

10m 11 21 p.m. 0

Status of the Eastern Brown Pelican in South Carolina

By Philip M. Wilkinson

Study Completion Report
October, 1977 -
September, 1982

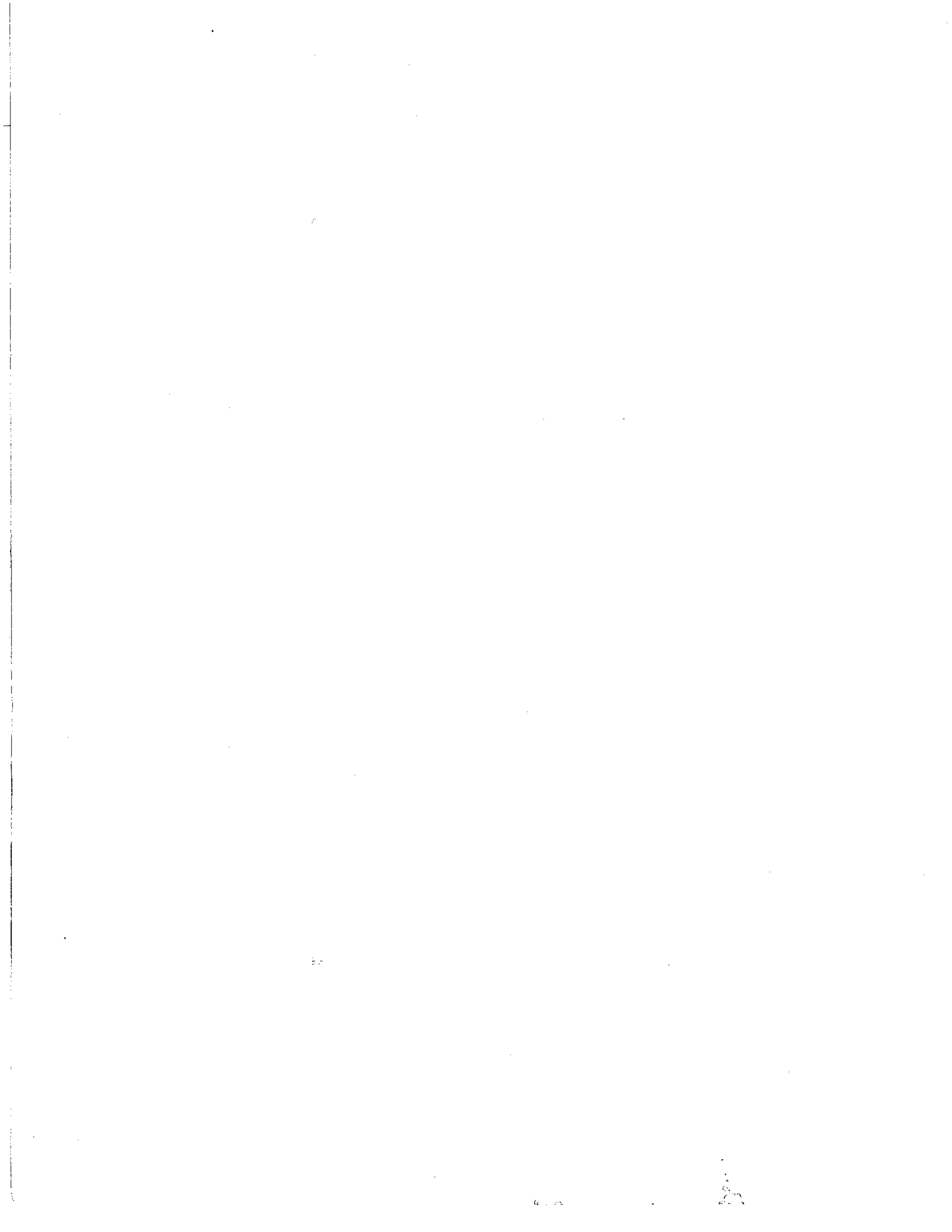
E-1 , Study Nos. VI-D-1
and VI-D-2



S.C. Wildlife and Marine Resources Department
Division of Wildlife and Freshwater Fisheries



Equal Opportunity Agency



ABSTRACT

Band recoveries from pelicans banded in South Carolina during the past 50 years were analyzed. Computer printouts were summarized and put in tabular form. Maps and graphs were made showing recoveries by location, month of recovery, and general ages of birds recovered.

For purposes of this report, banding records from 1931 to 1980 (n=17,603) were analyzed. There were 1,340 band recoveries (7.6%) from these bandings. Most band recoveries from South Carolina-banded pelicans were from Florida (n=858), followed by South Carolina (n=313), North Carolina (n=80), Georgia (n=50) and Cuba (n=29). South Carolina pelicans recovered in Florida were almost exclusively from Florida's east coast.

The month of highest recovery rate was in January followed by December, February and March. The months of lowest band recovery rate were May and September. Band recoveries were highest in Florida in the fall, winter and spring, and highest in South Carolina in summer. The time and rate of band recovery by region indicate South Carolina pelicans largely winter in Florida and spend their summers in South Carolina. Band returns substantiate high juvenile mortality rates, which tend to level off after the birds are 4 years of age.

Loafing sites were assessed along the South Carolina coast to determine the feasibility of capturing adult pelicans by means of a rocket-net system. Indications were that it was not feasible to rocket-net pelicans on loafing areas.

One thousand two hundred ninety-six preflight pelicans were marked over a period of 3 years (1979-1981) on their natal rookeries. The juvenile pelicans were individually marked with a combination of leg and wing markers to enable each bird to be recognized from a distance. These marked pelicans were observed during monthly coastal flights. Reports of color-marked pelicans were also received by mail and phone from persons who observed them during all seasons in four states (North Carolina, South Carolina, Georgia and Florida).

