The Breeding Status of the American Oystercatcher on the East Coast of North America and Breeding Success in North Carolina

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Abstract.—We studied American Oystercatchers (*Haematopus palliatus*) by examining reproductive success and the factors affecting it at one location, and by examining the status and trends of breeding population numbers from Florida to Nova Scotia on the east coast of North America. We conducted our field research on Cape Lookout National Seashore, Carteret County, North Carolina from 1997 to 1999, and we documented larger scale breeding population trends by contacting state biologists and reviewing the literature and historical accounts. Presence of eggs and young were checked two to five times per week (by observing from a distance), and efforts were made to determine the reasons for loss of the nest contents. We monitored a total of 245 nests and found low productivity. At least one egg in 32 (13%) nests hatched and one or more chicks fledged from 12 broods. Overall, 14 chicks successfully fledged (nine from North Core Banks and five from South Core Banks) during the three years of the study. Of the 213 clutches that did not hatch, 163 (76%) failed because of predation, and 46 (22%) because of overwash or severe weather. Our minimum estimate for the number of oystercatchers breeding along the entire Atlantic coast and the Gulf coast of Florida is 1,624 pairs. North of Virginia, numbers appear to be stable or slowly increasing and the species has expanded as far north as Cape Sable Island in Nova Scotia. From Virginia south, breeding numbers show a decline in recent years. The number of oystercatchers breeding on barrier islands in Virginia has decreased by more than 50% in the last 20 years. Given their relatively small numbers and inherently low productivity, American Oystercatchers are at risk in rapidly changing coastal ecosystems. *Received 1 June 2000, accepted 11 October 2000.*

Key words.—American Oystercatcher, *Haematopus palliatus*, Cape Lookout National Seashore, North Carolina, population, predation, productivity, reproductive success.

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The numbers and distribution of the American Oystercatcher (*Haematopus palliatus*) breeding along the Atlantic coast of North America have changed dramatically during the last century. The historic range included the entire Atlantic coast of the United States and may have extended as far north as the Labrador Peninsula of Canada (Audubon 1835; Bent 1929; Forbush and May 1939; Nol and Humphrey 1994). By 1900, the American Oystercatcher had been extirpated from areas north of Virginia because of market hunting, egg collecting, and human disturbance, and was declining over much of its remaining range (Richards 1890; Bailey 1913; Bent 1929; Howell 1932; Nol and Humphrey 1994). In the last half of the 20th century, however, oystercatchers began re-colonizing portions of their former range and have since re-established sizeable numbers in New York (Post and Raynor 1964; Zarudsky 1985) and New Jersey (Kramer 1948), and have expanded their breeding range into New England (Humphrey 1990; Myers *et al.* 1998). In 1997, the first recent and confirmed oystercatcher nest in Canada was found on Cape Sable Island, Nova Scotia (Myers *et al.* 1998; Mawhinney *et al.* 1999).

As a possible response to habitat loss and increased predation on more traditional ocean-front habitats, oystercatchers now nest on spoil islands, marshes, and forest edges (Soots and Parnell 1975; Lauro and Burger 1989; Toland 1992). American Oystercatchers have apparently also responded to habitat limitations in some areas by nesting communally (Chapman 1982; Humphrey 1988; Lauro *et al.* 1992). American Oystercatchers are protected in both Georgia and Florida because of small or declining numbers (Geor-

gia Department of Natural Resources 1992; Below 1996), and have shown signs of decline in South Carolina (S. Dodd, pers. comm.) and Virginia (Williams *et al.* 1998).

While numerous studies have examined the demographic characteristics of the European Oystercatcher (*Haematopus ostralegus*) (Goss-Custard *et al.* 1982; Safriel *et al.* 1984; Ens 1992; Kersten and Brenninkmeijer 1995), more limited information is available on the population dynamics of American Oystercatchers. Several studies have measured productivity through to fledging (Humphrey 1988; Nol 1989; Novick 1996), while others only document hatching success (Lauro and Burger 1989; Corbat 1990). Only one study has examined the return rates to breeding sites (Nol 1984, 1985), and no data exist on post-fledging or subadult survival rates.

