. We report on 1226 nests monitored from 1995-2005. We used 1046 nests in the Program Mark analysis because data for some nests were not collected in manner consistent with the Program Mark format.

We modeled nest survival for each year and location to identify temporal and spatial variation across the study area. In 2004, the year following Hurricane Isabel, we observed a

sharp increase in nesting success at some locations. We incorporated this into our models as hurricane effects. Five candidate models were compared for each study location; 1) A two parameter model that considered a single year hurricane effect and an average of all non-hurricane years, 2) A pre/post hurricane model that compared nesting success before and after the hurricane, 3) A three parameter model that compared all years before the hurricane, the hurricane year, and the next year after the hurricane. This model allowed for an intermediate drop in nesting success following the productivity boom, rather than an immediate return to pre-hurricane levels or a sustained high productivity, 4) A model that included a separate parameter for each year, suggesting that there was no specific hurricane effect, just inter-annual variation, and 5) a single parameter model that assumed constant survival across the study period.

For islands where a specific hurricane effect was found and where data were available, we used four habitat types (Small Flat, Large Flat, Beach, Dunes) as covariates to identify the effects of habitat on nesting success and examine changes in these effects after the hurricane. We tested for evidence of habitat effects, whether a shift in habitat use occurred following the hurricane, and whether the effect of each habitat was different after the hurricane.

Results

Overall observed hatching success from the beginning of egg laying through hatching for all years was 0.297, and ranged among sites and years from 0.0 to 0.80 (Table 1). In other words, on average, 29.7% of the nests we monitored survived to hatching. This binomial calculation is a simple and unrealistic model for estimating nesting success. The Mark nest survival module accounts for nests that are never found, or nests that fail before they are found. The Program Mark estimate for daily nest survival was 0.949 (95% CI = 0.9430, 0.9507). The probability of a nest surviving to hatching was $0.949^{27} = 0.243$ (95% CI = 0.205, 0.255) that is an

estimated 24.3% of all nests survived to hatching.

The entire 95% confidence interval for the Program Mark estimate of nest survival to hatching is lower than the observed hatching success rate. This means that the binomial success rate is biased high (approximately 5.4%) because it only considers nests that are found and monitored by the observers.

Hatching success was highly variable among years, and among locations. Model results showed that daily survival rates were different among study sites. The AIC measure of model fit for all sites combined (4317.97) was substantially higher than the model that evaluated sites separately (4272.04). In addition, the daily survival rate confidence intervals for the three sites did not overlap, indicating highly significant differences in daily survival among the three major sites (Table 2). Cape Lookout National Seashore had the lowest overall daily survival rate, followed by Cape Hatteras. The study sites in the Cape Fear estuary had the highest overall daily survival rate.

Modeling Hurricane Effects

We compared alternative models of examining the effect of Hurricane Isabel on American Oystercatcher daily survival rates at Cape Hatteras and Cape Lookout National Seashores. The effects of the hurricane were not uniform across the islands. On South Core Banks, Cape Lookout National Seashore, the strongest model support (82%) was assigned to the year effects model (#4), suggesting that any change in nest survival was best explained by normal inter-annual variation. On North Core Banks the model that included a hurricane effect and a separate parameter to allow for a decline in nesting success after the initial effect (#3), was the strongest model (56%). There was also some support for model 2, the simplified pre/post hurricane model. Together, these models provide evidence that Hurricane Isabel had a strong

effect on the daily survival rates of American Oystercatcher nests on North Core Banks.

On Ocracoke and Bodie Islands of Cape Hatteras National Seashore there was support for all three hurricane models and model 5, the constant survival model. There was very little support for the year effects model (#4). This suggests that there was little inter-annual variation and while there may have been a hurricane effect, it was small and primarily occurred in 2004, the year following the hurricane. On Hatteras Island the results were directly opposite. There was strong support for the year effects model (#4) and very little for the constant survival or any of the hurricane models (#5, 1, 2, and 3).

North Core Banks on Cape Lookout showed the strongest hurricane effects. Habitat data for all nests on this island were collected from 1999 – 2005. We found that nest survival increased in all habitats following the hurricane, but the largest increase was for nests in the dune habitat (Table 3). The survival probability for nests in dunes increased from 0.125 prior to Hurricane Isabel (1999-2003), to 0.705 the year following the hurricane (2004). Nest survival in all habitats dropped in 2005, though not to pre-2004 levels. Oystercatcher pairs also shifted habitats in 2004 following the hurricane. Pairs moved away from beach nesting sites entirely, and onto large and small flats created by storm overwash. The percentage of birds nesting on small flats, the most productive habitat type, doubled after the hurricane (Table 4).

Sources of nest failure

Mammalian depredation was the major identifiable cause of nest failure from 1995-2005 at our study sites accounting for approximately 29% of the nest failures observed (Figure 2). The Program Mark estimate of daily survival on Hatteras Island fell from 0.953 (27.3% survival) in the period 1999–2001 to 0.878 (3.0% survival) in 2002, after foxes successfully colonized the island. The daily survival rate increased again to 0.976 (51.9% survival) from 2003-2005 after

control measures were initiated and Hurricane Isabel altered habitats on the Outer Banks. Approximately 12% of nests were lost to over-wash and other weather related causes. Approximately 8% of nests were destroyed by humans (usually vehicles), avian predators, ghost crabs or abandoned for unknown reasons (Figure 2). We could not identify the causes of failure for 51% of failed nests. Because we were not able to observe the causes of most nest failures directly, we had to rely on indirect evidence, such as eggshell fragments or the footprints left by predators, to infer the causes of nest failures. Nests reported as undetermined generally represent nests where wind or water erased any clues of the causes of failure.

Raccoons are the primary mammalian predator on our study sites, and the presence or absence of raccoons has a dramatic effect on daily nest survival rates. Nests on islands with raccoons had a 0.9395 (S.E. (S) = 0.0024) daily survival rate, while nests on islands without raccoons had a 0.9679 (S.E. (S) = 0.0030) daily survival rate. Daily survival for nests not exposed to raccoon depredation was significantly greater than daily survival for nests exposed to raccoon depredation ($Z = 7.29$, $p < 0.0001$).

Discussion

Hatching success is highly variable, but generally very low for American Oystercatchers in North Carolina. Our data show binomial models overestimate hatching success because some nests fail and are never found. Mammalian depredation is the primary source of American Oystercatcher nest failure. Raccoons accounted for most nest failures at Cape Lookout, while foxes, feral cats, and raccoons were important predators at Cape Hatteras. From 1999 – 2003 productivity was significantly greater on islands without raccoons. In 2004 and 2005 these differences were not observed because some islands with poor fledging success experienced a sharp increase in productivity following Hurricane Isabel and because of predator control

measures implemented at Hatteras Island.

Models of the effects of Hurricane Isabel reveal some very interesting patterns. Although significant hurricane damage was evident from New Drum Inlet, Cape Lookout, to Cape Point, Cape Hatteras, not all American Oystercatcher populations were affected in the same way. Daily survival rates on Ocracoke Island, which was directly in the path of the hurricane showed, only a mild, single year hurricane effect that was similar to a model with constant survival over all years. This is probably because Ocracoke was free of raccoons before the hurricane. Oystercatchers on Ocracoke typically had the highest daily nest survival rates of any island on the Outer Banks even before the hurricane, so any new habitat opened up by Isabel was less important to birds nesting on Ocracoke than it was at other locations. In addition, much of the new overwash habitat was quickly eliminated as Route 17 was cleared and the artificial dunes rebuilt over the summer of 2004.

Just across Ocracoke inlet, American Oystercatchers on North Core Banks showed a dramatic increase in nesting success in 2004. Much of the island was overwashed during the hurricane (Figure 3) which created several large flats and numerous small flats and flattened the primary dunes in many areas. Following the hurricane, many Oystercatchers moved their nest sites to take advantage of the new habitat. Prior to the hurricane 23% of nests were found on the beach. In 2004 there were no beach nests, and in 2005 only 7% of Oystercatcher nests were located in this habitat. A habitat shift alone does not explain the high success observed following the hurricane. Nesting success was higher in all habitats after the storm, but most notably in areas previously containing large primary dunes. From 1999 to 2003 only about 12% of nests in dune habitats survived, with mammalian depredation accounting for 78% of failures in this habitat. We often observed raccoon tracks following the dune line and nests in this habitat

more depredation in dunes

were typically easy (for us, and presumably, raccoons) to find. In 2004, 70.4% of nests in dune habitat survived, which was comparable to the high success rates in other habitat, but nest success began to drop again in 2005. Our results suggest that predator populations may have been reduced by the hurricane. If predator populations were unaffected by the storm we would expect to have seen only a modest increase in nesting success due to the creation of new overwash habitats. The high survival of nests in dune habitats suggests that predator populations were reduced by the storm. Although we do not have quantitative estimates of predator abundance for any year of the study, raccoon and feral cat tracks were seen daily on North Core Banks through 2003, but they were very rare in 2004 and uncommon in 2005. The decline of nesting success in 2005, particularly in dune habitat, suggests that the predator populations were already beginning to recover. If this trend holds we would expect to see further decline in nesting success in 2006, possibly back to pre-hurricane levels.

South Core Banks showed a modest increase in nesting success, but it was not outside of the range of annual variation (Table 1). South Core Banks was not in the direct path of the storm and the island is wider and higher than North Core Banks near the south end. Some overwash flats were opened up near the north end of the island, but not to the extent that occurred on North Core Banks. It seems likely that more of the predators survived on South Core, than on North Core Banks, though we have not estimated the size of the predator populations on either island.

Hatteras Island also showed a relationship between nesting success and predators. While model results did not show a hurricane effect for this island, this may be because nesting success was extremely variable and already increasing, even before the storm. After a year of almost complete nest failure in 2002 when foxes colonized the island, the National Park Service initiated a control program, which has continued through 2005. This program appears to have

succeeded because nest survival rebounded in 2003, and increased again in 2004. The relative contributions of the control program versus the hurricane to increases in nest success are unclear. The small number of nests on Bodie Island precludes drawing and meaningful conclusions, but this area supports high populations of raccoons and foxes during the breeding season.

Oystercatcher Chick Survival

Introduction

The sources and timing of mortality are very difficult to determine for precocial shorebird chicks. Chicks often leave the nest within a few hours of hatching, after which they are cryptic and highly mobile. If a chick is lost to predators, exposure, or other factors it is usually impossible to determine the cause of death. Because many breeding attempts fail at this stage, several recent studies have stressed the need for a better understanding of the factors affecting chick mortality (Davis et al. 2001, McGowan, 2005). During the 2005 breeding season we used radio telemetry to monitor chicks on Hatteras Island, Cape Hatteras National Seashore, and North Core Banks, Cape Lookout National Seashore to determine the timing and sources of chick mortality.

