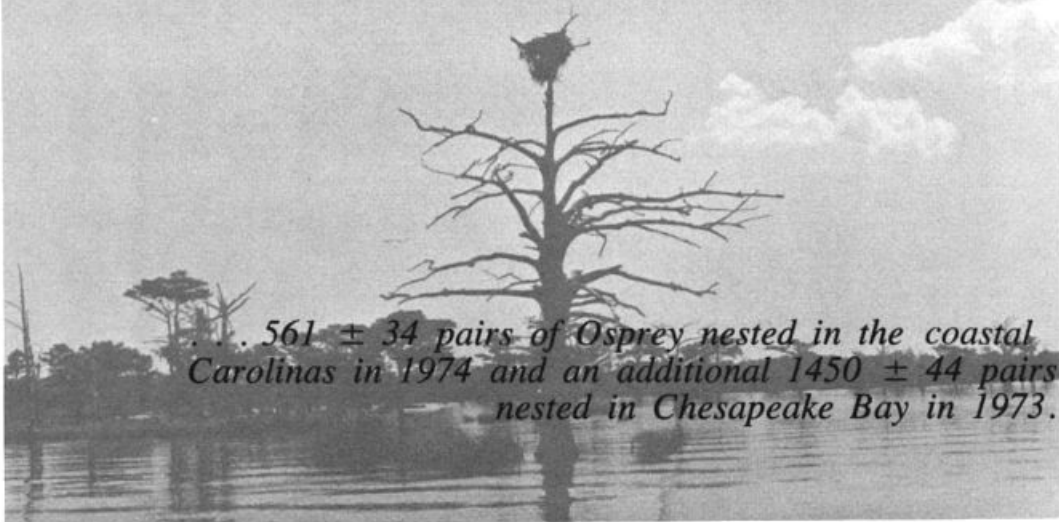


Osprey Nesting Populations in the Coastal Carolinas

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... 561 ± 34 pairs of Osprey nested in the coastal Carolinas in 1974 and an additional 1450 ± 44 pairs nested in Chesapeake Bay in 1973.

The Osprey (*Pandion haliaetus carolinensis*) is considered by many ornithologists to be endangered in most segments of its range, particularly along the Atlantic Coast. For example, Arbib (1973:944) lists the species as "...still a threatened species everywhere except apparently along the Northern Pacific Coast, and in the Western Great Lakes region." Henny and Ogden (1970) reviewed the population declines in the northeastern United States where pesticides were implicated; however, little was known about the populations south of Chesapeake Bay or in the western United States. The Bureau of Sport Fisheries and Wildlife (1973), in its recent revision of the Redbook *Threatened Wildlife of the United States*, lists the Osprey's status as undetermined with more information needed.

An aerial survey, and several intensive ground surveys, were initiated in Chesapeake Bay in 1973 (Henny *et al.* 1974) to obtain information for assessing the species' current distribution and abundance. The study was extended to the coastal portion of North and South Carolina in 1974. The results of the Carolina investigation are compared with the Chesapeake Bay findings. Fortunately, two areas in North Carolina were subjected to intensive investigation before the 1950s; they were Great Lake in the Croatan National Forest (Philipp 1910, Pearson *et al.* 1943, Borden 1949, Grant 1970) and Orton Pond near Wilmington (Pearson *et al.* 1919, Simpson 1943, Parnell and Walton 1974). The early studies provide some

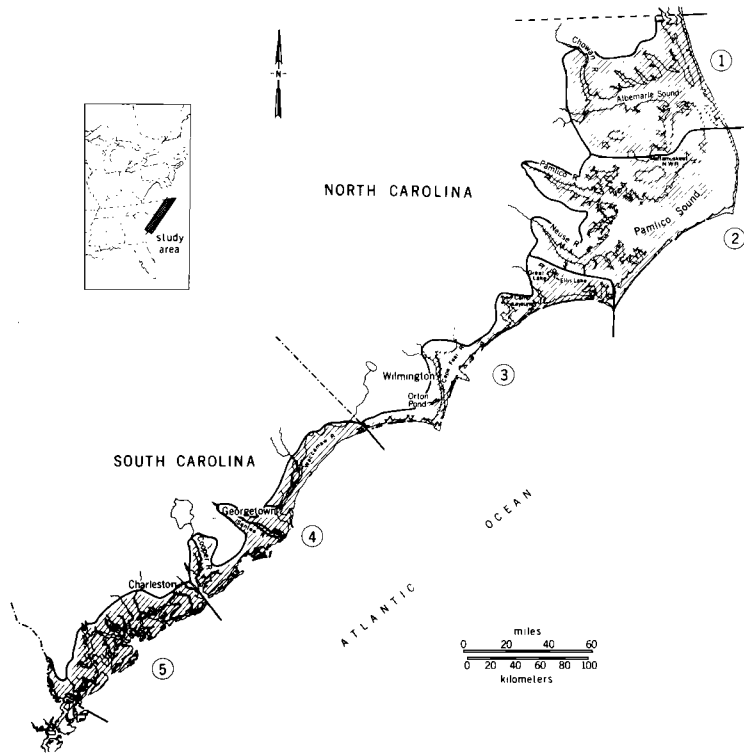
basis for making comparisons; however, the major emphasis of this paper is to provide baseline data for future comparisons.