A 1995 study of American Oystercatchers on Cape Lookout National Seashore (Novick 1996) raised concerns of the National Park Service over the low productivity of oystercatchers breeding there. Of 36 nesting attempts documented, 30 chicks hatched but only seven chicks fledged. Successful breeding occurred mainly in areas where human activity was low. Predation was the main cause of nest loss, and at least five chicks were run over by vehicles on the beach.

In 1997, we began a study of American Oystercatchers breeding on Cape Lookout National Seashore in order to examine productivity and the factors affecting it. In addition, we sought to document its breeding status in other areas. The objectives of this paper are: 1) to present site-specific data on American Oystercatcher reproductive success; and 2) to summarize information on the present and historical numbers of oystercatchers breeding along the entire Atlantic coast of North America and the Gulf coast of Florida.

STUDY SITES AND METHODS

We studied American Oystercatchers from 1997 to 1999 on North Core Banks and South Core Banks (Fig. 1), two of the three barrier islands that comprise Cape Lookout National Seashore in Carteret County, North Carolina. North Core Banks is just under 36 km long, extending from Ocracoke Inlet in the north (35°03.90'N, 76°02.48'W), south to New Drum Inlet (34°51.18'N, 76°19.17'W). South Core Banks has 40.3 km of beach, extending from New Drum Inlet in the north (34°51.09'N, 76°13.51'W), south to Cape Point, and west to Power Squadron Spit (34°37.7'N, 76°33.19'W). The third island, Shackleford Banks, is 14.5 km long and extends from Barden Inlet in the west, east to Beaufort Inlet. Vehicles are permitted on the beach and on the backroad system between the primary

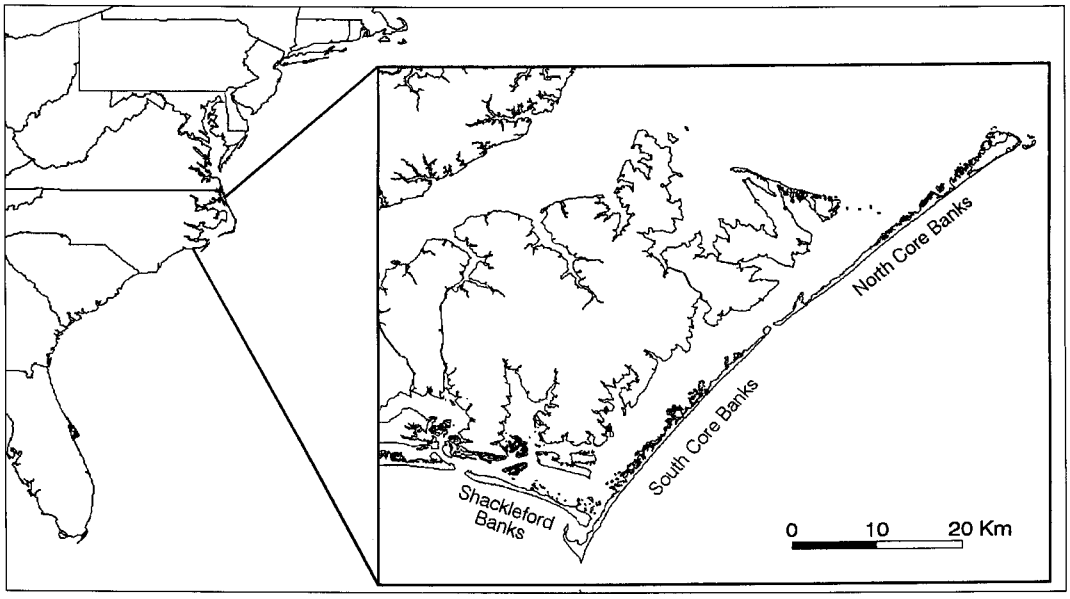

Figure 1. Map of the eastern coast of the USA showing the position of Cape Lookout National Seashore: North Core Banks, South Core Banks, and Shackleford Banks.

dunes and marsh on both North and South Core Banks. North Core Banks was monitored in 1998 and 1999; South Core Banks was monitored in all three years of the study.