Methods

Chicks were radio marked as soon as they were mobile, usually within 24-48 hours of hatching. We attached ATS A2420 transmitters (1.3 grams) to the scapular region of the chick using surgical grade skin glue (Figure 4). Chicks were checked every 24 hours for the first week, and every 1-3 days thereafter. Transmitter range was 400-1000 meters depending on terrain. When a chick died, we located the remains and tried to determine the cause of death. After the same chicks reached four weeks, their ATS transmitters were replaced with PD2 model transmitters from Holohil Systems. These transmitters were designed to last at least six months

and were attached to a permanent leg band (Figure 5).

We monitored chick survival on the other islands of Cape Hatteras and Cape Lookout with the same protocols used in previous years. When a nest hatched, the young were checked every 2-4 days until fledging or until all the chicks were lost. With careful monitoring it was possible to determine annual fecundity, or the number of chicks fledged per pair, although not the cause or exact timing of chick mortality. Adult Oystercatchers exhibit markedly different behavior patterns when they have chicks. They are much more aggressive toward intruders and use different alarms calls. By observing adult behavior it was generally possible to determine whether a pair still had chicks, even if the chicks could not be found. In most cases chicks were located by observing adults from a distance using a spotting scope and a portable blind if necessary. On the rare occasion that a dead chick was found, we attempted to determine the cause of death. We calculated overall fecundity by dividing the number of chicks that survived to fledging by the number of breeding pairs for each year.

Results

We estimated fecundity from 1226 nesting attempts monitored over 11 years. Fecundity was highly variable among years and among locations (Table 1). Only 232 chicks fledged from all our sites between 1995 and 2005. On average, 0.29 chicks fledged for every nesting pair and 0.19 chicks for every nesting attempt. Prior to 2005 sources of chick mortality were not well known, but included starvation, exposure, and vehicle traffic. Mortality from Vehicles was first documented in 2003, when five chicks from three nests on Cape Lookout and Cape Hatteras were run over by off road vehicles. In 2004 at least three chicks from three nests were run over. A fourth chick on North Core Banks died after fledging when it was struck by a vehicle. By using radio transmitters to track oystercatcher chicks on North Core Banks and Hatteras Island in

2005 we were successful in determining sources of chick mortality (Figure 6, Table 5). Two chicks were killed by an ATV on Cape Lookout shortly after starting the study. Other chick predators included Great Horned Owls (*Bubo virginianus*), Fish Crows (*Corvus ossifragus*), Feral Cats (*Felis catus*), American Mink (*Mustela vison*), and Ghost Crabs (*Ocypode quadrata*). 80% of Chick mortality occurred in the first week (Figure 7).

After fledging, radio-marked chicks were tracked daily until mid-August, when field personnel were no longer available. No fledgling mortality occurred during this time (Table 6). A survey flight on September 15th covered the Outer Banks from Nags Head to Morehead City, and located 11 of 14 radio-marked chicks still near their nest sites with adult pairs (Table 6). Two of the three missing chicks were over two months past fledging and could have already migrated. We did not check on the status of the third chick due to an antenna malfunction during the flight. No radio-marked chicks were found during winter boat surveys covering all major roost sites in Virginia, North Carolina and Georgia. Two chicks were found wintering in separate locations in eastern Florida.

Despite high hatching success for the Cape Fear River nests (Table 1), the number of chicks that survived to fledging in 2002 and 2003 was very low. Overall, only 13 chicks of the 68 chicks that hatched on the Cape Fear River islands survived to fledging. Lea and Hutaff Islands had very high hatching and fledging success in 2003. Data for nests on the Cape Fear River and Lea and Hutaff islands were not available for 2004, and 2005 data are still pending from North Carolina Audubon.

Discussion

Estimates of fledging success and fecundity are difficult to obtain for cryptic, highly mobile oystercatcher chicks. Our estimates may be low because it is often difficult to locate

chicks as they get close to fledging. Our estimates of fecundity generally tracked our estimates of nesting success. In 2004, North Core Banks had the highest fledging success of any site or year previously recorded in North Carolina (Table 1). In North American similar high rates of fledging success have only been recorded on a few predator free islands off the Virginia coast (Wilke and Watts 2004).

Radio tagging chicks has given us a better understanding of the causes of nesting failures after hatching. Avian predators played a larger role than previously known. Both Great Horned Owls and Fish Crows were identified as chick predators in 2005. Chicks are clearly most vulnerable during the first week after hatching when 80% of chick mortality occurred (Figure 7).

ORV impacts

Radio tracking also provided new insights about chick behavior. Very young chicks are highly mobile, much more so than we previously believed. Within 24 hours of hatching, adults begin bringing their chicks to the waterline to feed, particularly after dark. This pattern continues throughout the chick-rearing stage. At night, chicks were always located at the waterline or on the open beach. During the day chicks spent most of their time hiding in the dunes. Movement between the dunes and the waterline places young chicks at considerable risk from vehicle traffic. We regularly observed chicks hiding in vehicle tracks in response to adult alarm calls and also observed chicks, and even some adults, running or flying directly into the headlights of oncoming vehicles at night. Shortly after we initiated the radio tracking study, we documented the mortality of a brood of two-day old chicks that were run over by an ATV on North Core Banks. We had radio-tagged the recently hatched brood at the nest on 16 June 2005. That same evening the chicks were relocated hiding in seaweed at the tide line with the adult pair. The following morning we tracked the transmitter signals to a similar location and found

two of the chicks crushed in a fresh ATV tire track, just above the high tide line (Figure 8). These observations highlight the difficulty of documenting the mortality of young Oystercatcher chicks. Without radio telemetry we would likely never have known the fate of the chicks killed on 17 June because the incoming tide would have quickly removed any sign of them. Had that occurred, the cause of nest failure would have been classified as "unknown" which we assign to 42% of our nestling losses because the chicks simply disappear (Figure 6).

The incident was documented by National Park Service law enforcement and we made a separate report to the Superintendent of Cape Lookout National Seashore. Shortly thereafter the National Park Service initiated a new policy under which they closed sections of beach with unfledged chicks to vehicle traffic, and re-routed traffic around the birds via the interdune road. No additional mortality of radio-tagged chicks was documented after this policy was initiated. After the beach sections were closed, chicks were regularly observed on the open beach and at the tide line during daylight hours, suggesting that vehicle traffic was altering chick behavior and foraging patterns. Cape Hatteras National Seashore implemented a policy of completely closing sections of beach with oystercatcher broods in 2005 and no chick mortality due to vehicles was documented. We plan to continue the radio telemetry study in 2006 to further document sources of mortality and explore the relationship between vehicle use, policies, and chick survival.

CALO

American Oystercatcher Demography and Annual Movement Patterns

Introduction

We have been trapping and banding breeding American Oystercatchers on the Outer Banks of North Carolina since 1999. Our goal is to establish a color-banded population to study patterns of dispersal and survival of birds nesting along the Atlantic coast of the southeastern United States. We are currently revising Davis' (1999) demographic model to investigate

population trends. Fecundity and annual adult survival are the only demographic parameters for which we have reasonably reliable estimates for our oystercatcher populations. Other important demographic parameters, including juvenile and sub-adult survival, are not known for American Oystercatchers. Davis and others have stressed the importance of long term banding studies to generate better estimates of demographic rates. As we attempt to estimate these rates, we are currently using juvenile survival rates, sub-adult survival rates, and sub-adult transition probabilities from long-term studies of the European Oystercatcher (*Heamatopus ostralegus*) (Boyd 1962; Harris 1967; Goss-Custard et al. 1982; Safriel et al. 1984; Ens et al. 1995; Kersten and Brenninkmeijer 1995).

Our model can be used to estimate the probability that a population will decline, go extinct, or increase over time given assumptions about population size and vital rates (Akçakaya et al. 1999, Mace et al. 2001, Lande 2002). Additionally the model can be used to test the sensitivity of the population to each demographic parameter (Akçakaya et al. 1999, Mace et al. 2001, Lande 2002). These analyses provide a useful framework for assessing the relative costs and benefits of various management options for American Oystercatchers on the Outer Banks of North Carolina. Our model results show that American Oystercatcher populations are most sensitive to variations in adult survival and high variation in annual fecundity.

Interest in American Oystercatcher research has grown over the past few years. In addition to the work in North Carolina, there are color-banding projects in Massachusetts, New Jersey, Virginia, South Carolina, and Georgia. All researchers working with American Oystercatchers have agreed on a uniform banding and reporting scheme. In 2004 a large scale coordinated resighting effort was initiated to expand and standardize the largely ad hoc and opportunistic efforts to date. A central database of all banded oystercatchers and resightings is

now maintained at North Carolina State University. We are currently using data from this coordinated resighting effort to estimate key demographic parameters, including survival and transition rates for each age class. Using these estimates we hope to generate much more accurate population models than are currently available. Better population models are important for assessing the effects of management actions and projecting future population trends.

Communication among scientists, and managers involved in American Oystercatcher research is facilitated by a website maintained at NCSU (Simons and Schulte, http://www2. ncsu. edu/unity/lockers/project/grsmgis/AMOY/Research. htm). The site contains information on current American Oystercatcher research and monitoring efforts in North America. Sightings of banded birds are reported through this site and added to the central database. The site has proven to be an excellent tool for public education and involvement.

Methods

Adult birds were captured using a decoy and noose carpet method developed at NCSU (McGowan and Simons 2005). A remote-controlled decoy and song playback device is used to lure territorial breeding oystercatchers to a bal-chatri type noose carpet (Berger and Mueller 1959, Bub 1991). The noose carpets are made out of four-foot by one-foot panels of one-inch by one-inch welded wire fencing. Each panel is covered with hundreds of slipknot "nooses" tied from 50 lb. test clear fishing line. The panels are staked down and covered with one to two inches of sand so that the nooses protrude out of the sand. We placed several panels around an oystercatcher decoy in the middle of an active oystercatcher territory (Figure 9). Placing the decoy in an active breeding territory stimulates the resident pair to display to and attack the decoy as if it were a real intruder. Eventually the bird's tangle their feet in the slip-knot nooses as they approach the decoy.

In 2005 we used a cast resin oystercatcher decoy made by Mad River Decoy (Figure 10). This decoy was much more durable than previous foam and light wood versions and held up to the rigors of the field season. We mount the decoy on a wooden box containing two radio-controlled servomotors. The motors and controller were adapted from a standard model airplane remote control kit available at many hobby shops. One servomotor turns the decoy from side to side. The second servomotor activates a mercury tip switch that controls an amplified speaker and mp3 player with oystercatcher territorial calls. The device allows us to move the decoy and play calls at will. We are most successful trapping birds just prior to egg laying when they are courting and making nest scrapes, although the method works well throughout the nesting season.