There were 413 reports of pelican sightings that were specially marked as juveniles on South Carolina rookeries. The most frequently reported observations were of wing-marked pelicans (n=387). Survival of these marked pelicans and/or their markers was low after their first winter. The marked juveniles were observed both north and south of the rookeries along the coast shortly after fledging. In late August sighting reports indicated a general movement south along the coast. Sighting recoveries were high along the Georgia coast in September and October. In November and December sightings were highest from the north to central east coast of Florida. In late winter and early spring these juveniles were most often sighted from the central east coast of Florida to the Florida Keys.

One marked pelican nested at 1 year of age. Two nested as 2-year-olds, ten as 3-year-olds, five as 4-year-olds and one nesting pelican still retained its marker after 5 years.

Seasonal abundance indicated pelican numbers in South Carolina were lowest in January and February and highest in May, June and July.

Monthly coastal aerial surveys were conducted to determine pelican numbers in South Carolina. Nest counts were made from aerial photographs

and ground surveys. Reproductive success was determined by ground counts of preflight young.

The number of nesting pelicans in South Carolina has generally increased from 1970 (N=1,116) until the present (n=5,100). Fledgling success increased similarly during the same period. The lowest fledgling success was in 1970 (n=945) and the highest in 1984 (n=6,700).



TABLE OF CONTENTS

	Page
LIST OF TABLES	i
LIST OF FIGURES	ii
INTRODUCTION	1
ACKNOWLEDGEMENTS	5
METHODS	7
Banding Analysis	7
Mark Adults	7
Marking Juveniles	8
Monitoring	10
Surveys to Monitor Seasonal Population Trends, Nesting Effort and Nesting Success	10
RESULTS	11
Banding Analysis of South Carolina-Banded Eastern Brown Pelicans	11
Recovery Area	14
Time of Recovery	33
Time of Recovery by Region	34
Mortality	34
Marked Adults	39
Feasibility of Rocket-Netting Adult Pelicans on Loafing Areas	39
MARK AND MONITOR JUVENILES	46
Sighting Returns	46
Movements of Marked Juvenile Pelicans	46
Nesting Sightings of Marked Pelicans of Known Age	47

Rookery Selection by Marked Pelicans	48
Seasonal Distribution, Abundance, Nesting Effort and Reproductive Success	48
Seasonal Abundance	48
Seasonal Distribution	53
Nesting Effort and Reproductive Success	66
DISCUSSION	68
LITERATURE CITED	72
APPENDIX 1	73
A Partial Pelican Bibliography	73

LIST OF TABLES

Table	Page
1. Number of pelicans banded in South Carolina by year banded.	12
2. Pelican recoveries from 1931-1980.	13
3. Eastern Brown Pelican band recoveries showing age of bird and where recovered.	15-22
4. Number of bands recovered from South Carolina-banded pelicans by month recovered (1931-1980).	33
5. A comparison of recoveries in South Carolina to recoveries outside of South Carolina by recovery month (1931-1980).	35
6. Pelican nesting efforts and fledgling success in South Carolina rookeries, 1974-1980.	67

LIST OF FIGURES

Figure	Page
1. Map of current brown pelican breeding colonies in South Carolina.	6
2. North Carolina, recoveries of 3- to 11- month-old pelicans.	23
3. North Carolina, recoveries of 12- to 23- month-old pelicans.	24
4. North Carolina, recoveries of 24- month-old and older pelicans.	25
5. South Carolina and Georgia, recoveries of 0- to 2- month-old pelicans.	26
6. South Carolina and Georgia, recoveries of 3- to 11- month-old pelicans.	27
7. South Carolina and Georgia, recoveries of 12- to 23- month-old pelicans.	28
8. South Carolina and Georgia, recoveries of 24- month-old and older pelicans.	29
9. Florida, recoveries of 3- to 11- month-old pelicans.	30
10. Florida, recoveries of 12- to 23- month-old pelicans.	31
11. Florida, recoveries of 24- month-old and older pelican.	32
12. A comparison of band recovery rates of South Carolina-banded pelicans in South Carolina and Florida by age class.	36
13. A comparison of band recoveries of South Carolina-banded pelicans during and after their first year by month recovered.	37
14. A comparison of band recoveries of South Carolina-banded pelicans in South Carolina and Florida by month recovered.	38
15. Relative numbers of pelicans present in South Carolina by month - 1978.	50
16. Relative numbers of pelicans present in South Carolina by month - 1979.	51

17.	Relative numbers of pelicans present in South Carolina by month - 1980.	52
18.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in January.	54
19.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in February.	55
20.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in March.	56
21.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in April.	57
22.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in May.	58
23.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in June.	59
24.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in July.	60
25.	Average (1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in August.	61
26.	Average (1978, 1979) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in September.	62
27.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in October.	63
28.	Relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in November, 1979.	64
29.	Average (1978, 1979, 1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in December.	65



INTRODUCTION

In the late 1960's the Eastern Brown Pelican (Pelecanus occidentalis carolinensis) experienced a population decline in South Carolina and in many other parts of its range. The decline was thought by some to be caused by various pesticides that were heavily used at that time. Generally, however, the decline was poorly understood, so there were few, if any, remedies for it. As a result, the Eastern Brown Pelican was listed as endangered in 1974. Several factors hindered accurate assessment of the pelicans' plight. One factor was a lack of knowledge about their nesting ecology. Little was known about the age composition of nesters in the colonies, whether pairs renested when nests were destroyed, the nest attendance of a nesting pair or the distances they traveled from the colonies when feeding. Nesting interchange between colonies was also poorly understood.