Nest searching began in mid-April (except in 1997 on South Core Banks, when it did not begin until early May), and clutch survival was checked two to five times per week by observing adults on the nest from a distance. After hatching, chicks were located from a distance when possible, or assumed when adult behavior indicated chick presence. Nests located on the ocean beach were marked with warning signs (30 cm × 30 cm plastic sign nailed to a 5 cm × 5 cm wooden post) placed approximately 10 m from the nest to protect the eggs from vehicles and pedestrians. Nests were observed regularly until they failed or the eggs hatched, and every effort was made to determine the reasons for nest loss. Evidence included predator tracks immediately around the nest, signs of storm overwash, or signs of human disturbance. We calculated hatching and fledging success as a percentage of nesting attempts, and also applied the Mayfield method (Mayfield 1975; Johnson 1979) to calculate the probability of eggs surviving to hatching. We were not able to calculate the probability of survival from egg laying to fledging because of the difficulty in determining precisely when a chick was either lost or fledged.

We conducted surveys in mid-May and mid-June of 1998 and 1999 on North Core Banks, South Core Banks, and Shackleford Banks to estimate the total number of breeding pairs. Adult oystercatchers were counted as an observer drove along the primary dune line of each island. We used the peak count of active nesting territories as our estimate of the number of breeding pairs on each island.

Following the 1998 breeding season, we contacted biologists from Florida to Nova Scotia to obtain the most recent estimates of American Oystercatcher breeding numbers. We also reviewed the literature and historical accounts to examine changes in distribution and numbers breeding.

RESULTS

Reproductive Success

We monitored 245 oystercatcher nests which contained eggs (133 on North Core Banks and 112 on South Core Banks) during the three years of study. Nests were located in three main habitat types—ocean beach (39%), sand flats (35%), and interdunal areas (26%). Of the 245 nests monitored, at least one egg hatched in 32 (13%) of the nests and 12 (5%) of the breeding attempts fledged at least one chick. Overall, 14 chicks successfully fledged (9 from North Core Banks and 5 from South Core Banks) during the three years of the study (Table 1).

We computed a nest survival rate of 0.928 (SE ± 0.00475) per nest-day (213 nests lost during 2,961 nest-days of incubation). Assuming an average incubation period of 27 days (ranges from 25-30 days), the probability that a clutch survived to hatching was 0.133.

The percentage of clutches hatching at least one egg ranged from 7% on North Core Banks in 1998 to 27% on South Core Banks in 1998 (Table 1). The percentage of clutches that fledged at least one chick ranged from 2% on South Core Banks in 1999 to 8% on South Core Banks in 1998. Of clutches that hatched chicks, the percentage

Table 1. Hatching and fledging success of American Oystercatchers on Cape Lookout National Seashore, 1997-1999.

Year	No. of pairs	No. of clutches	No. of clutches that hatched eggs (%)	No. of clutches that fledged chicks (%)	% of hatched clutches that fledged chicks	No. of chicks fledged	Estimate of chicks fledged per pair
South Core Banks							
1997	22[a]	34[a]	4 (12)[a]	2 (6)	50	2	0.09[a]
1998	28	26[b]	7 (27)[b]	2 (8)	29	2	0.07
1999	28	52	5 (10)	1 (2)	20	1	0.04
North Core Banks							
1998	32	72	5 (7)	3 (4)	60	4	0.12
1999	33	61	11 (18)	4 (7)	36	5	0.15
Total		245	32 (13)	12 (5)	38	14	

[a]Surveys limited and monitoring started late, so % of clutches that hatched eggs and no. of chicks fledged per pair may be overestimates.

[b]Less frequent monitoring so numbers of clutches underestimated and percentage of clutches that hatched eggs overestimated.

fledging at least one chick ranged from 20% on South Core Banks in 1999 to 60% on North Core Banks in 1998 (Table 1).

Surveys conducted in 1998 and 1999 gave nearly identical estimates of breeding numbers. On North Core Banks we found 32 and 33 pairs of oystercatchers in 1998 and 1999, respectively. On South Core Banks, 28 pairs were counted in both years (Table 1). The estimated number of chicks fledged per pair each year ranged from 0.04-0.15 (Table 1). On Shackleford Banks we found nine pairs in both 1998 and 1999.