We successfully trapped 98 breeding adults from 2002 to 2005 using this method, and we found that it is an effective way to trap breeding adult birds with minimal disturbance to the nest site. No injuries, aside from very minor skin abrasions on the tibiotarsus, have resulted from our trapping efforts. The trap consists of a set of noose carpets (Bub 1991) that are partially buried in the sand.

Captured adults and chicks were originally marked with steel USFWS bands and combinations of Darvic color bands (Figure 11). Under a new cooperative banding scheme, adopted by all researchers in the American Oystercatcher working group and approved by the Bird Banding Lab, birds are now marked with two identical bands engraved with a unique two-digit code as well as a metal USFWS band. North Carolina bands are green with white lettering (Figure 12). Other states are using yellow with black lettering (Massachusetts), orange with black lettering (New Jersey), black with white lettering (Virginia), blue with white lettering (South Carolina), and red with white lettering (Georgia). See Table 7 for a complete list of

oystercatchers banded in North Carolina.

Results

Seventy-four individual birds banded in North Carolina have been resighted on their wintering habitats from Virginia to the Gulf Coast of Florida (Figure 13). Many reports are from Cape Romain National Wildlife Refuge, SC where up to 20% of the oystercatcher population in North America winters. An individual banded as a chick near Buxton Village in Cape Hatteras National Seashore was reported by three different people in Fort Myers Beach Florida in the winter and spring of 2003. This bird was seen again in Forth Myers in the winter of 2003-2004 and in June of 2004 it returned within a few miles of its hatch site on Cape Hatteras. This bird returned again in 2005, paired and defended a territory on Cape Hatteras, but it was not observed nesting. At least six other Oystercatchers that hatched in 2001 and 2002 returned to the Outer Banks in the summer of 2004. None of these birds nested, but several were observed exhibiting territorial behavior and fighting with resident adults (McGowan et al. 2005). In 2005 a bird banded as a chick on North Core Banks in 2002 returned to the island, paired successfully, and fledged a chick. This is the first record of the age of first breeding in American Oystercatchers.

Discussion

The color banding effort has already produced better estimates of adult survival, and the annual movement patterns of birds in all age classes. We now know that members of family groups do not migrate together and may disperse across the range of the species. Additional observations will make it possible to estimate the average age of first breeding, and rates of return and recruitment. Age of first breeding is an important metric, because it provides the best evidence of density dependence. Delayed breeding, a result of older experienced birds excluding younger birds from nesting areas, is typical of populations experiencing density dependence. In

2006 we will conduct comprehensive resight surveys throughout the Outer Banks to document the survival and movement of banded adults, and the return rates of subadults. We will focus on increasing the number of banded pairs by catching unbanded members of breeding pairs. In 2006 season we plan to band the entire cohort of American Oystercatcher chicks that fledge from Cape Hatteras and Cape Lookout National Seashores.

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Tables and Figures.

Table 1. American Oystercatcher productivity in North Carolina from 1995-2005.

Year and Location	Breeding pairs	Clutches	Nests hatched	Nest survival (observed)	Nest survival (Mark)	Chicks fledged	Fecundity (Chicks/pair)
North Core Banks							
1998	32	72	5	0.069	NA	4	0.13
1999	33	61	11	0.180	0.170	5	0.15
2000	29	36	7	0.194	0.248	1	0.03
2001	22	52	11	0.212	0.173	2	0.09
2002	22	46	5	0.109	0.084	5	0.23
2003	19	37	7	0.189	0.157	2	0.11
2004	22	25	20	0.800	0.736	33	1.50
2005	16	20	11	0.550	0.453	6	0.38
Middle Core Banks							
2004	5	5	4	0.800	0.008	7	1.40
2005	7	9	5	0.556	0.511	9	1.29
South Core Banks							
1995	20	36	12	0.333	NA	7	0.35
1997	22	34	4	0.118	0.036	2	0.09
1998	28	26	7	0.269	0.135	2	0.07
1999	28	52	5	0.096	0.115	1	0.04
2000	22	39	18	0.462	0.303	8	0.36
2001	24	57	8	0.140	0.158	1	0.04
2002	22	44	5	0.114	0.061	1	0.05
2003	21	59	9	0.153	0.121	6	0.29
2004	20	31	13	0.419	0.279	6	0.30
2005	24	27	9	0.333	0.317	4	0.17
Ocracoke Island							
1996	12	12	8	0.667	NA	8	0.67
1999	15	17	7	0.412	0.321	2	0.13
2000	12	17	6	0.353	0.270	7	0.58
2001	13	15	11	0.733	0.624	17	1.31
2002	12	18	6	0.333	0.266	3	0.25
2003	8	12	4	0.333	0.255	1	0.13
2004	9	11	7	0.636	0.566	8	0.89
2005	5	10	3	0.300	0.295	1	0.20
Hatteras Island							
1997	22	26	13	0.500	NA	8	0.36
1999	24	31	7	0.226	0.287	3	0.13

Table 1 (cont.). American Oystercatcher productivity in North Carolina from 1995-2005.

Year and Location	Breeding pairs	Clutches	Nests hatched	Nest survival (observed)	Nest survival (Mark)	Chicks fledged	Fecundity (Chicks/pair)
2000	23	29	10	0.345	0.265	2	0.09
2001	24	28	10	0.357	0.259	6	0.25
2002	21	25	3	0.120	0.030	4	0.19
2003	14	21	8	0.381	0.372	4	0.29
2004	15	18	14	0.778	0.703	9	0.60
2005	17	25	13	0.520	0.501	10	0.59
Bodie Island							
1996	2	2	1	0.500	NA	2	1.00
1999	2	2	0	0.000	0.030	0	0.00
2000	2	3	0	0.000	0.081	0	0.00
2001	2	3	1	0.333	0.285	1	0.50
2002	3	5	1	0.200	0.138	2	0.67
2003	5	5	1	0.200	0.307	0	0.00
2004	3	7	0	0.000	0.091	0	0.00
2005	2	3	1	0.333	0.390	0	0.00
Cape Fear Islands							
2002	32	48	27	0.563	0.534	6	0.19
2003	34	49	15	0.306	0.367	7	0.21
Lea and Hutaff Islands							
2003	16	16	11	0.688	0.617	9	0.56
Total/mean	**787**	**1226**	**364**	**0.297**	**0.243**	**232**	**0.29**

Table 2. Differences in overall daily nest survival rates among study sites in North Carolina.

Site	Daily Survival Rate	Standard Error	95% CL (lower)	95% CL (upper)
Cape Lookout	0.9387751	0.0026583	0.9333528	0.9437828
Cape Hatteras	0.9570017	0.0030243	0.950668	0.9625542
Cape Fear Estuary	0.971848	0.0035899	0.9638899	0.9780921

Table 3. Program Mark nest survival by habitat on North Core Banks, Cape lookout National Seashore.

Year	Beach	Large Flat	Small Flat	Dunes
1999-2003	0.168	0.161	0.218	0.003
2004	NA	0.736	0.775	0.705
2005	0.476	0.466	0.531	0.42

Table 4. Percentage of nests by habitat type on North Core Banks, Cape Lookout National Seashore.

Year	Beach	Large Flat	Small Flat	Dunes
1999-2003	23	31	16	30
2004	0	42	31	27
2005	7	14	34	45

Table 5. Timing and sources of pre-fledging mortality of radio-marked American Oystercatcher chicks on Cape Hatteras and Cape Lookout National Seashores in 2005.

Chick ID	Hatch Date	End Date	Survival days	Outcome	Cause of Mortality[a]
Cape Hatteras National Seashore					
B3_A	5/25/2005	7/7/2005	43	Fledged	
H5_A	5/27/2005	7/1/2005	35	Fledged	
H5_B	5/27/2005	7/1/2005	35	Fledged	
O5_A	6/2/2005	6/6/2005	4	Died	Unknown
O5_B	6/2/2005	6/6/2005	4	Died	Unknown
B7_A	6/11/2005	7/27/2005	46	Fledged	
B7_B	6/11/2005	7/5/2005	24	Died	Unknown
B7_C	6/11/2005	6/24/2005	13	Died	Unknown; Collected chick
B6_A	6/12/2005	6/14/2005	2	Died	Crow depredation
H8_A	6/16/2005	7/28/2005	42	Fledged	
H8_B	6/16/2005	7/28/2005	42	Fledged	
B2_A	6/17/2005	7/9/2005	22	Died	Cat depredation
B2_B	6/17/2005	7/9/2005	22	Died	Cat depredation
B9_A	6/18/2005	6/20/2005	2	Died	Unknown; Chick dead in nest
H10_A	6/18/2005	6/24/2005	6	Died	Mink depredation
H10_B	6/18/2005	6/24/2005	6	Died	Mink depredation
H10_C	6/18/2005	6/24/2005	6	Died	Crow depredation
H4_A	7/2/2005	7/11/2005	9	Died	Unknown
H4_B	7/2/2005	8/6/2005	35	Fledged	
H12_A	7/7/2005	7/10/2005	3	Died	Unknown
H12_B	7/7/2005	7/11/2005	4	Died	Unknown
H12_C	7/7/2005	8/17/2005	41	Fledged	
H1_A	7/29/2005	8/6/2005	8	Died	Ghost crab
Cape Lookout National Seashore					
N02_A	5/29/2005	7/1/2005	33	Fledged	
N03_A	6/3/2005	6/5/2005	2	Died	Exposure from storm
N03_B	6/3/2005	6/5/2005	2	Died	Exposure from storm
N03_C	6/3/2005	6/5/2005	2	Died	Exposure from storm

Table 5 (cont.). Timing and sources of pre-fledging mortality of radio-marked American Oystercatcher chicks on Cape Hatteras and Cape Lookout National Seashores in 2005.

Chick ID	Hatch Date	End Date	Survival days	Outcome	Cause of Mortality[a]
N04_A	6/13/2005	7/21/2005	38	Fledged	
N04_B	6/13/2005	7/21/2005	38	Fledged	
N01_A	6/15/2005	6/17/2005	2	Died	Unknown
N01_B	6/15/2005	6/18/2005	3	Died	Great Horned Owl
N07_A	6/14/2005	7/20/2005	36	Fledged	
N08_A	6/15/2005	6/17/2005	2	Died	ATV
N08_B	6/15/2005	6/17/2005	2	Died	ATV
N08_C	6/15/2005	6/17/2005	2	Died	Ghost crab
N10_A	6/14/2005	6/19/2005	5	Died	Unknown
N10_B	6/14/2005	7/17/2005	33	Died	Great Horned Owl
N16_A	6/23/2005	6/30/2005	7	Died	Unknown
N16_B	6/23/2005	7/26/2005	33	Fledged	
N05_A	6/26/2005	6/29/2005	3	Died	Unknown
N14_A	7/13/2005	7/19/2005	6	Died	Unknown
N14_B	7/13/2005	8/14/2005	32	Died	Cat depredation
N12_A	7/3/2005	7/5/2005	2	Died	Injuries to head - siblicide?
N12_B	7/3/2005	8/5/2005	33	Fledged	

[a] The cause of mortality was unknown when both the chick and transmitter disappeared.