There are no previous records of statewide pelican surveys in South Carolina. No attempts have been made to determine the numbers of pelicans using the state's coastal areas during any season of the year. Nest counts and in some cases, fledgling counts have been made in the Cape Romain National Wildlife Refuge (CRNWR) annually since the late 1930s.

Becket (1966) censused nesting pelicans on Deveaux Bank in 1964 and CRNWR personnel censused nesting pelicans in the refuge during the same year, but there is no evidence that these counts were standardized or coordinated.

Blus et al. (1979) counted nests and numbers of fledglings in all South Carolina rookeries from 1969 through 1976. This was the first effort

toward determining the statewide population status of pelicans in South Carolina.

To determine some of the nesting ecology parameters, a method of marking individually recognizable nesting adults was needed. In the past, techniques have been developed, sometimes with limited success, for marking game birds for individual recognition. Knowlton et al. (1964) had limited success in marking wild turkeys with colored leg markers of the type described by Downing and Marshall (1959). Back tag markers similar to those described by Blank and Ash, (1956) and evaluated by Labisky and Mann (1962) and Gullion et al. (1962), were not satisfactory because the markers became obscured by the long contour feathers on the turkeys' backs.

Knowlton et. al. (1964) placed plasticized nylon markers on the patagium of each wing of 242 turkeys to mark the animals for subsequent individual recognition in the field. His turkeys could be individually identified at distances of up to 183 meters. After 12 to 16 months, only two turkeys had one wing marker missing.

During 2 years of field trials, Anderson (1963) found various species of waterfowl could be individually identified up to 150 meters by means of a colored, semirigid plastic material attached to the patagium of each wing.

Bruce Hanson of the Northern Prairie Research Station (Pers. Comm.) has successfully used a "Lyn Ply Plastic" leg band that allowed Canada Geese to be individually recognized for up to four years.

Schreiber (1976) placed colored leg and wing streamers on brown pelican nestlings. The material became worn and frayed and did not remain on the birds for more than 6 to 9 months. Nesbitt (1979) tested four potential

wing marker materials for color fastness and durability. The materials were subjected to severe artificial conditions.

When marking pelicans, several factors must be considered: first, how to capture the sample population to be marked; second, where to attach the marker so that it is visible; and third, finding a material that can withstand the deteriorating effects of salt water and the wear caused by the birds diving and feeding activities.

Birds captured for marking studies may also be banded with regular U.S. Fish and Wildlife Service aluminum bands. This requires little extra effort and can yield additional information. In the past 50 years over 17,000 juvenile pelicans have been banded in South Carolina. This effort has not yielded significant insight into the biology of the species simply because no one has analyzed the band return data.

Surveys to determine seasonal population status, nesting effort, and reproductive success were conducted using several types of aircrafts. During the nesting season ground nest counts in ~~the~~ rookeries were conducted immediately following ~~the~~ aerial surveys for the purpose of comparing the two methods of counting nests. The banding analysis, marking studies and population monitoring were undertaken to determine the overall status of the pelican population in South Carolina during all seasons of the year.

Pelicans have nested on as many as 11 different sites in South Carolina since 1900 (Blus et al.1979).

The most important of these rookeries were: Egg Bank in St. Helena Sound, Deveaux Bank at the mouth of the North Edisto River, Bird Island in Bulls Bay, Marsh Island in Bulls Bay, and Bird-Key Stono at the mouth of

the Stono River. These islands have gone through cycles of accretion and erosion during the course of their existence, however; only Deveaux Bank has completely eroded away (Fig. 1). These rookeries have supported some of the largest numbers of nesting pelicans recorded on the east coast.