Predation was the major cause of clutch loss, accounting for a total of 77% of the 213 nests lost during the egg stage (Table 2). While we were unable to identify the specific predator in over half of these instances, we feel confident that monitoring storm events allowed us to eliminate overwash as an explanation. Of the 62 clutches predated by identified sources, 49 were taken by Raccoons (*Procyon lotor*) and the remainder by feral cats. Severe weather or storm overwash caused 46 (22%) nest failures (Table 2). One nest was abandoned for unknown reasons, and one was abandoned due to human disturbance. Two clutches were destroyed and one chick was killed by vehicles. We also found one chick (approximately two weeks old) that had apparently been abandoned and which died soon afterwards.

Breeding Numbers

The breeding range of American Oystercatchers extends from Nova Scotia south to Panama and west to Baja California (Nol and Humphrey 1994). Our minimum estimate for the number of oystercatchers breeding along the entire Atlantic coast and the Gulf coast of Florida was 1,624 pairs (Table 3). Survey data for Massachusetts and New Jersey were several years old (where numbers are thought to be increasing), and the estimate for North Carolina was based on limited surveys. The largest numbers were in New Jersey, Virginia and Florida (Table 3).

The number of American Oystercatchers breeding in areas north of Virginia appears to be stable or slowly increasing. Recent data show that numbers in Maine, Rhode Island, Connecticut and Delaware have risen slowly over the past 20 years (Table 3). Numbers breeding in Massachusetts and New Jersey appear to have increased in recent years, but neither state is currently monitoring oystercatchers. In New York, surveys conducted since 1986 indicate stable numbers (Sommers *et al.* 1996; J. McDougal, pers. comm.). No oystercatchers have been observed nesting along New Hampshire's 13 km coast, most of which is rocky (J. Kanter, pers. comm.).

Oystercatcher breeding numbers appear to have declined from Virginia south in recent years. Early in the 20th century, evidence of declines in oystercatcher numbers in Virginia raised concerns over possible extinction (Bailey 1913; Forbush and May 1939). Numbers recovered and annual barrier island surveys begun in 1979 in Virginia showed numbers there increased to a peak of 1,274 individuals in 1984 (Williams *et al.* 1990). Numbers on the Virginia barrier is-

Table 2. Reasons for clutch loss during the egg stage for American Oystercatchers on Cape Lookout National Seashore, 1997-1999. Numbers reported are numbers lost to each cause with the percent contribution in parentheses.

	South Core Banks			North Core Banks		
Reason for clutch loss	1997	1998	1999	1998	1999	Total
Predation, unknown source	9 (30)	17 (90)	21 (45)	27 (40)	27 (54)	101 (47)
Predation, mammalian	18 (60)		9 (19)	20 (30)	15 (30)	62 (29)
Overwash/Severe weather	3 (10)	2 (10)	17 (36)	18 (27)	6 (12)	46 (22)
Abandonment					1 (2)	1 (<1)
Human Disturbance/Vehicle				2 (3)	1 (2)	3 (1)
Total no. of clutches lost during egg stage	30	19	47	67	50	213

Table 3. Estimates of American Oystercatcher breeding numbers on the east coast of North America, from Nova Scotia to Florida.