Table 6. Post-fledging monitoring of radio-tagged American Oystercatcher chicks from Cape Hatteras and Cape Lookout National Seashores in 2005.

Chick ID	Fledge Date	Last Monitoring Date	Detected on aerial survey (9/15/2005)	Detected on winter boat surveys	Winter Location
H5_A	7/1/2005	8/20/2005	X		
H5_B	7/1/2005	8/20/2005	X		
B3_A	7/7/2005	8/19/2005			
B7_A	7/27/2005	8/19/2005	X		
H8_A	7/28/2005	8/20/2005	X		
H8_B	7/28/2005	8/20/2005	X		
H4_B	8/6/2005	8/20/2005	X		
H12_C	8/17/2005	8/20/2005			
N02_A	7/1/2005	8/17/2005			
N04_A	7/21/2005	8/17/2005	X	X	Indian River County, Fl
N04_B	7/21/2005	8/17/2005	X		
N07_A	7/20/2005	8/17/2005	X		
N16_B	7/26/2005	8/17/2005	X		
N12_B	8/5/2005	8/17/2005	X	X	Duval County, Fl

Table 7. Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
805-60021	5/10/1999	CALO - NCB	-;DB(1)/S	-;-	Adult
805-60022	5/11/1999	CALO - NCB	-;DG(1)/S	-;-	Adult
805-60024	5/12/1999	CALO - NCB Mile 21.3	-;GF/S	-;RD/WH	Adult
805-60026	5/12/1999	CALO – NCB	WH;GF/S	WH;DB/RD	Adult
805-60027	5/13/1999	CALO – NCB	WH;DG(B)/S	WH;-	Adult
805-60038	5/12/2000	CALO – NCB	-;S	-;DB(7)/DG(5)	Adult
805-60039	5/16/2000	CALO – NCB	-;S	-;DG(6)/RD(5)	Adult
805-60040	5/16/2000	CALO – NCB	-;S	-;RD(6)/DB(8)	Adult
805-60041	5/17/2000	CALO – NCB	-;S	-;YE(9)/DG(7)	Adult
805-60042	5/19/2000	CALO – NCB	-;S	-;DG(8)/RD(7)	Adult
875-98376	5/19/2000	CALO - NCB - Mile 4.3	DG(37);-	DG(37);S	Adult
805-60044	6/12/2000	CALO – NCB	-;S	-;YE(8)/DB(10)	Adult
805-60049	6/28/2000	CALO – NCB	-;S	-;RD(8)/DG(10)	Adult
805-60050	7/5/2000	CALO - NCB	-;S	-;DG(14)/YE(10)	Adult
805-60051	5/25/2001	CALO - NCB Mile 3.7	-;DG/S	-;DB	Adult
805-60052	5/25/2001	CALO - NCB Mile 3.5	-;DG/S	-;RD	Adult
805-60053	5/26/2001	CALO - NCB Mile 4.7	-;DG/S	-;YE	Adult
805-60055	5/31/2001	CALO - NCB Mile 6.6	DG(B);DG/S	-;WH	Adult
805-60056	6/3/2001	CALO - NCB Mile 16.3	-;GF/S	-;DB/OR	Adult
805-60058	6/12/2001	CALO - NCB Mile 5.9	-;GF/S	-;YE/DG	Adult

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
805-60060	6/17/2001	CALO - NCB Mile 8.4	-;S	-;WH/OR	Adult
805-60061	6/18/2001	CALO - NCB Mile 11.7	-;S	-;WH/DB	Adult
805-60062	6/18/2001	CALO - NCB Mile 11.7	-;S	RD;DG/RD	Adult
805-60064	6/19/2001	CALO - SCB Mile 38	-;S	-;RD/OR	Adult
805-60067	7/13/2001	CALO - NCB Mile 8.9	-;S	-;OR/OR	Adult
805-60068	3/28/2002	CALO - NCB Mile 13.8	YE;S	YE;OR/RD	Adult
805-60069	4/1/2002	Battery Is.	OR;GF/S	OR;YE/RD	Adult
805-60070	4/1/2002	Battery Is.	WH;DG/S	DB;-	Adult
805-60074	5/17/2002	CALO - NCB Mile 0.0	WH;GF/S	WH;RD/RD	Adult
875-98366	5/21/2002	CAHA - Hatteras Island Mile 28	DG(28);-	DG(28);S	Adult
805-60076	5/21/2002	CAHA - Hatteras Island South Beach	WH;S	WH;DG/DG	Adult
805-60078	5/22/2002	CAHA - Ocracoke Island	WH;GF/S	WH;DB/DB	Adult
805-60080	5/27/2002	CALO - SCB Mile 38	OR;S	OR;WH/WH	Adult
805-60082	5/28/2002	CALO - SCB The Spit	OR;GF/S	OR;OR/OR	Adult
875-98375	5/31/2002	CALO - NCB Mile 6.15	OR;DG/S	OR;DB/DB	Adult
805-60084	6/1/2002	CALO - NCB Mile 8.4	DB;S	WH;DB/WH	Adult
805-60086	6/9/2002	CAHA - Hatteras Island Buxton	RD;GF/S	DB;RD/RD	Adult
875-98362	6/13/2002	CAHA - Hatteras Island Buxton	DG(24);-	DG(24);S	Adult
805-60094	6/17/2002	Battery Is.	-;GF/S	RD;OR/WH	Adult
805-60097	6/18/2002	Battery Is.	DG;GF/S	-;WH/DG	Adult
805-60099	6/18/2002	South Pelican Is.	YE;GF/S	RD;DB/YE	Adult
805-60028	5/9/1999	CALO - NCB	-;DB(3)/S	-;RD(6)	Chick
805-60029	5/9/1999	CALO - NCB	-;DB(3)/S	-;DG(2)	Chick
805-60030	5/9/1999	CALO - NCB	-;-	-;YE(3)/S	Chick
805-60034	6/22/1999	CALO - NCB	-;-	-;DG(3)/S	Chick
805-60035	6/27/1999	CALO - NCB	-;-	-;RD(3)/S	Chick
805-60036	6/28/1999	CALO - NCB	-;YE(4)/S	-;RD(4)	Chick
805-60037	6/28/1999	CALO - NCB	-;DB(5)/S	-;DG(4)	Chick
805-60045	6/22/2000	CALO - NCB Mile 18.5	-;DG(9)/S	-;-	Chick
805-60046	6/17/2000	CALO – SCB	-;DG(11)/S	-;-	Chick
805-60047	6/8/2000	CALO – SCB	DB;GF/S	YE;DG/RD	Chick
805-60048	6/8/2000	CALO – SCB	-;DG(13)/S	-;-	Chick
805-60054	5/31/2001	CALO – NCB Mile 9.6	-;DG/S	-;DG	Chick
805-60057	6/5/2001	CALO – NCB Mile 10.3	-;GF/S	-;OR	Chick
805-60059	7/1/2001	CALO – NCB Mile 0.0	-;GF/S	-;OR/YE	Chick
805-60063	6/19/2001	CALO – SCB Mile 38	-;DG/S	-;RD/DB	Chick
805-60065	7/12/2001	CALO – NCB Mile 0.2	-;GF/S	-;RD/YE	Chick
805-60066	7/13/2001	CALO – NCB Mile 8.9	-;GF/S	-;WH/WH	Chick
805-60071	5/13/2002	Battery Island	-;GF/S	-;WH/RD	Chick
805-60072	5/13/2002	Battery Island	-;GF/S	-;OR/DB	Chick

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
805-60073	5/13/2002	Battery Is.	-;GF/S	-;DB/WH	Chick
805-60077	5/22/2002	CAHA – Ocracoke Island	-;DG/S	-;YE/DB	Chick
805-60079	5/25/2002	CALO – NCB Mile 9.55	WH;DG/S	-;YE/DB	Chick
805-60081	5/28/2002	CALO – SCB The Spit	-;GF/S	-;YE/WH	Chick
805-60085	6/1/2002	CALO – NCB Mile 5.9	-;GF/S	WH;RD/WH	Chick
805-60087	6/11/2002	CAHA – Hatteras Island Buxton	-;GF/S	-;OR/DG	Chick
805-60088	6/11/2002	CAHA – Hatteras Island Buxton	RD;GF/S	DB;OR/DG	Chick
805-60089	6/11/2002	CAHA – Hatteras Island Buxton	YE;GF/S	YE;YE/YE	Chick
805-60091	6/14/2002	CAHA – Ocracoke Island	YE;-	-;GF/S	Chick
805-60092	6/14/2002	CAHA – Ocracoke Island	RD;GF/S	-;-	Chick
805-60093	6/16/2002	CALO – NCB Mile 9.55	-;DG	RD;S	Chick
805-60095	6/17/2002	South Pelican Is.	WH;GF/S	-;RD/RD	Chick
805-60096	6/17/2002	South Pelican Is.	YE;GF/S	DB;OR	Chick
805-60098	6/18/2002	Battery Is.	-;GF/S	-;RD/RD	Chick
805-60100	6/29/2002	CALO – NCB Mile 9.55	DB;-	RD;S	Chick
975-85201	7/1/2002	CALO – NCB Mile 2.3	-;GF/S	-;DG/YE	Chick
975-85202	7/1/2002	CALO – NCB Mile 2.3	RD;S	-;YE	Chick
975-85203	5/27/2003	Battery Is.	WH;DG(A)/S	YE;-	Chick
975-85204	5/27/2003	South Pelican Is.	RD;DG(A)/S	OR;-	Chick
975-85205	6/1/2003	CAHA – Hatteras Island	-;DG(A)/S	-;DB/DB	Chick
975-85206	6/2/2003	CAHA – Ocracoke Island	OR;DG(B)/S	OR;-	Adult
975-85207	6/5/2003	CALO – SCB mile 24.1	YE;DG(B)/S	WH;-	Adult
975-85208	6/6/2003	CALO – SCB mile 39.75	RD;DG(B)/S	YE;-	Adult
875-98335	6/6/2003	CALO – SCB, Cape point	DG(16);-	DG(16);S	Adult
975-85291	6/18/2003	CALO – NCB mile 3.2	S;-/DG(A)	WH;OR/OR	Chick
975-85210	6/18/2003	CALO – NCB mile 3.2	DG(H);-/DG(A)	WH;OR/S	Chick
975-85293	6/23/2003	CALO – NCB mile 10.4	S;-/DG(A)	-;DG/WH	Chick
975-85211	6/25/2003	CALO – SCB mile 40.55	-;-/DG(A)	RD;RD/RD/S	Chick
875-98321	4/17/2004	CAHA – Hatteras Island South Beach	DG(01);-	DG(01);S	Adult
875-98322	4/17/2004	CAHA – Hatteras Island Hatteras Inlet	DG(02);-	DG(02);S	Adult
875-98323	5/4/2004	CALO – NCB mile 3.0	DG(03);-	DG(03);S	Adult
875-98324	5/6/2004	CALO – NCB mile 9.5	DG(04);-	DG(04);S	Adult
875-98325	5/15/2004	CAHA – Hatteras Island – North of Buxton	DG(05);-	DG(05);S	Adult
875-98326	5/15/2004	CAHA – Hatteras Island – North of Buxton	DG(06);-	DG(06);S	Adult
875-98327	5/16/2004	CAHA – Hatteras Island, Cape Point	DG(07);-	DG(07);S	Adult
875-98328	5/17/2004	CALO – NCB Mile 0.0	DG(08);S	DG(08);-	Adult