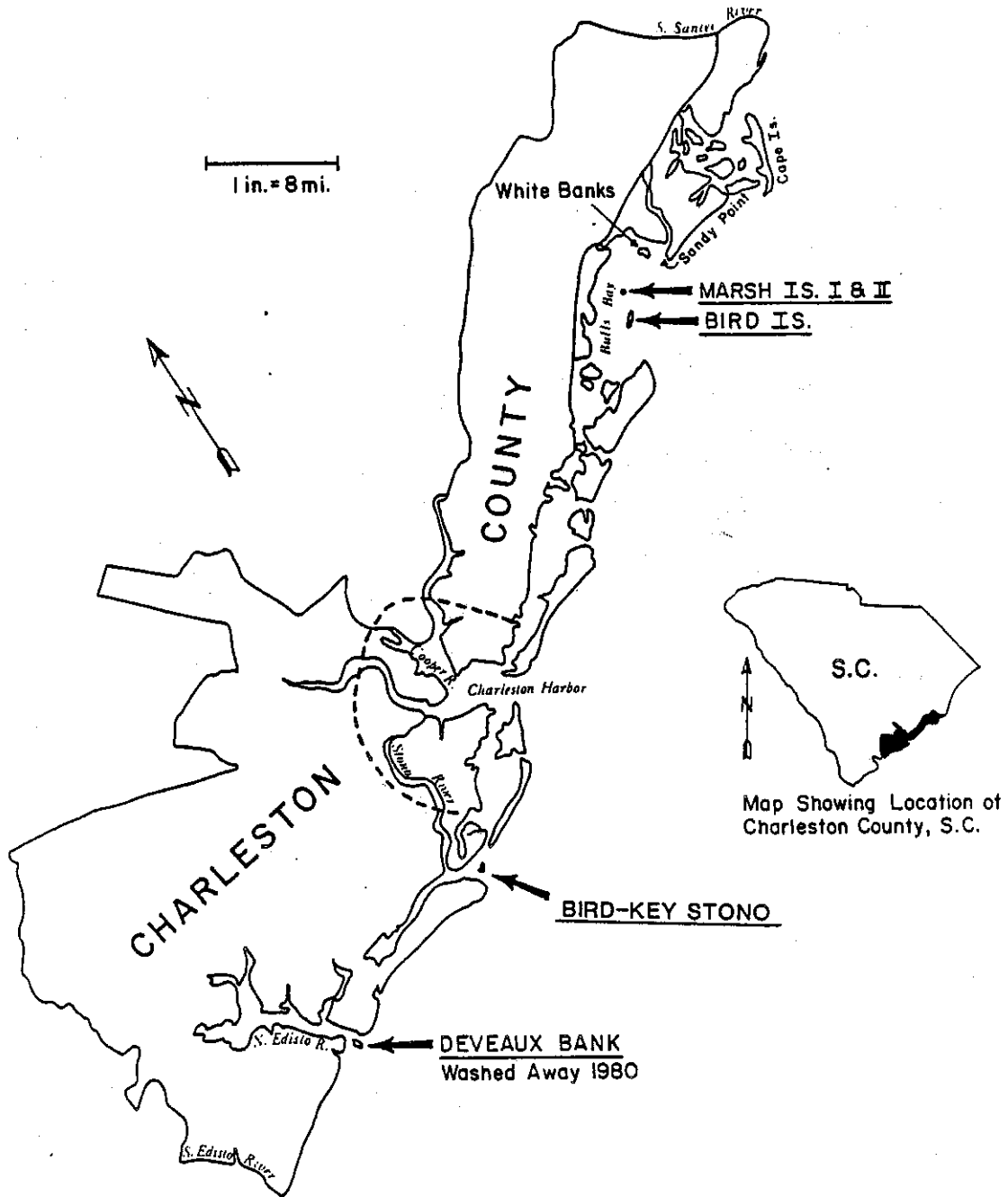
ACKNOWLEDGEMENTS

I would like to express my thanks to George Garris of the United States Fish and Wildlife Service at the Cape Romain National Wildlife Refuge for his help and to his staff for their assistance in banding and monitoring the pelican rookeries in the Bulls Bay area. Ann Stark, of the National Audubon Society also gave me tremendous assistance with nest counts on Deveaux Bank.

I am also grateful to technicians John Coker, Carl Wright, Jane Beam Lindsey, and Susan Muniah for their assistance both in the field and in the laboratory and to Karen Swanson for designing the cover.

A special thanks to Priscilla Knight and Martin Hudson who helped with every aspect of this study.

Fig. 1 Map of Current (1984) Brown Pelican Breeding Colonies in South Carolina



METHODS

Banding Analysis

We analyzed band recoveries from the 17,603 pelicans banded in South Carolina during the past 50 years. Computer printouts were summarized and/or put in tabular form. Maps were made showing recoveries by location, month of recovery, and general age of birds recovered. For recovery maps, movements, and band recovery rate, no general deletions were made in the analysis. Recoveries with any of the following characteristics were deleted: (1) colony mortalities where banding Lat./Long. and recovery Lat./Long. were the same, the recovery month was earlier than August, and the banding year was the same as the recovery year, (2) when the bird's age was unknown, (3) where mortality was questionable, and (4) when the recovery (how obtained) was due to skeletal remains, so the information obtained was vague or insufficient. All birds considered in the analysis were "locals" and were incapable of sustained flight when banded. These birds were aged according to a 1 August-31 July calendar. In year-specific mortality, August 1 is used as the beginning day of each year.

Mark Adults

Flights in a Cessna 180 were made monthly from January through July, 1978, to determine locations along the South Carolina coast regularly used by pelicans for loafing. Each loafing site was assessed as to its accessibility, nearness to cover, suitability for boat anchorage, distance

from a rookery and the degree of human disturbance on it. After suitable areas were found, further reconnaissance by boat determined the time of day, stage of tide, and with what regularity pelicans used each of the locations.

Six locations in lower Winyah Bay in Georgetown County where pelicans were regularly seen loafing were selected to test a rocket-net system. The capture device was a nylon rocket-net system. The net measured 43 feet by 57 feet, had a mesh size of 2 inches square, and was fitted with a 2 foot fringe to prevent captured animals from escaping from under the edge of the net. The net was propelled by four recoilless net-trap rockets. The net was setup on a level area that exceeded the length and width.

The four rocket launchers were spaced at equal distances along the back edge of the net. The two corner rockets were aimed outward about 35 degrees from a line perpendicular to the net. The tie down lines from the trailing edge of the net were fastened to sandbags. When possible the apparatus was placed in position that allowed it to fire the rockets in the direction of the wind.

Marking Juveniles

One thousand two hundred ninety-six preflight pelicans were marked over a period of 3 years (1979-1981). In 1979 fledgling pelicans were marked with orange wing markers with white numbers. One hundred fifty fledglings on Marsh Island in Bulls Bay were marked on the left wings, while 150 fledglings on Deveaux Bank were marked on the right wings. Wing markers on birds hatched from Marsh Island had white letters in a series from C01

through C00, and E51 through E00. The markers used on fledglings from Deveaux Bank were also orange, lettered in a series of white numbers from A01 through A00, and E01 through E50. Each pelican was also affixed with an orange Lin-Ply Plastic leg band with white numbers that matched those on the wing marker. U.S. Fish and Wildlife Service aluminum butt-end bands were placed on the other leg opposite to the colored leg band.

In 1980 the colored leg bands were not used. One hundred forty-five yellow wing markers with dark green lettering were placed on the left wing of fledgling pelicans on Marsh Island in Bulls Bay. They were numbered in a series from J01 through J00 and from K01 through K49. Similar markers (151) were placed on the right wing of fledglings on Bird-Key Stono. They were numbered K50 through K00, and T01 through T00. Regular U.S. Fish and Wildlife Service bands were placed on the left leg.