State/Province	Year	Number of adults	Trend	Source
Nova Scotia	1998	1 pair	No change (1st nest in 1997)	Nova Scotia Dept. of Natural Resources; Myers *et al.* 1998
Maine	1998	2 pairs	Increase (1st nest in 1994)	Maine Coastal Islands Sanctuaries; Petit Manan National Wildlife Refuge
New Hampshire	1998	0	No change	New Hampshire Fish & Game
Massachusetts	1992	77 pairs	Increase (18 pairs in 1979, but no current estimate)	Myers *et al.* 1998
Rhode Island	1998	26 pairs	Increase (1st nest in 1976)	Rhode Island Fish & Wildlife Service; Myers *et al.* 1998
Connecticut	1998	14 pairs	Increase (2 pairs in 1981)	Connecticut Dept. of Environmental Protection; Myers *et al.* 1998
New York	1998	111 pairs	Unknown (108 pairs in 1986, but peak count of 213 pairs in 1993)	New York State Dept. of Environmental Conservation
New Jersey	1992	250 pairs	Unknown (no regular monitoring)	New Jersey Division of Fish, Game & Wildlife; Nol and Humphrey 1994
Delaware	1998	15 pairs	Increase (8 pairs in 1986)	Delaware Natural Heritage Program; Nol and Humphrey 1994
Maryland	1998	75 pairs	Unknown (but probably little change in recent years)	Maryland Dept. of Natural Resources
Virginia	1999	255 pairs	Decline (619 pairs in 1979)	B. Williams, pers. comm.
North Carolina	1999	300 pairs	Unknown (no statewide surveys ever conducted)	North Carolina Wildlife Resources Commission
South Carolina	1998	112 pairs[a]	Possible decline (decline from 118 nests in 1989 to 57 in 1998 on Cape Romain National Wildlife Refuge and 147 pairs estimated for 1986)	South Carolina Dept. of Natural Resources; Nol and Humphrey 1994
Georgia	1999	86 pairs	Possible increase (70 pairs in 1980), but first coast-wide survey	Georgia Dept. of Natural Resources; Rappole 1981
Florida	1998	300 pairs	Probable decline (especially on Atlantic coast)	Florida Coastal Islands Sanctuaries
Total		1,624 pairs		

[a]Minimum estimate based on nest counts.

lands have declined since 1989. Counts have not been above 1,000 individuals since then, and the count in 1999 was just 509 individuals (Williams *et al.* 1997; B. Williams, pers. comm.). In South Carolina, monitoring of nests on Cape Romain National Wildlife Refuge indicated a probable decline in oystercatcher numbers (Table 3). An estimated 147 pairs nested in South Carolina in 1986 (Nol and Humphrey 1994) compared to 112 estimated in 1998. In Georgia, the first coast-wide survey of breeding oystercatchers in 1999 recorded 86 pairs (B. Winn, pers. comm.), compared to estimates of 35 pairs in 1945 (Greene *et al.* 1945) and 70 pairs in 1980 (Rappole 1981). In Florida, oystercatchers were once considered common, but by 1932 had become "rare and local" (Howell 1932) and remained so 20 years later (Sprunt 1954). Counts during the non-breeding season, however, indicate that winter numbers have increased greatly since 1932 (Stevenson and Anderson 1994). Of the 300 pairs now estimated for Florida, about 50% are found in the Tampa Bay region (A. Schnapf, pers. comm.), and approximately 70 pairs breed in

Apalachicola Bay (J. Gore, pers. comm.). On the Atlantic coast of Florida, oystercatcher numbers are small and the birds are widely dispersed (Below 1996).

DISCUSSION

Hatching success for American Oystercatchers on Cape Lookout National Seashore was similar to that in Nol's (1989) 4-year study in Virginia—13% and 14%, respectively. Fledging success, however, was lower at Cape Lookout. On average, 5% (12 of 245) of clutches produced at least one fledged chick at Cape Lookout (Table 1) compared to 10% (22 of 229 nests) in Virginia (Nol 1989). The lower fledging success on Cape Lookout may indicate higher predation rates there during the nestling stage than at the Virginia site. Nol and Humphrey (1994) noted that oystercatcher productivity can be variable from year to year. This variability was evident at Cape Lookout. For example, in 1995 and from 1997 to 1999 on South Core Banks, the percentage of clutches that fledged chicks was 17%, 6%, 8%, and 2%, respectively (Novick 1996; this study). Yearly variability in productivity emphasizes the importance of consistent monitoring, while site-to-site differences in hatching and fledging success emphasize the need for multiple-site studies conducted to fledging.

Nest predation rates were high at Cape Lookout where as many as 77% of all clutches were lost to predation (Table 2). On Monomoy National Wildlife Refuge in Massachusetts, Humphrey (1988) attributed 33% of clutch losses to overwash and 20% to predation by large gulls during his 3-year study. No mammalian predators were identified at Humphrey's study site. In Virginia, Nol (1989) found that of pairs failing to hatch any eggs, 90% lost their clutches to overwash and 10% to predation. Additionally she observed that of pairs that hatched eggs but fledged no young, 43% failed because of high tides and 29% because of predation. It appears that predation and nest overwash are the main causes of oystercatcher clutch loss, but the relative effect of these factors varies by location and variation in weather.