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
875-98329	5/18/2004	CALO - NCB Mile 0.0	DG(09);-	DG(09);S	Adult
875-98330	5/24/2004	CAHA - Green Island	DG(10);-	DG(10);S	Adult
875-98331	5/24/2004	CAHA - Green Island	DG(11);-	DG(11);S	Adult
875-98332	5/24/2004	CAHA - Hatteras Island, South Beach	DG(12);-	DG(12);S	Adult
2406-00411	5/25/2004	CAHA - Ocracoke, Pair O08	DG(13);-	DG(13);S	Adult
875-98333	5/25/2004	CAHA - Ocracoke, Pair O07	DG(14);-	DG(14);S	Adult
875-98334	5/26/2004	CALO – NCB Mile 6.15	DG(15);-	DG(15);S	Adult
875-98336	5/28/2004	CALO - SCB Mile 37.3	DG(17);-	DG(17);S	Adult
2406-00412	5/29/2004	CALO – NCB Mile 18.5	DG(18);-	DG(18);S	Adult
875-98338	5/31/2004	CALO - NCB Mile 0.0	DG(19);-	DG(19);S	Chick
875-98339	5/31/2004	CALO - NCB Mile 0.0	DG(20);-	DG(20);S	Chick
875-98340	6/1/2004	CAHA - Ocracoke Inlet	DG(21);-	DG(21);S	Adult
875-98361	6/1/2004	CAHA – Ocracoke, Pair O1	DG(22);-	DG(22);S	Adult
2406-00413	6/1/2004	CAHA – Buxton Washout	DG(23);-	DG(23);S	Adult
875-98363	6/2/2004	CAHA - Hatteras Inlet	DG(25);-	DG(25);S	Adult
875-98364	6/3/2004	CAHA - 1 Mile North of Ramp 34	DG(26);-	DG(26);S	Adult
875-98365	6/3/2004	CAHA - 1 Mile North of Ramp 34	DG(27);-	DG(27);S	Adult
875-98368	6/7/2004	CALO - SCB Mile 39.7	DG(29);-	DG(29);S	Chick
875-98367	6/8/2004	CALO - NCB Mile 10.3	DG(30);-	DG(30);S	Adult
875-98369	6/9/2004	CALO - NCB Mile 0.0	DG(31);-	DG(31);S	Chick
875-98370	6/10/2004	CALO - NCB Mile 18.5	DG(32);-	DG(32);S	Chick
875-98371	6/10/2004	CALO - NCB Mile 18.5	DG(33);-	DG(33);S	Chick
875-98372	6/10/2004	CALO - NCB Mile 6.9	DG(34);-	DG(34);S	Chick
875-98373	6/10/2004	CALO - NCB Mile 6.9	DG(35);-	DG(35);S	Chick
875-98374	6/11/2004	CALO - NCB Mile 8.9	DG(36);-	DG(36);S	Chick
875-98377	6/16/2004	CALO – MCB - Mile 0.6	OR;DG/S	DB;DB	Chick
875-98378	6/16/2004	CALO – MCB - Mile 0.6	DB;DG/S	DB;RD	Chick
875-98379	6/16/2004	CALO – MCB - Mile 0.6	RD;DG/S	YE;WH	Chick
875-98380	6/17/2004	CALO - NCB Mile 6.9	DG(38);-	DG(38);S	Chick
875-98381	6/18/2004	CAHA - Ocracoke Inlet.	DB;DG/S	YE;WH	Chick
875-98382	6/18/2004	CAHA - Ocracoke Inlet.	OR;DG/S	YE;DB	Chick
875-98383	6/18/2004	CAHA - Hatteras Island Hatteras Inlet	RD;DG/S	OR;WH	Chick
875-98384	6/19/2004	CAHA - 0.8 miles south of Ramp 27	DG(56);-	DG(56);S	Chick
875-98385	6/19/2004	CAHA - 0.8 miles south of Ramp 27	DG(57);-	DG(57);S	Chick
875-98386	6/19/2004	CAHA - 1 mile S of Ramp 27	WH;DG/S	DG;WH	Chick

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
875-98387	6/19/2004	CAHA - 0.8 miles south of Ramp 27	DG(58);-	DG(58);S	Chick
875-98388	6/22/2004	CALO - NCB Mile 7.15	DG(39);-	DG(39);S	Adult
875-98389	6/22/2004	CALO - NCB Mile 6.01	DG(40);-	DG(40);S	Adult
875-98390	6/23/2004	CALO - Old Dump Island at Old Drum Inlet	DB;DG/S	RD;RD	Chick
875-98391	6/26/2004	Sandbag Island.Pair S02	DG(41);-	DG(41);S	Chick
875-98392	6/26/2004	Sandbag Island.Pair S02	DG(42);-	DG(42);S	Chick
875-98393	6/26/2004	Sandbag Island.Pair S02	DG(43);-	DG(43);S	Chick
875-98394	6/27/2004	CALO - NCB Mile 6.01	DG(44);-	DG(44);S	Chick
875-98395	6/27/2004	CALO - NCB Mile 6.01	DG(45);-	DG(45);S	Chick
875-98396	6/27/2004	CALO - NCB Mile 2.0	DG(46);-	DG(46);S	Chick
875-98397	6/27/2004	CAHA – Ocracoke - Pair O07	DG(47);-	DG(47);S	Chick
875-98398	6/27/2004	CAHA – Ocracoke - Pair O07	DG(48);-	DG(48);S	Chick
875-98399	6/27/2004	CAHA – Ocracoke - Pair O03	DG(49);-	DG(49);S	Chick
875-98400	6/27/2004	CAHA – Ocracoke - Pair O05	DG(50);-	DG(50);S	Chick
875-98421	6/27/2004	CAHA – Ocracoke - Pair O06	DG(51);-	DG(51);S	Adult
875-98422	6/28/2004	CAHA - Avon - 0.9 Miles North of Ramp 34.	DG(52);-	DG(52);S	Chick
875-98423	6/28/2004	CAHA - Avon - 0.9 Miles North of Ramp 34.	DG(53);-	DG(53);S	Chick
875-98424	6/28/2004	CAHA - 1.4 miles south of Ramp 27.	DG(54);-	DG(54);S	Chick
875-98425	6/28/2004	CAHA - 1.4 miles south of Ramp 27.	DG(55);-	DG(55);S	Chick
875-98426	6/28/2004	CAHA - 1.4 miles south of Ramp 27	DG(59);-	DG(59);S	Adult
875-98427	6/29/2004	CALO - NCB Mile 6.01	DG(60);-	DG(60);S	Chick
875-98428	6/29/2004	CALO - NCB Mile 7.15	DG(61);-	DG(61);S	Chick
875-98429	6/30/2004	CALO - NCB Mile 6.3	DG(62);-	DG(62);S	Chick
875-98430	6/30/2004	CALO - NCB Mile 9.5	DG(63);-	DG(63);S	Chick
875-98431	6/30/2004	CALO - NCB Mile 7.15	DG(64);-	DG(64);S	Chick
875-98432	6/30/2004	CALO - NCB Mile 7.15	DG(65);-	DG(65);S	Chick
875-98433	6/30/2004	CALO - NCB Mile 10.3	DG(66);-	DG(66);S	Chick
875-98434	6/30/2004	CALO - NCB Mile 10.3	DG(67);-	DG(67);S	Chick
875-98435	7/1/2004	CALO - NCB Mile 3.9	DG(68);-	DG(68);S	Chick
875-98436	7/1/2004	CALO - NCB Mile 3.9	DG(69);-	DG(69);S	Chick
875-98437	7/1/2004	CALO - NCB Mile 3.9	DG(70);-	DG(70);S	Chick
875-98348	7/3/2004	CALO - NCB Old Drum Inlet	DG(71);-	DG(71);S	Chick
875-98349	7/3/2004	CALO - NCB Old Drum Inlet	DG(72);-	DG(72);S	Chick
875-98350	7/3/2004	CALO - NCB Mile 9.5	DG(73);-	DG(73);S	Adult
875-98441	7/3/2004	CALO - NCB Mile 6.3	DG(74);-	DG(74);S	Chick
875-98442	7/4/2004	CALO - NCB Mile 3.4	DG(75);-	DG(75);S	Chick
875-98443	7/4/2004	CALO - NCB Mile 3.4	DG(76);-	DG(76);S	Chick