Wing markers were not used in 1981. Instead, international orange plastic leg bands were used. One hundred fifty bands lettered 01 through 00 (line below) and $\overline{01}$ through $\overline{50}$ (line above) were placed on the right legs of birds on Marsh Island. The same number of markers (150) were placed on the left legs of hatchlings on Bird-Key Stono. Their number series was $\overline{51}$ through $\overline{00}$ (line above), and 01 through 00 (line below). U.S. Fish and Wildlife Service bands were placed on the other leg opposite to the colored leg bands.

In 1978, 400 fledglings were banded with aluminum interlocking bands on their right legs and aluminum butt-end bands on their left legs.

Monitoring

Marked pelicans were observed and counted during monthly coastal flights. Reports of color-marked pelicans were received by mail and phone from persons who observed them during all seasons in four states (North Carolina, South Carolina, Georgia and Florida). These observations, along with our own, were mapped to show when and where the birds were seen, which sometimes indicate direction of movement.

Surveys to Monitor Seasonal Population Trends, Nesting Effort and Nesting Success.

Monthly aerial surveys were conducted along the coast to determine pelican numbers in South Carolina. Aerial photographs of colonies during the nesting season were taken at altitudes of 200 to 500 feet to determine nesting effort. Nest counts were also made from the ground and compared with counts made from aerial photographs. Reproductive success was determined by ground counts of preflight young and information obtained from the nesting efforts of adults.

RESULTS

Banding Analysis of South Carolina-Banded Eastern Brown Pelicans

Eastern Brown Pelicans in South Carolina were first banded in 1931 and have been banded during 36 of the past 54 years for total of 18,898 banded pelicans. For purposes of this report banding records from 1931 through 1980 (n=17,603) were analyzed (Table 1). During this period there were 1,340 band recoveries (7.6%), and most of these were from Florida (n=858), followed by South Carolina (n=313), North Carolina (n=80), Georgia (n=50) and Cuba (n=29)(Table 2).

bands up to 1980

Table 1. Number of Pelicans Banded in South Carolina by Year Banded.

Year	No. Banded	
1931	37	
1932	98	
1935	31	
1938	40	
1939	60	
1940	74	
1941	102	14 banding years spanning 31 years
1942	90	
1946	200	
1947	50	
1950	683	
1956	100	
1959	73	
1961	<u>200</u>	
Total	1,838	10%
1963	1267	
1964	1572	
1965	1674	
1966	1221	
1967	826	
1968	860	
1969	1158	
1970	643	
1971	857	
1972	705	18 banding years spanning 18 years
1973	707	
1974	1403	
1975	890	
1976	400	
1977	400	
1978	399	
1979	483	
1980	<u>300</u>	
Total	15,765	90%

Total of 32 banding years spanning 50 years

Total pelicans banded in all years, 17,603

Table 2. Pelican Recoveries from 1931 - 1980.

Area	No. of Recoveries
FL	858
GA	50
NC	80
SC	313
VA	1
AL	1
LA	1
HON	1
BAH IS	5
CUB	29
JAM	<u>1</u>
Total	1,340

Recovery Areas.- Figures 2 through 11 and the accompanying Table 3 illustrate recovery areas along the coasts of North Carolina, South Carolina, Georgia and Florida of pelicans of various age classes.

Initially, young pelicans (0-2 months old) were recovered on or near the rookery where they had been banded (Fig. 4). More returns were received from the vicinity of the Deveaux Bank rookery than rookeries in Bulls Bay because of the higher potential for human encounter on the more developed beaches near Deveaux Bank.

Recoveries were highest of pelicans 3 months to 1 year old in Florida, suggesting that most South Carolina pelicans spend their first winter on the east coast of Florida.

The band recovery rate from South Carolina and points south was much greater (95.3%) than that from areas to the north (4.7%). Most recoveries reported north of South Carolina occurred near the mouth of the Cape Fear River in North Carolina (Fig. 3). In South Carolina the area of highest band recovery was near the mouth of the North Edisto River. These recoveries were primarily from pelicans associated with the Deveaux Bank rookery. Charleston Harbor supports a large number of pelicans and also had a high band recovery rate. In Florida recoveries were distributed along the entire east coast, but the highest recoveries were from Talbot Island, Daytona Beach, New Smyrna Beach, Merritt Island, Melbourne, Fort Pierce and the Miami area.

Table 3. Eastern Brown Pelican Band Recoveries Showing Age of Bird and Where Recovered.

North Carolina

No.*	Lat./Long.	General Area	Age of Recovery in Months				Total
			0-2	3-11	12-23	24+	
1	0361-0754	Currituck Sound		1			1
2	0355-0753	Nags Head, Bodie Is.		1		1	2
3	0354-0753	Oregon Inlet		1			1
4	0352-0753	Outer Banks, Avon, Gull Is.			3	1	4
5	0351-0753	Cape Hatteras				1	2
6	0350-0755	Ocracoke		1	1	3	5
7	0350-0760	Portsmouth Is.		3	3	1	7
8	0345-0761	Core Banks, Swash Inlet		1	3	2	6
9	0344-0762	Core Sound			2		2
10	0343-0761	Cape Lookout		2			2
11	0344-0763	Beaufort, Beaufort Inlet		2	2	1	5
12	0344-0764	Moorehead City, Bogue Sound	2				2
13	0344-0765	Bogue Sound		2			2
14	0343-0772	New River, New River Inlet		1			1
15	0343-0773	Inland W. of New River		1			1
16	0341-0773	Old Topsail Inlet		2			2
17	0341-0774	Wrightsville, Rich Inlet		2			2
18	0341-0775	Wilmington, Cape Fear River		3			3

* Numbers refer to locations on maps, Fig. 3-11.