METHODS

We located active Osprey nests by flying a Cessna 182 aircraft about 200 feet above the water along the coasts of North and South Carolina and the associated rivers, creeks, sounds and bays. The upper portions of several river systems were not surveyed because the nesting density of Ospreys generally decreased with distance from the coast. We believe the excluded portions had few nesting Ospreys, although some birds have been reported nesting inland. Boundaries for this survey are shown in Figure 1.

Our survey was divided into two phases: (1) location of active nests from the air (April 3-12), and (2) an air:ground comparison by boat (April 17-30). Sixty hours of flying time were logged in the initial phase of the survey, and nearly all of the active nests had incubating adults. A nest was classified as active if an Osprey was at or near the nest site when the survey was made. The air:ground comparison procedure allowed us to assess the consistency and reliability of the aerial

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counts and to make adjustments for active nests missed during the initial survey.

The procedure for estimating the total nesting population and its associated visibility rate is a modification of the Petersen Estimator and is a double sampling scheme (for details see Henny *et al.* 1974). We let a finite population of size N (N unknown) be sampled by two methods. The data were then recorded so that we knew n_1 , the number of elements observed by method 1 (aerial survey); n_2 , the number of elements observed by method 2 (ground survey); and m , the number of elements observed by both methods. Then,

$$\hat{N} = \frac{n_1 n_2}{m}$$

is a reasonably good estimator of N (the total nesting population in a given area). Thus, \hat{N}/n_1 becomes the estimator of the aerial visibility rate.

Our initial approach for calculating the variance was quite simple (see Henny *et al.* 1974), but yielded an estimate that was slightly biased low. K. P. Burnham (*Ms.* in prep.) provided the derivation of the new variance estimate used in this study. The initial 95 per cent confidence interval for the Chesapeake Bay population was 1450 ± 30 pairs while our improved estimate was ± 44 .

Aerial counts in locations not surveyed from the ground were adjusted by the aerial visibility rates. All of coastal North and South Carolina was surveyed by air, but only a selected portion was surveyed from the ground because of the time-consuming nature of surveys by boat. The

consistency of the visibility rates estimated from the air:ground comparison areas lends added confidence to the breeding population estimates (Table 1). Nests believed to have been missed by both surveys are accounted for in estimates presented in this paper.

Nests at Lake Mattamuskeet and Ellis Lake were most visible because all nests were located on over-water sites. Ground counts for both lakes were used in this report although the lakes were also surveyed from the air. Throughout the paper, it should also be recognized that the estimated number of nesting pairs may include a few non-breeders (see Henny and VanVelzen 1972).

DISTRIBUTION AND ABUNDANCE

The distribution and abundance of breeding Ospreys in 1974 is discussed in terms of five geographical units within the Atlantic Coastal Plain (Table 2). The first two units (Albemarle Sound and Pamlico Sound, N.C.) are within the Embayed section of the Coastal Plain (Fenneman 1938) which is characterized by branching bays or estuaries. The remaining three units belong within the Sea Island section of the Coastal Plain. Fenneman (1938:38) notes, "Except near the coast no abrupt change would be noted in passing southward from the Embayed section into the Sea Island section. ...Extensive drowning disappears, as do also the great barrier beaches. Rows of islands of a different origin take their places."

Table 1. — Number of active Osprey nests (nesting pairs) seen from the air and the ground.