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
875-98444	7/19/2004	Cape Fear - Ferry Slip Island	DG(77);-	DG(77);S	Chick
875-98445	7/19/2004	Cape Fear - Ferry Slip Island	DG(78);-	DG(78);S	Chick
875-98446	7/19/2004	Cape Fear - South Pelican Is.	DG(79);-	DG(79);S	Chick
875-98447	7/19/2004	Cape Fear - South Pelican Is.	DG(80);-	DG(80);S	Chick
875-98448	7/22/2004	CALO - SCB mile 22.6 nest 28	DG(81);-	DG(81);S	Chick
875-98449	7/22/2004	CALO - SCB mile 22.6 nest 28	DG(82);-	DG(82);S	Chick
875-98450	7/29/2004	CAHA - Ocracoke Pair O03	DG(83);-	DG(83);S	Chick
875-98451	7/29/2004	CAHA - Ocracoke Pair O03	DG(84);-	DG(84);S	Chick
875-98452	8/1/2004	CALO – NCB Mile 6.15	DG(85);-	DG(85);S	Chick
875-98453	8/5/2004	CALO - SCB Mile 23.5	DG(86);-	DG(86);S	Chick
875-98454	8/5/2004	CALO - SCB Mile 23.5	DG(87);-	DG(87);S	Chick
875-98455	3/19/2005	CAHA - Hatteras Is, Hatteras inlet	DG(88)	DG(88);S	Adult
875-98456	3/20/2005	Ocracoke Inlet – Shellcastle/ Ballast rocks Is.	DG(89)	DG(89);S	Adult
875-98457	3/20/2005	Ocracoke Inlet -Shellcastle/ Ballast rocks Is.	DG(90)	DG(90);S	Adult
875-98458	3/20/2005	Ocracoke inlet – Shellcastle/ Northernmost marsh Is.	DG(91)	DG(91);S	Adult
875-98459	3/21/2005	CAHA -Hatteras Is, Hatteras spit, the breach	DG(92)	DG(92);S	Adult
875-98460	4/1/2005	CAHA - Bodie Island spit.	DG(A1)	DG(A1);S	Adult
875-98461	4/2/2005	CAHA - 1 mile N. of ramp 30	DG(A2)	DG(A2);S	Adult
875-98462	4/3/2005	CAHA - 1.8 miles south of ramp 23	DG(A3)	DG(A3);S	Adult
875-98463	4/3/2005	CAHA - 1.8 miles south of ramp 23	DG(A4)	DG(A4);S	Adult
875-98464	4/3/2005	CAHA - Sandy Bay/Isabel Inlet - sound side	DG(A5)	DG(A5);S	Adult
875-98466	4/17/2005	CAHA - Cape Point	DG(A7)	DG(A7);S	Adult
875-98468	4/18/2005	CALO - SCB mile 38.5	DG(A9)	DG(A9);S	Adult
875-98469	5/7/2005	CALO - NCB mile 9.9	DG(A0)	DG(A0);S	Adult
875-98471	5/7/2005	CALO - NCB mile 4.5	DG(C2)	DG(C2);S	Adult
875-98472	5/7/2005	CALO - NCB mile 4.5	DG(C3)	DG(C3);S	Adult
875-98473	5/8/2005	CALO - NCB mile 10.4	DG(C4)	DG(C4);S	Adult
875-98474	5/9/2005	Ocracoke inlet - Shellcastle Islands - with duck blind.	DG(C5)	DG(C5);S	Adult
875-98475	5/9/2005	Ocracoke inlet – Shellcastle/ Northernmost marsh Is.	DG(C6)	DG(C6);S	Adult
875-98476	5/9/2005	Ocracoke inlet – Shellcastle/ Northernmost marsh Is.	DG(C7)	DG(C7);S	Adult
875-98477	4/10/2005	CAHA - Bodie Island spit. North side of bay.	DG(C9)	DG(C9);S	Adult
875-98478	4/10/2005	CAHA 0.8 miles S. of ramp 27	DG(C8)	DG(C8);S	Adult

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
875-98479	5/11/2005	Oregon inlet, East waterbird island (near bridge)	DG(C0)	DG(C0);S	Adult
875-98480	5/11/2005	Oregon inlet - Island MN (north side)	DG(E1)	DG(E1);S	Adult
785-09571	5/11/2005	Oregon inlet - Island MN (north side)	DG(E2)	DG(E2);S	Adult
875-98481	5/11/2005	Oregon Inlet - Island L. NW side.	DG(E3)	DG(E3);S	Adult
875-98482	5/11/2005	Oregon inlet - Island D (East side)	DG(E4)	DG(E4);S	Adult
875-98483	5/11/2005	Oregon Inlet -Wells Island	DG(E5)	DG(E5);S	Adult
875-98484	5/11/2005	Oregon Inlet - Wells Island	DG(E6)	DG(E6);S	Adult
875-98485	5/11/2005	Oregon Inlet - Island G	DG(E7)	DG(E7);S	Adult
875-98486	5/13/2005	CALO - Shackleford Banks - West end	DG(E8)	DG(E8);S	Adult
875-98487	5/13/2005	CALO - Shackleford Banks - mile 49.9	DG(E9)	DG(E9);S	Adult
875-98488	5/17/2005	CALO - NCB - Mile 15.5	DG(E0)	DG(E0);S	Adult
875-98489	5/17/2005	CALO - NCB - Mile 3.8	DG(F1)	DG(F1);S	Adult
875-98492	5/26/2005	CALO - NCB - Mile 12.2	DG(F4)	DG(F4);S	Adult
875-98493	5/26/2005	CALO - NCB - Mile 6.8	DG(F5)	DG(F5);S	Adult
875-98494	5/26/2005	CALO - NCB - Mile 0.2	DG(F6)	DG(F6);S	Adult
875-98495	6/1/2005	CAHA - South Beach	DG(F7)	DG(F7);S	Adult
875-98497	6/13/2005	Oregon Inlet - Island MN	DG(93)	DG(93);S	Chick
875-98498	6/13/2005	Oregon inlet, East waterbird island (near bridge)	DG(94)	DG(94);S	Chick
875-98499	6/18/2005	CAHA - South Beach	DG(H2)	DG(H2);S	Chick
875-98500	6/18/2005	CAHA - South Beach	DG(H3)	DG(H3);S	Chick
875-98402	6/18/2005	CAHA - North Beach	DG(H4)	DG(H4);S	Chick
875-98403	6/19/2005	Ocracoke Island 3.3 miles north of ramp 67	DG(95)	DG(95);S	Chick
875-98404	6/19/2005	CALO - SCB - mile 44.8	DG(F9)	DG(F9);S	Chick
875-98405	6/20/2005	CALO – SCB - power squadron spit - sound side	DG(F0)	DG(F0);S	Chick
875-98406	6/22/2005	CALO - MCB - north end	DG(K1)	DG(K1);S	Chick
875-98407	6/22/2005	CALO - MCB - north end	DG(K2)	DG(K2);S	Chick
875-98408	6/25/2005	CALO - NCB - Mile 10.5	DG(J1)	DG(J1);S	Chick
875-98409	7/9/2005	CALO - NCB - Mile 15.5	DG(J2)	DG(J2);S	Chick
875-98410	7/9/2005	CALO - NCB - Mile 15.5	DG(J3)	DG(J3);S	Chick
875-98411	7/10/2005	CALO - NCB - Mile 10.8	DG(J5)	DG(J5);S	Chick
875-98413	7/12/2005	CALO - MCB - 0.5 miles south of Old Drum inlet	DG(K3)	DG(K3);S	Chick
875-98414	7/12/2005	CALO - MCB - 0.5 miles south of Old Drum inlet	DG(K4)	DG(K4);S	Chick

Table 7 (cont.). Band Combinations of American Oystercatchers banded in North Carolina.

USFWS #	Date	Banding Location	Left Leg	Right Leg	Age
875-98415	7/12/2005	CALO - MCB - 0.5 miles south of Old Drum inlet	DG(K5)	DG(K5);S	Chick
875-98416	7/14/2005	CAHA - South Beach	DG(H6)	DG(H6);S	Chick
875-98417	7/14/2005	CAHA - South Beach	DG(H7)	DG(H7);S	Chick
875-98418	7/15/2005	CAHA - 0.6 Miles north of Ramp 30	DG(H8)	DG(H8);S	Chick
875-98419	7/20/2005	CALO - MCB - NW corner at Old Drum inlet	DG(K6)	DG(K6);S	Chick
875-98420	7/20/2005	CALO - MCB - NW corner at Old Drum inlet	DG(K7)	DG(K7);S	Chick
1055-04701	7/21/2005	CALO - NCB - Mile 7.6	DG(J6)	DG(J6);S	Chick
1055-04702	8/1/2005	CALO - NCB - Mile 6.01	DG(J7)	DG(J7);S	Chick
1055-04703	8/2/2005	CAHA - Ocracoke, 1.6 miles north of ramp 70	DG(K8)	DG(K8);S	Chick
1055-04704	8/2/2005	CAHA - Cape Point	DG(H9)	DG(H9);S	Chick
1055-04705	8/3/2005	CALO - MCB - 1.2 miles south of Old Drum inlet	DG(K9)	DG(K9);S	Chick
1055-04706	8/3/2005	CALO - MCB - 1.2 miles south of Old Drum inlet	DG(K0)	DG(K0);S	Chick
1055-04708	8/10/2005	CAHA - North of Buxton	DG(H0)	DG(H0);S	Chick

Key. DG = Dark Green, LG = Light Green, GF = Green Flag, DB = Dark Blue, LB = Light Blue, RD = Red, OR = Orange, YE = Yellow, WH = White, BK = Black, S = USFWS band, - = No Band, ; = separator for upper and lower legs, / = separator for two bands on the same part of the leg, (##) = engraved code on a band.

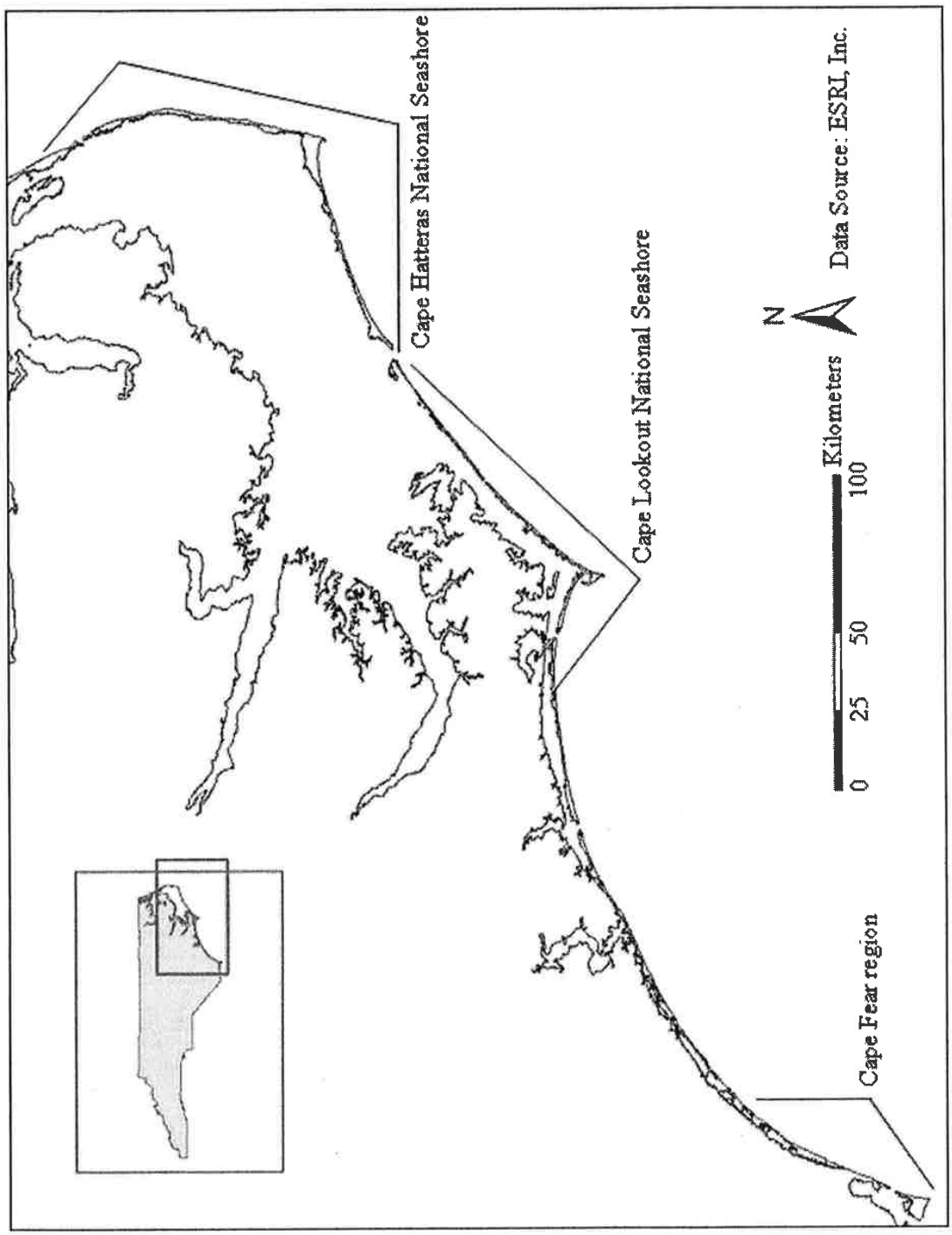

Figure 1. American Oystercatcher study sites in North Carolina.