No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
19	0340-0781	Inland W. of Cape Fear		2	1		3
20	0340-0775	Cape Fear River, Sea Breeze		5	1	2	8
21	0335-0780	Southport, Oak Is.	1	6		1	8
22	0335-0775	Cape Fear, Smith Is.			1		1
23	0335-0781	Lockwoods Folly Inlet		2			2
24	0335-0782	Tubbs Inlet, Shallotte Inlet		4			4
25	0335-0783	Little River Inlet		2			<u>2</u>
							78
<u>South Carolina</u>							
26	0334-0784	North of Myrtle Beach	1	1			2
27	0334-0785	Myrtle Beach		6	3		9
28	0333-0785	Surfside Beach	1	1			2
29	0333-0790	Murrells Inlet		5	1	2	8
30	0332-0790	Litchfield Bch., N. of North Inlet	1	2	2		
31	0332-0791	North Inlet		2		1	3
32	0331-0791	North Island, Winyah Bay		3		2	5
33	0330-0790	Off of South Island		1			1
34	0330-0792	Cape Is., Raccoon Key		4		2	6
35	0330-0793	Bulls Bay near White Banks		3		1	4
36	0325-0793	Bulls Bay, Marsh & Bird Islands	12	1	2	6	21
37	0325-0792	Offshore Bulls Bay	1				1
38	0330-0795	Upper Cooper River			1		1

No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
39	0330-0801	Upper Ashley River				1	1
40	0325-0794	Capers & Dewees Is.		1		1	2
41	0324-0794	Isle of Palms, Dewees Inlet	1	2	1	2	6
42	0325-0800	Ashley River		1			1
43	0325-0795	Wando & Cooper Rivers		3	1		4
44	0324-0795	Charleston Harbor	5	28	5	10	48
45	0324-0800	Stono River		2			2
46	0324-0801	Wadmalaw River	1				1
47	0323-0795	Stono Inlet, Folly Is.	4	4	2	5	15
48	0323-0800	Kiawah & Seabrook Is.	13	1		5	19
49	0323-0801	Seabrook Is., Deveaux Bank, N. Edisto Is.	54	11	10	13	88
50	0323-0802	S. Edisto River, N. Otter Is., Hutchinson Is.		1			1
51	0323-0804	N. Broad River, Coosaw River, Port Royal Is.	1	2		1	4
52	0323-0810	N.W. of Ridgeland	8				8
53	0322-0800	E. of St. Helena Snd.	8				8
54	0322-0802	Fripp Inlet, St. Helena Snd.	3	3		5	11
55	0321-0802	Fripp Island		1		1	2
56	0322-0803	Beaufort River	1			1	2
57	0322-0804	Broad River, Port Royal, Parris Is.		2			2
58	0321-0803	St. Phillip & Pritchard Islands			1	1	2
59	0321-0804	Hilton Head Is.		5	2	5	12

No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
60	0320-0805	Savannah River, Jones & Dafuskie Is.				1	1
							308
<u>Georgia</u>							
61	0320-0805	McQueens & Tybee Is., Savannah River		1		2	3
62	0320-0810	Hutchinson Is., Savannah River		6			6
63	0315-0805	Wassaw & Little Tybee Is., Wassaw Snd.		8	1	2	11
64	0315-0810	Skidaway & Little Wassaw Is., Ossabaw Snd.			1	3	4
65	0314-0810	St. Catherines Snd.				1	1
66	0313-0810	Eastern portion of St. Catherines Is.	1				1
67	0313-0811	N. Sapelo Is., Sapelo River		1	1	2	4
68	0313-0822	Offerman, Pierce & Wayne Co.		1			1
69	0312-0811	Sapelo Is., Doboy Snd.			1	2	3
70	0311-0811	Altamaha Snd.				1	1
71	0311-0812	St. Simons Is.				2	2
72	0310-0813	Colonels & South Is.		1			1
73	0310-0812	Brunswick & Jeckyll Is.		5			5
74	0305-0812	N. part of Cumberland Is., St. Andrews Snd.	1	2	1	4	
75	0304-0812	St. Marys Entrance				1	1
							48

No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
<u>Florida</u>							
76	0304-0812	Fernandina Beach		10		2	12
77	0303-0812	Amelia Is., S. Amelia River		5	3	3	11
78	0303-0813	Nassau River W. of Amelia Is.		2			2
79	0302-0812	Talbot Is.		25	1	5	31
80	0302-0813	St. Johns River, Reddie Point		1		3	4
81	0302-0814	N.W. of St. Johns River, Garden City			1		1
82	0301-0812	Jacksonville Beach	1	13	1	5	20
83	0301-0814	W. of St. Johns River, Wesconsett		10	3	4	17
84	0300-0814	Orange Park, Doctors Inlet		1	1		2
85	0300-0811	Offshore, Guano River		4	1	1	6
86	0300-0812	Guano Canal		2			2
87	0295-0811	St. Augustine Inlet		14	2	3	19
88	0295-0812	Tolomoto River W. of St. Augustine		19		4	23
89	0294-0811	S. Anastasia Is., Matanzas River		12	2	2	16
90	0294-0812	W. of Crescent Beach		1			1
91	0293-0811	Matanzas River, Marineland		2			2
92	0293-0810	E. of Matanzas River		5			5
93	0292-0810	Ormond by the Sea, N. of Daytona Beach		6	1	3	10
94	0291-0810	Ormond, Daytona Beach		31	2	1	34