Location	Air <i>n</i> ¹	Ground <i>n</i> ²	Both <i>m</i>	Tot. Est. <i>N</i>	Visibility Rate <i>N/n</i> ¹
Camp Lejeune	26	41	23	46.35	1.78
Orton Pond	39	61	39	61.00	1.56
Other Areas ^x	40	71	40	71.00	1.78
Lake Mattamuskeet and Ellis Lake	60	69	60	69.00	1.15
Weighted Mean ^y					

^x Includes portions of Cape Fear River, Waccamaw River, Chowan River, and Santee Hunt Club.

^y Includes Camp Lejeune, Orton Pond, and "Other Areas". Lake Mattamuskeet and Ellis Lake are unique and treated as a separate entity

Albemarle Sound

No concentration points were noted for the 94 breeding pairs of Ospreys in Albemarle Sound and the surrounding vicinity. Most of the pairs were located around Currituck Sound, Roanoke Island, and the Chowan River; the remainder were dispersed throughout the unit. A few pairs were noted on the Outer Banks in the vicinity of Kitty Hawk. No nesting pairs were observed at Lake Phelps, Pungo Lake, or Alligator Lake.

Pamlico Sound

The 121 pairs nesting along Pamlico Sound were concentrated at Mattamuskeet National Wildlife Refuge (N.W.R.) and Swanquarter N W R. and the adjacent area. Thirty-eight pairs were nesting on Cypress trees (*Taxodium distichum*) in Lake Mattamuskeet, the largest natural lake in North Carolina which averages only 2 feet in depth. It is 18 miles long, 5 to 6 miles wide, and contains about 40,000 acres. Large-scale drainage operations to convert the lake bottom to farmland began in 1914, but the plan was eventually abandoned. The lake bed was dry in 1928 when surveyed as a possible refuge site (F.M. Uhler, personal comm.). In 1934, the land was acquired by the U.S. Government, and the refuge was established. Increment borings of the Cypress used as nest sites in 1974 placed their age at 30 to 40 years, which corresponds with the period shortly after the land was acquired for the refuge and reflooding began. Narrative Reports from as early as 1938 mentioned the presence of Ospreys on the refuge although quantitative data were lacking.

The concentration near Swanquarter probably resulted from the large numbers of trees killed by the flooding caused by a hurricane in the mid-1950s. The tall snags now provide excellent nesting sites. The majority of the remaining pairs were scattered throughout the Pamlico and Neuse Rivers and their tributaries.

South Coast, North Carolina

More than one-half the Ospreys along the South Coast were concentrated at Ellis Lake (31 pairs) in the Croatan National Forest, Camp Lejeune Marine Base (50 pairs), and Orton Pond (61 pairs). Fortunately, historical information is available for Ellis Lake and Orton Pond (Table 3). Nearly all of the remaining 94 pairs nested along the Intracoastal Waterway or adjacent creeks and ponds.

Ellis Lake and Great Lake—These two adjacent lakes are considered one unit. Philipp (1910:317) stated that Ospreys were "Abundant at Lake Ellis and at Great Lake, N.C., where there is a large breeding colony. On June 20 [1909], thirty occupied nests were counted around Great Lake, which had young in them of various stages of growth, many being ready to fly. . . . all were in cypress trees, usually out in the lake itself. " No mention was made in 1909 of the number, if any, of Ospreys nesting at Ellis Lake (an old plantation rice reservoir of 225 acres). Ellis Simon, the owner of Ellis Lake and the adjacent area, indicated that the rice-growing era ended in 1898, the same year that a hunting club was organized. Furthermore, Ellis Lake was increased in size to 1542 acres by a concrete dam constructed in 1947. In an attempt to piece together further information regarding the history of Ellis Lake, six live Cypress used as nest sites in 1974 were aged by the increment bore method. Ages ranged from 55 to 65 years. Thus, it appears that shortly after the end of the rice-growing era (circa 1910) the Cypress trees became established. Prior to 1910 and for many years thereafter Ellis Lake was probably not suitable for nesting Ospreys due to the lack of nesting sites. Management of the lake specifically for fishing and hunting began in the late 1930s and 1940s, which corresponds quite well to a period of accelerated growth in the Cypress now used as nesting sites

Table 2. — The distribution of nesting pairs of Ospreys in coastal North and South Carolina.