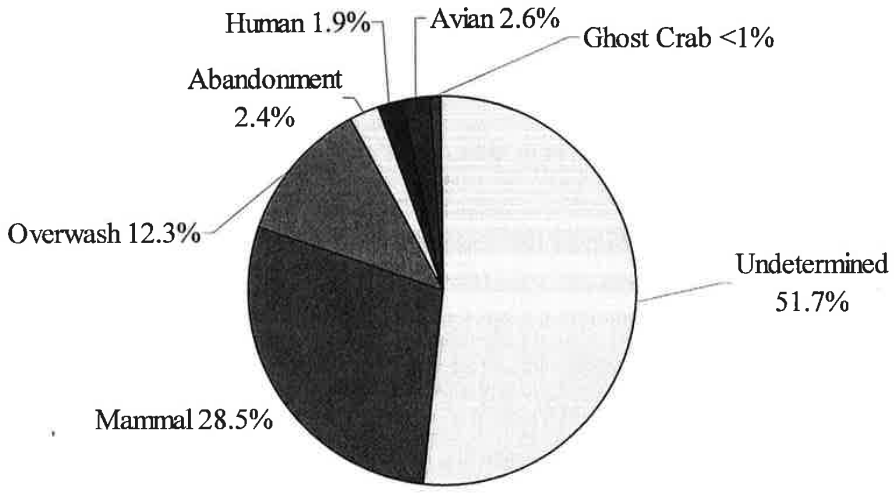

Figure 2. Causes of American Oystercatcher nest failure on the Outer Banks (1995-2005) and the Cape Fear River estuary (2002-2003) in North Carolina (N=831).

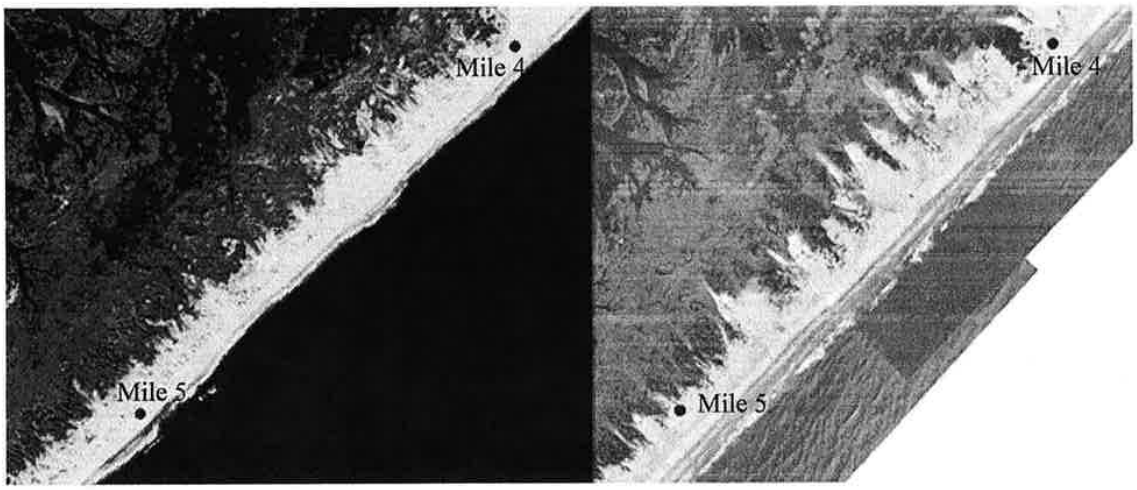

Figure 3. A section of North Core Banks in 1998 (left) and 2004 (right) showing the overwash and dune breakup caused by Hurricane Isabel in 2003. NPS mile markers are used as reference points.

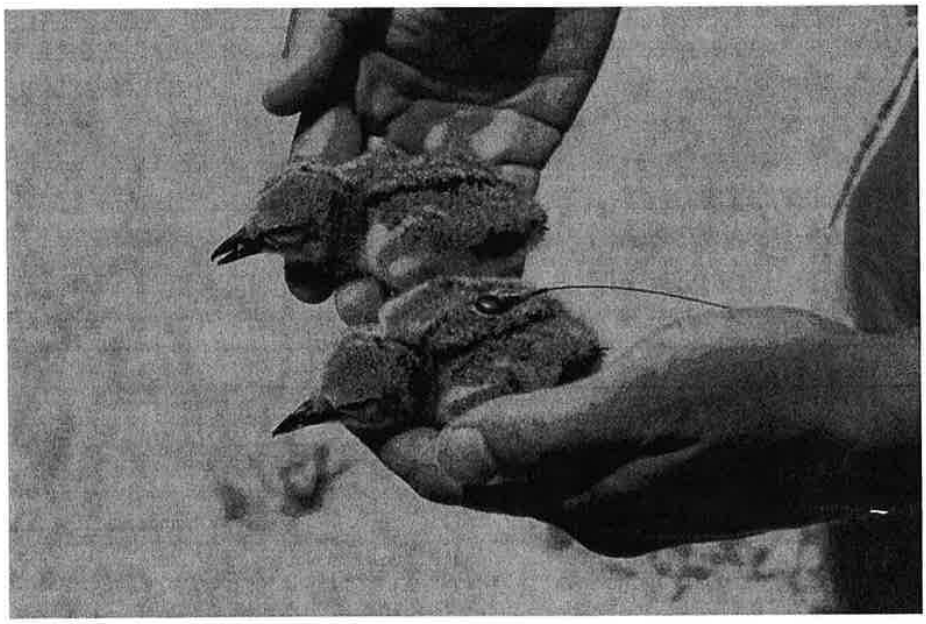

Figure 4. Recently hatched American Oystercatcher chicks. Lower chick is wearing a radio transmitter.

Figure 5. Juvenile American Oystercatcher with color bands (J7) and a leg band radio transmitter. Photo by Pat Leary.

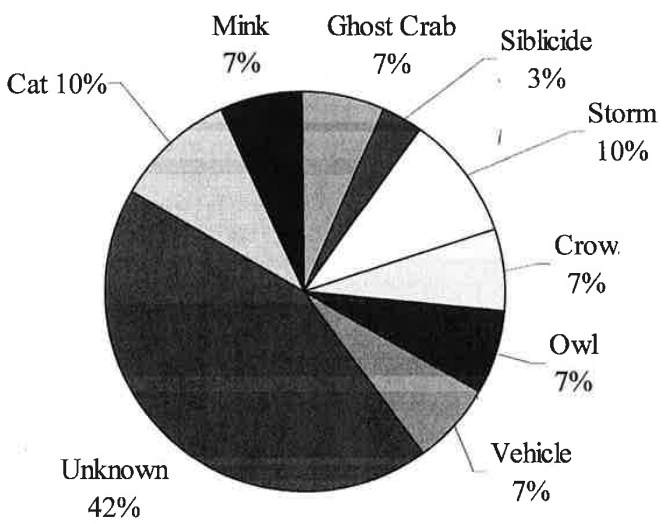

Figure 6. Causes of pre-fledging American Oystercatcher chick mortality at Cape Hatteras and Cape Lookout National Seashores in 2005 (N=30).

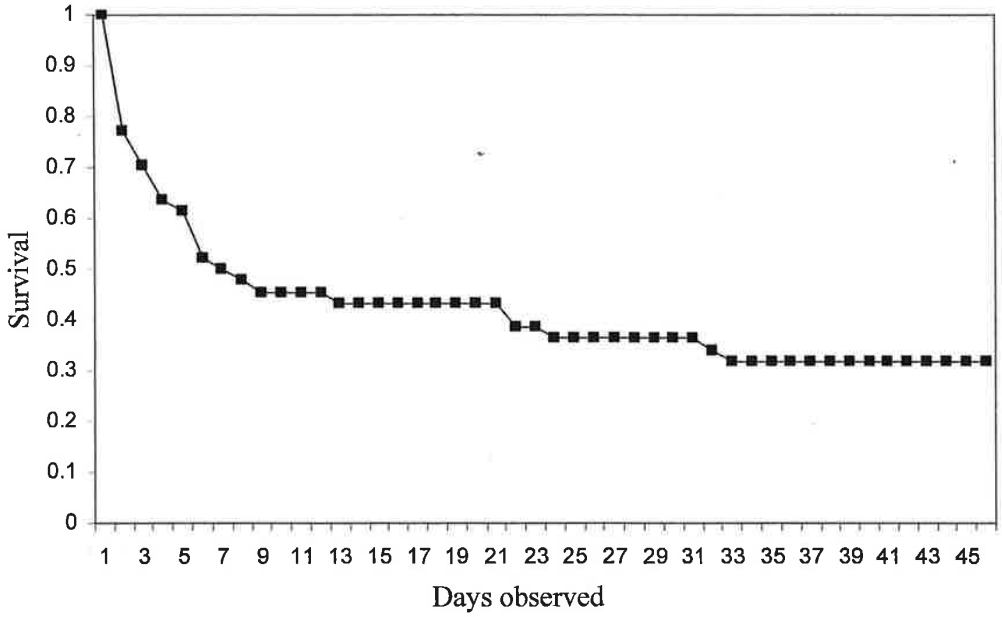

Figure 7. The Kaplan-Meier survival curve for pre-fledging American Oystercatcher chicks on Cape Hatteras and Cape Lookout National Seashores in 2005 (N=44).