No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
95	0290-0805	Ponce de Leon Inlet, New Smyrna Beach		38	4	6	48
96	0290-0810	W. of Ponce de Leon		1			1
97	0290-0800	E. of Ponce de Leon Inlet		1			1
98	0285-0804	Indian River North, N. end of Mosquito Lagoon		8	3	2	13
99	0284-0804	S. Mosquito Lagoon, N. Indian River		3		1	4
100	0283-0804	Titusville, N. Merritt Is.		10	2	2	14
101	0283-0805	Loughmans Lake				2	2
102	0282-0802	Off Canaveral Peninsula		2		4	6
103	0282-0803	Canaveral Peninsula		25	3	1	29
104	0282-0804	Merritt Is., Cocoa		40	4	5	49
105	0281-0803	Cocoa Beach		23	3	8	34
106	0280-0803	Melbourne, Indian River		48	6	8	62
107	0280-0802	Offshore of Melbourne Beach				1	1
108	0280-0804	W. of Melbourne, Indian River		1			1
109	0275-0803	Indian River, Sebastian Creek		8	2		10
110	0275-0802	Indian River, Sebastian Inlet		7	1	1	9
111	0274-0802	Wabasso, Winter Beach, Indian River		22	5		27
112	0273-0802	Vero Beach, Indian River		11	4	3	18
113	0273-0801	Indian River Shoal		1			1
114	0272-0801	S. Indian River, Ft. Pierce		36	4	7	47

No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
115	0272-0802	Ft. Pierce		1			1
116	0271-0801	S. Indian River, Jensen Beach		20	1	5	26
117	0271-0800	S. Indian River, St.Lucie Inlet				1	1
118	0270-0800	Hobe Sound		5	1		6
119	0270-0801	Salerno, St. Lucie Canal		8	1		9
120	0265-0800	Jupiter Inlet		10	2		12
121	0264-0800	W. Palm Beach, Palm Beach		25	1	3	29
122	0263-0800	Lake Worth, Lantana		13		2	15
123	0262-0800	Delray Beach, Boca Raton		2		1	3
124	0261-0800	Hillsboro Inlet, Pompano Beach		8	2		10
125	0260-0800	Ft. Lauderdale, Everglades		13	2		15
126	0260-0801	W. of Ft.Lauderdale		4	1		5
127	0255-0800	Golden Beach		2			2
128	0255-0801	N. Miami, Little River		1		1	2
129	0254-0800	Miami Beach, Key Biscayne		24	2	1	27
130	0254-0801	Miami, Coral Gables		27	2	3	32
131	0253-0801	Eastern Biscayne Bay			1		1
132	0252-0801	Elliott Key, Old Rhodes Key		2			2
133	0252-0802	E. tip Florida, W.of Keys		3		1	4
134	0251-0802	Barnes Sound		1			1
135	0250-0802	Rodriquez Key, Rock Harbor		4	2	1	7



No.*	Lat./Long	General Area	0-2	3-11	12-23	24+	Total
136	0245-0803	Plantation, Upper Matacumbie Key	5				5
137	0245-0804	Lower Matacumbie Key			1		1
138	0244-0804	Long Key	1				1
139	0244-0805	Duck & Grassy Key	1				1
140	0244-0810	Boot & Vaca Key	4		2	1	7
141	0244-0812	Big Prince, Torch & Content Key	1				1
142	0243-0813	Key West, Boca China Key	3				3
143	0251-0810	Cape Sable	1				1
144	0260-0814	Naples			1		1
145	0265-0820	Port Charlotte				1	1
146	0281-0830	W. of Pasco Cnty.	1				1
147	0300-0841	Apalachee Bay				1	1
148	0295-0842	Peninsula Point	1				<u>1</u>
							830