Location	Nesting Sites							Total
	Live Trees			Snags	Channel Markers	Tower or	Pole or	
	Cypress	Pine	Other			Power Line	Platform in Water	
North Carolina								
Albermarle Sound								
Total (Est.) ¹	11(18.7)	5(8.5)	0	35(59.5)	1(1.7)	0	3(5.1)	93.5
Pamlico Sound								
Lake Mattamuskeet ²	33	0	0	5	0	0	0	38.0
Remainder (Est.) ¹	0	0	2(3.4)	46(78.2)	0	1(1.7)	0	83.3
Total (Est.)	33.0	0	3.4	83.2	0	1.7	0	121.3
South Coast								
Ellis Lake ²	28	0	3	0	0	0	0	31.0
Camp Lejeune ³	0	3.5	3.5	40.6	0	1.2	1.2	50.0
Orton Pond ³	44	6	0	11	0	0	0	61.0
Remainder (Est.) ¹	5(8.5)	13(22.1)	2(3.4)	34(57.8)	1(1.7)	0	0	93.5
Total (Est.)	80.5	31.6	9.9	109.4	1.7	1.2	1.2	235.5
TOTAL (North Carolina)	132.2	40.1	13.3	252.1	3.4	2.9	6.3	450.3
South Carolina								
North Coast								
Santee Hunt Club ⁴	30	0	0	0	0	0	0	30.0
Waccamaw River ⁴	5	0	0	14	2	0	0	21.0
Remainder (Est.) ¹	2(3.4)	3(5.1)	0	22(37.4)	0	1(1.7)	0	47.6
Total (Est.)	38.4	5.1	0	51.4	2.0	1.7	0	98.6
South Coast								
Total Area (Est.) ¹	0	0	0	4(6.8)	0	3(5.1)	0	11.9
TOTAL (South Carolina)	38.4	5.1	0	58.2	2.0	6.8	0	110.5
GRAND TOTAL								
(North and South Carolina)	170.6	45.2	13.3	310.3	5.4	9.7	6.3	560.8

1 Used air: ground visibility rate of 1.70 x air count().
 2 Ellis Lake and Lake Mattamuskeet ground count April, May, and June.
 3 Used air: ground visibility rate obtained from that area.
 4 Ground count was believed complete.

When Davis, Pearson, and Royal (Pearson *et al.* 1943) visited Great Lake on June 11, 1939, no nesting Ospreys were found. A fire in the Great Lake area that burned for 6 months destroyed much of the Osprey habitat in the mid-1930s and may have accounted for the absence of birds in the area in 1939 (E. Simon, personal comm.). Borden (1949), apparently discussing the 1948 nesting season, reported six Osprey nests at Great Lake, but no mention was made of Ospreys at Ellis Lake. Ospreys were nesting at both lakes in the late 1950s and early 1960s (C. D. Peterson, personal comm.). Three old Osprey nests were located at Great Lake in 1969, but none were active; however, 17 Osprey nests (12 active) were located on July 5, 1969 at Ellis Lake (Grant 1970). Grant concluded that Great Lake apparently changed in some way since Pearson and others visited it in the early 1900s. Cypress trees that were growing within Great Lake at the turn of the century were no longer present in 1974. In

contrast, man, by manipulating the water levels at Ellis Lake, particularly the 1947 dam, seems to have created new Osprey nesting habitat. The progeny of birds that originally nested at Great Lake probably now nest in the Cypress on Ellis Lake. Thus, the Ellis Lake-Great Lake area where approximately 30 pairs nested in 1909 was represented by 31 pairs in 1974.

Orton Pond—The reservoir at Orton Plantation was formed during the rice-growing era of the south (circa 1750). In 1872, the pond was listed as 7 miles long with a 12-foot head of water (Sprunt 1958). Pearson *et al.* (1919) indicated that at least 35 pairs of Ospreys nested on the pond. Counts made between 1920 and 1943 ranged from 36 to 50 active nests (Pearson *et al.* 1943, Simpson 1943). Parnell and Walton (1974) studied the population in 1969, 1970, and 1971 and recorded 43, 37, and 47 pairs, respectively. Our survey in 1974 showed an all-time high of 61 pairs.

North Coast, South Carolina

Ospreys are much less abundant in South Carolina than in North Carolina (111 vs. 450 pairs), nearly all the South Carolina birds nest along the North Coast (north of Charleston). Almost all of the birds nested at three concentration points — the Santee Hunt Club near the mouth of the South Santee River, the Waccamaw River near Georgetown, and the Charleston vicinity. Beckett (1970) reported 25 to 30 pairs nesting at the Santee Hunt Club in 1969. Our count in 1974 was nearly identical (30 pairs).