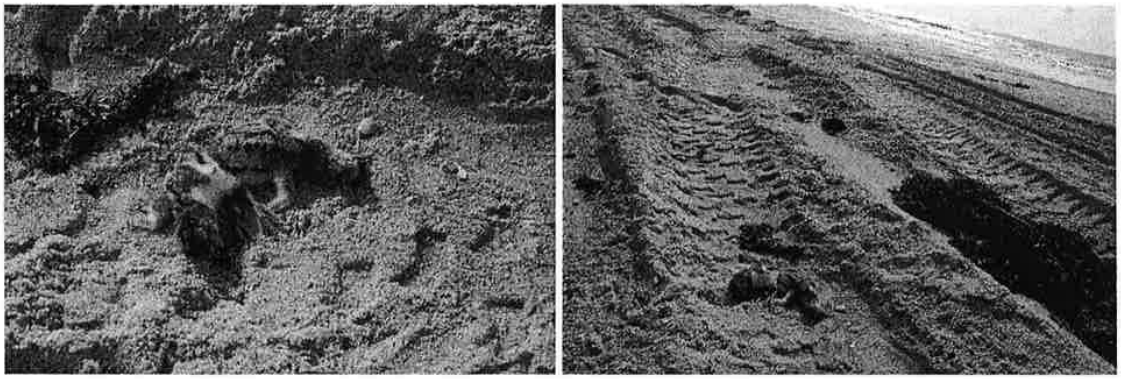

Figure 8. Radio-marked oystercatcher chicks crushed by an ATV.

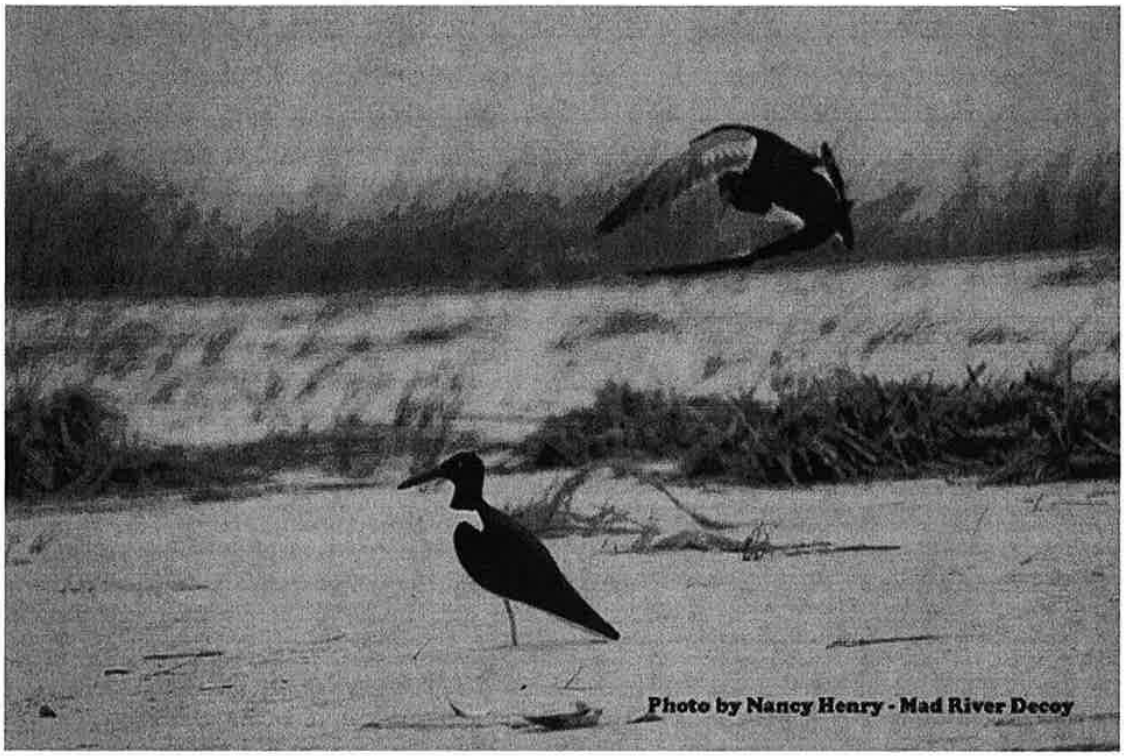

Figure 9. American Oystercatcher attacks the cast resin decoy.

Figure 10. Setting up the mechanical decoy and noose carpets.

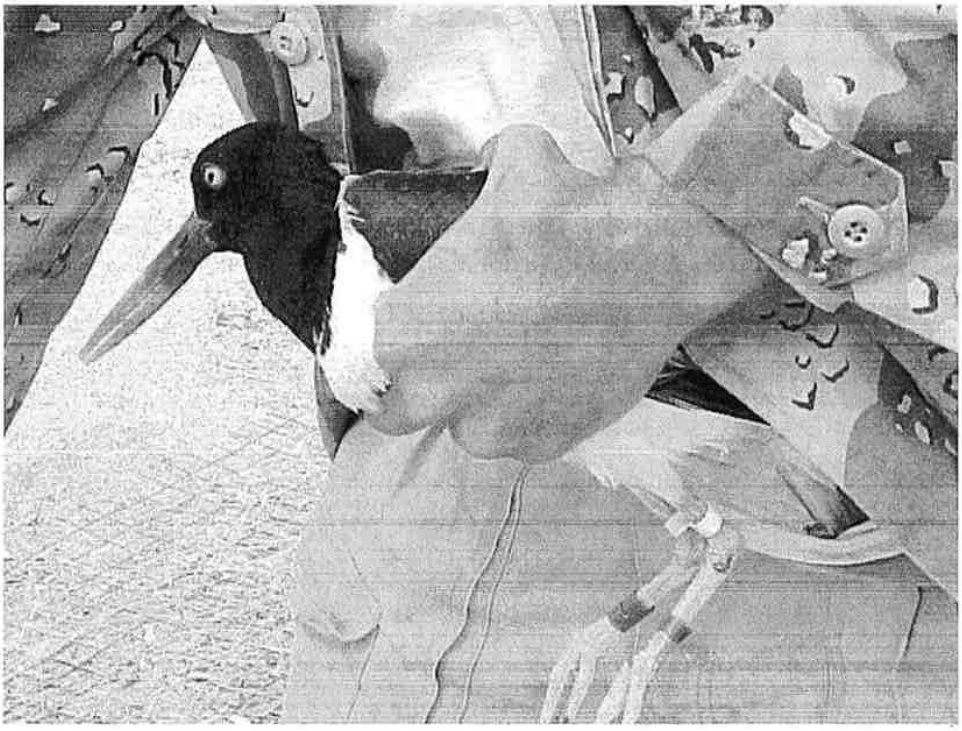

Figure 11. Color banded American Oystercatcher with a green flag on the left tarsus.

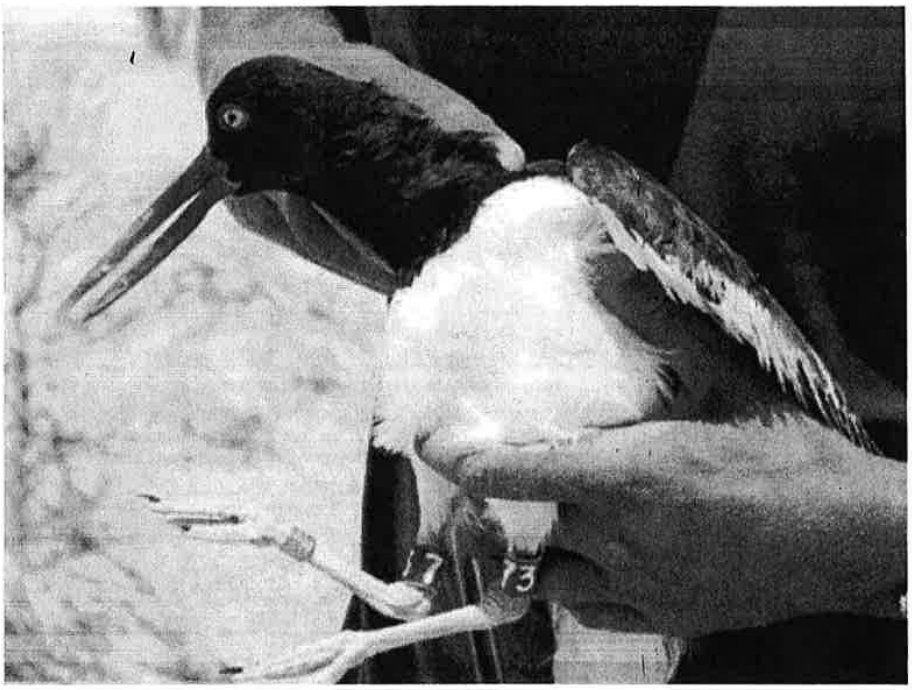

Figure 12. American Oystercatcher with engraved band code 73.

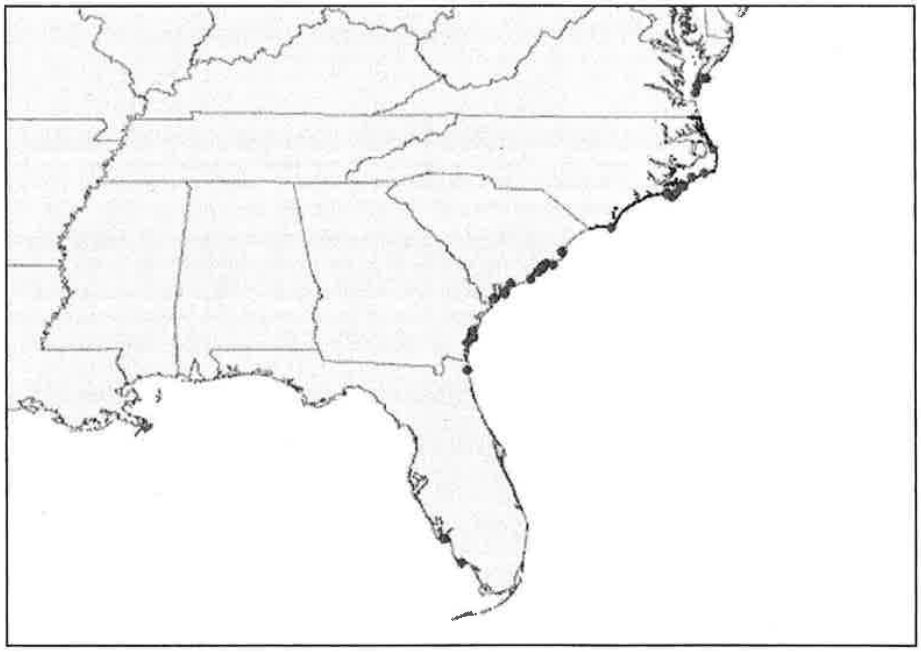

Figure 13. Winter resightings of American Oystercatchers banded in North Carolina.