Predators such as feral cats and Raccoons that benefit from human activity may be reducing American Oystercatcher numbers in some areas. On Cape Lookout raccoons are considered native, but preliminary surveys of abundance on South Core Banks in 1997 indicate that their numbers are highest where human activities are concentrated. Studies comparing oystercatcher productivity in areas free of mammalian predators (e.g., many dredge spoil islands) with areas having such predators are needed to assess what level of predation oystercatchers can withstand. Elevating nests and moving nests have both been suggested as possible remedies for reducing nest overwash. While these measures have been successfully implemented in a few instances (Nol and Humphrey 1994; D. Ramil, pers. comm.), we do not see them as viable management practices for oystercatchers in the majority of nesting habitats. This is especially true where predators are common because elevating nests may increase predation by making nests more visible. Moving oystercatcher nests may not be practical in habitats such as those on North Core Banks that are comprised of extensive, low-lying sand flats. These management alternatives may only be feasible at locations where predation rates are low or where elevated habitats adjacent to nest sites are available.

Accurate estimates of productivity and survival are essential to effective monitoring and management. Because few breeding attempts actually fledge chicks (as low as 20% in this study) (Table 1), nest monitoring must continue through fledging. Reliable estimates of post-fledging/subadult survival are currently unavailable. Estimates of annual post-fledging survival in the European Oystercatcher range from about 50% (Kersten and Brenninkmeijer 1995) to 88% (Goss-Custard *et al.* 1982). Subadult survival of European Oystercatchers varies, but increases with age (Goss-Custard *et al.* 1982; Goss-Custard and Durell 1984). Based on the only American Oystercatcher banding study (Nol 1984), Davis (1999) estimated the overall adult annual survival rate at 92%. Most annual adult survival estimates for European Oystercatchers fall between 85% and 95%,

with 95% considered the typical rate (Harris 1970; Safriel *et al.* 1984; Ens 1992; Kersten and Brenninkmeijer 1995).

Clearly American Oystercatchers have naturally low rates of annual productivity. The critical question is whether their productivity is sufficient to sustain oystercatcher numbers in the future. The oystercatcher's lifetime reproductive potential is limited by their delayed maturity, territoriality, and lengthy nesting cycle. These limitations are offset by the birds' longevity. American Oystercatchers live at least 10 years (Nol and Humphrey 1994), and probably 20-40 years, like the closely related European Oystercatcher (Ens *et al.* 1996). Population viability models developed by Davis (1999) emphasized the sensitivity of population trajectories to adult survival, but they also showed that changes in pre-adult survival could cause dramatic shifts in population trajectories. Interestingly, simulations illustrated that numbers were resilient to low nesting success, in that only an occasional good breeding season was enough to keep long-term population growth rates stable, or even positive (Davis 1999).

We estimate that there are at least 1,624 breeding pairs of American Oystercatchers on the entire Atlantic coast of North America and the Gulf coast of Florida (Table 3), but this is obviously an underestimate because many of the census data are not current or are incomplete. For example, in Virginia only barrier islands have been surveyed while there may be sizeable breeding numbers on inshore habitats (B. Truitt, pers. comm.). Better census data are clearly needed, but in any event, it is likely that the actual number of American Oystercatchers breeding along the Atlantic coast and Gulf coast of Florida is less than 3,000 pairs. By any standard, additional research and population monitoring are warranted.

Regular censuses are needed to track breeding and winter population trends and to document movement patterns. Data are especially lacking for non-beach habitats (where birds are more difficult to monitor and numbers appear to be increasing). Better estimates of fecundity and survival are needed for both historic and recently colonized habitats. Finally, given the American Oystercatcher's inherently low productivity and sensitivity to even slight changes in fecundity or survival rates, we need to know more about the effects of human disturbance on reproductive success. This is especially true in Virginia, North Carolina, and South Carolina, once the heart of the oystercatcher's breeding range, where recent evidence of declines are a cause for concern.

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