South Coast, South Carolina

Only 12 active nests were believed to exist in the region south of Charleston. This portion of South Carolina must be near the southern terminus of the breeding range for the migratory population nesting along the Atlantic Coast. Verified nesting records from Georgia, with one exception, are limited to the Savannah region, which is adjacent to the South Carolina border (Burleigh 1958).

PRODUCTION RATES

Observed production rates when compared with a norm considered necessary for maintaining a

stable population yields additional information regarding the status of a population. Henny and Wight (1969) estimated that 0.95 to 1.30 young must be fledged per breeding pair to maintain a stable Osprey population. Furthermore, Henny and VanVelzen (1972) estimated that approximately 5 to 10 per cent of a healthy Osprey population on the breeding grounds should consist of non-breeding 2-year-old "housekeepers" which associate with nests but do not lay eggs. They also indicated that the percentage of "housekeepers" may be slightly higher for populations in the southern portion of the breeding range (south of Virginia).

Observed production rates at Ellis Lake and Lake Mattamuskeet in 1974 were considered normal to excellent. Of the 31 pairs at Ellis Lake (28 breeders and 3 "housekeepers"), the 28 breeding pairs fledged 1.25 young per pair. At Lake Mattamuskeet 38 pairs were present (32 breeders and 6 "housekeepers"), and the 32 breeding pairs fledged 1.41 young per pair. The non-breeding segment of the population at the two areas totalled 13 per cent which is also indicative of a thriving population (slightly above the 5 to 10 per cent range for a southern breeding

Table 3. — Summary of nesting Ospreys at Great Lake, Ellis Lake, and Orton Pond.

Year	Number of Nesting Pairs			Date Visited	Authority
	Great Lake	Ellis Lake	Orton Pond		
1909	30			June 20	Philipp (1910)
1919 (prior to)			35 (at least)	—	Pearson <i>et al.</i> (1919)
1920			36 (6 old)	May 4	Pearson <i>et al.</i> (1943)
1939	0 (3 old) ¹			June 11	Pearson <i>et al.</i> (1943)
1943			50 (about)	March 31	Simpson (1943)
1948	6 (eastern shore)			June 28-July 5	Borden (1949)
1958-61	18-22	2-3		—	Peterson, C.D. (pers. comm.)
1969 ²	0 (3 old)	12 (5 old)	43	Complete season	Grant (1970), Parnell and Walton (1974)
1970			37	Complete season	Parnell and Walton (1974)
1971			47	Complete season	Parnell and Walton (1974)
1974	0	31	61	April 26 ³ Complete season ⁴	This study

1 Old nests are additional to active nests. In years when nests were visited in late June or July, some of the "old nests" may have been active earlier in season but were unsuccessful.

2 Great Lake and Ellis Lake from July 5 visit (Grant 1970).

3 Orton Pond.

4 Great Lake and Ellis Lake.

Table 4. — The percentage of Ospreys utilizing various types of nest sites.

Location	Live	Trees Dead	Total	Duck Blinds	Channel Markers	Other	Total Number Nests	Authority
Maryland ¹	—	—	18	39	21	22	786	Henny <i>et al</i> 1974
Virginia ¹	—	—	48	16	23	13	664	Henny <i>et al</i> 1974
North Carolina	41	56	97	0	1	2	450	This Study
South Carolina	39	53	92	0	2	6	111	This Study

¹ Refers to Chesapeake Bay only.

population). Additional productivity data from Orton Pond was collected in 1969, 1970, and 1971 (Parnell and Walton 1974). Production in 1969 and 1971 (1.03 and 1.16) was considered normal, while production in 1970 (1.50) was considered excellent. The nesting population at Orton Pond in 1974 was at an all-time high which may at least partially be due to the excellent recruitment in 1970. It takes three years for the birds to reach maturity (Henny and Wight 1969). The population at Ellis Lake has also increased in recent years (Table 3).

NESTING SITES

Live trees, primarily Cypress and Pine (*Pinus sp.*), and dead snags were used by 96 per cent of the Ospreys nesting in the Carolinas. The remaining birds nested on channel markers, poles or pilings in water, power lines, and a radar tower (Table 4). The height of nests in water-based Cypress trees was low (4-30 feet) compared to those in live Pines or snags on land (30-60 feet). It appears that the over-water nesting sites in the Cypress possibly afford some protection from land predators, and therefore height is not required. The distance above the water of each nest site at Orton Pond in 1974 is estimated in Table 5. Simpson (1943:29) indicated that the Osprey nest sites at Orton Pond varied "...in height above the water from a few feet to fifteen or twenty feet. One nest was placed so low on a stump that the water came to within a foot of the top of the nest." The nest heights in 1974 were quite similar.

Chesapeake Bay Ospreys use trees to a much lesser extent than Carolina birds. However, the distance above water of the over-water nesting structures in Chesapeake Bay was again low. Contents of the nests on channel markers and offshore duck blinds can be observed from a boat. Furthermore, some evidence is available from Chesapeake Bay indicating that the more stable over-water structures (primarily channel markers and duck blinds) were more successful than land-based nests, which may indicate a land pre-

dator problem or a wind problem with the latter. It is worth mentioning that 15 to 16 per cent of the channel markers in Chesapeake Bay were used as nesting sites by Ospreys (an estimated 316 pairs) in 1973. Another 416 pairs used duck blinds in Chesapeake Bay while 258 used miscellaneous structures. Only 460 (31.7 per cent) of the 1450 pairs in the Bay nested in trees. Although large numbers of offshore blinds were present in selected locations, e.g., Currituck Sound, no Ospreys nested on duck blinds in the Carolinas. Ospreys always nest on the roofs of duck blinds in Chesapeake Bay, but Carolina blinds do not have roofs. Therefore, Carolina blinds probably are not suitable for nesting Ospreys.

Table 5. — The estimated height above water of nest sites used by Ospreys at Orton Pond.

Height above water (feet)	Live Cypress	Dead Cypress	Live Pine	Dead Pine
0-6	1	7	—	—
7-12	9	1	—	—
13-18	9	1	—	—
19-24	10	—	—	—
25-30	12	—	—	—
31-36	1	—	—	—
37-42	—	—	(1) ¹	—
43-48	—	—	—	—
49-54	(2)	—	(3)	—
55-60	—	—	(2)	(2)

¹ Nests in trees growing from shoreline (not in water) are enclosed in parentheses.

DISCUSSION

An estimated 561 ± 34 pairs of Ospreys nested in the Coastal Carolinas in 1974 and an additional 1450 ± 44 pairs nested in Chesapeake Bay in 1973. Evidence from two locations in North Carolina suggested little or no change in numbers during the last several decades. Furthermore,

productivity appeared to be normal or slightly above normal. At least four of the major concentration sites in the Carolinas (Orton Pond, Lake Mattamuskeet, Santee Hunt Club, and Ellis Lake) were altered tremendously by man in the past. Similar findings were noted in Oregon, where Roberts and Lind (1974) reported "...a large majority of the reported nests are on or adjacent to man-made impoundments. Osprey nests were found on 11 reservoirs, a fact which suggests that this land management practice is beneficial to the welfare of the bird." Ospreys in the Carolinas nested primarily in trees (96 per cent), whereas trees were much less important to the Ospreys in Chesapeake Bay (31.7 per cent). The high use of miscellaneous man-made structures in the Bay together with the importance of altered habitat in the Carolinas suggests that the Osprey is quite adaptable.

Intensive studies on small areas may be of limited value for directly determining changes in abundance of an opportunistic nester such as the Osprey, i.e., a species with good pioneering ability that will take advantage of new habitat. However, productivity estimates from relatively small areas may be compared to a norm to provide additional insight into the status of a population. An extensive survey coupled with a few small intensive study areas to estimate productivity, such as the approach followed in this study, is probably the best way to evaluate population trends for Ospreys in a large geographical unit.

This study provides baseline data for evaluating future changes in distribution and abundance. Continued monitoring is planned at 3- to 5-year intervals by the U.S. Fish and Wildlife Service.

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A mail questionnaire survey concerning nesting Ospreys by Donald T. Harké and James Karenbrock, Division of Wildlife Services, USFWS, was instrumental in the decision that an aerial survey of the Carolinas was warranted, and that the coastal portion of the States was the logical place for such a survey. James F. Parnell, University of North Carolina at Wilmington, provided information regarding the timing of the nesting season in the Carolinas. Dan M. Connelly, North Carolina Wildlife Resources Commission, Theodore A. Beckett III, and Ronald M. Anglin (USFWS) assisted in the ground survey. Otto Florschütz, Jr. (USFWS) and Robert F. Soots (Campbell College) were instrumental in collecting the productivity data from Ellis Lake and Lake Mattamuskeet. Carroll F. Russell, Charles D. Peterson, and Julian I. Wooten of the Natural Resources and Environmental Affairs Division, Camp

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