State Totals

North Carolina	78
South Carolina	308
Georgia	48
Florida	<u>830</u>
	1,264

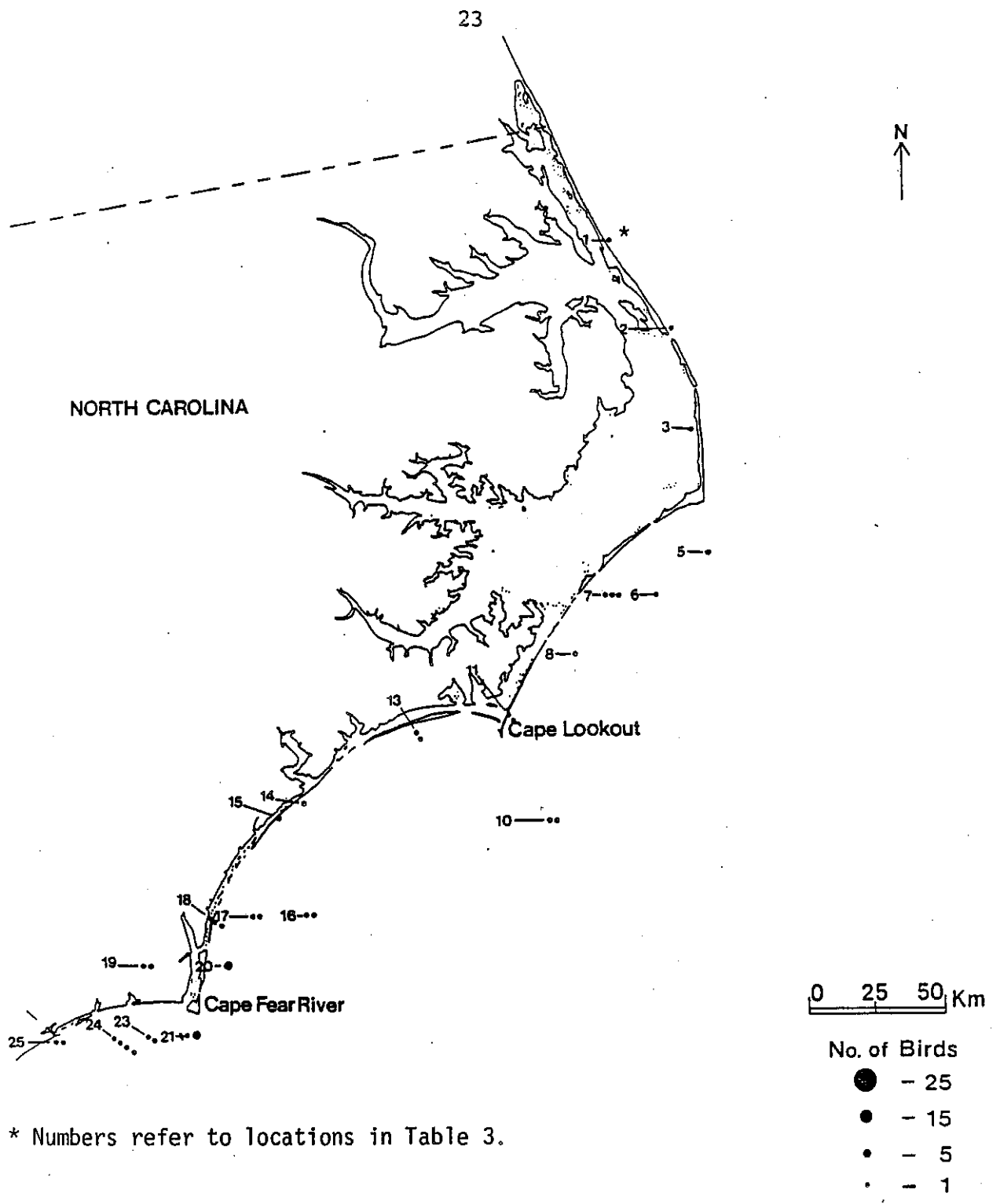


Fig. 2 North Carolina, recoveries of 3- to 11- month-old pelicans.

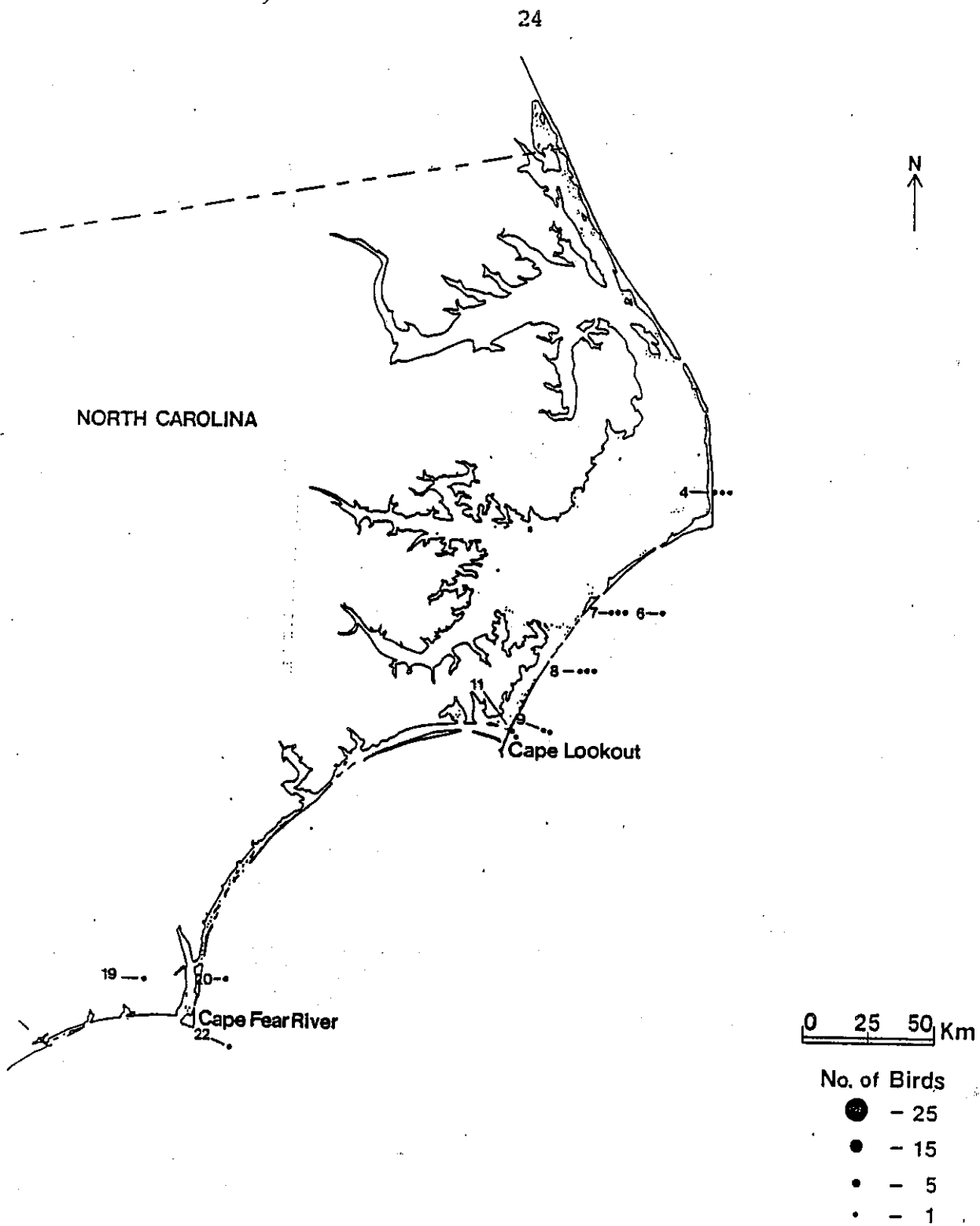


Fig. 3 North Carolina, recoveries of 12- to 23- month-old pelicans.

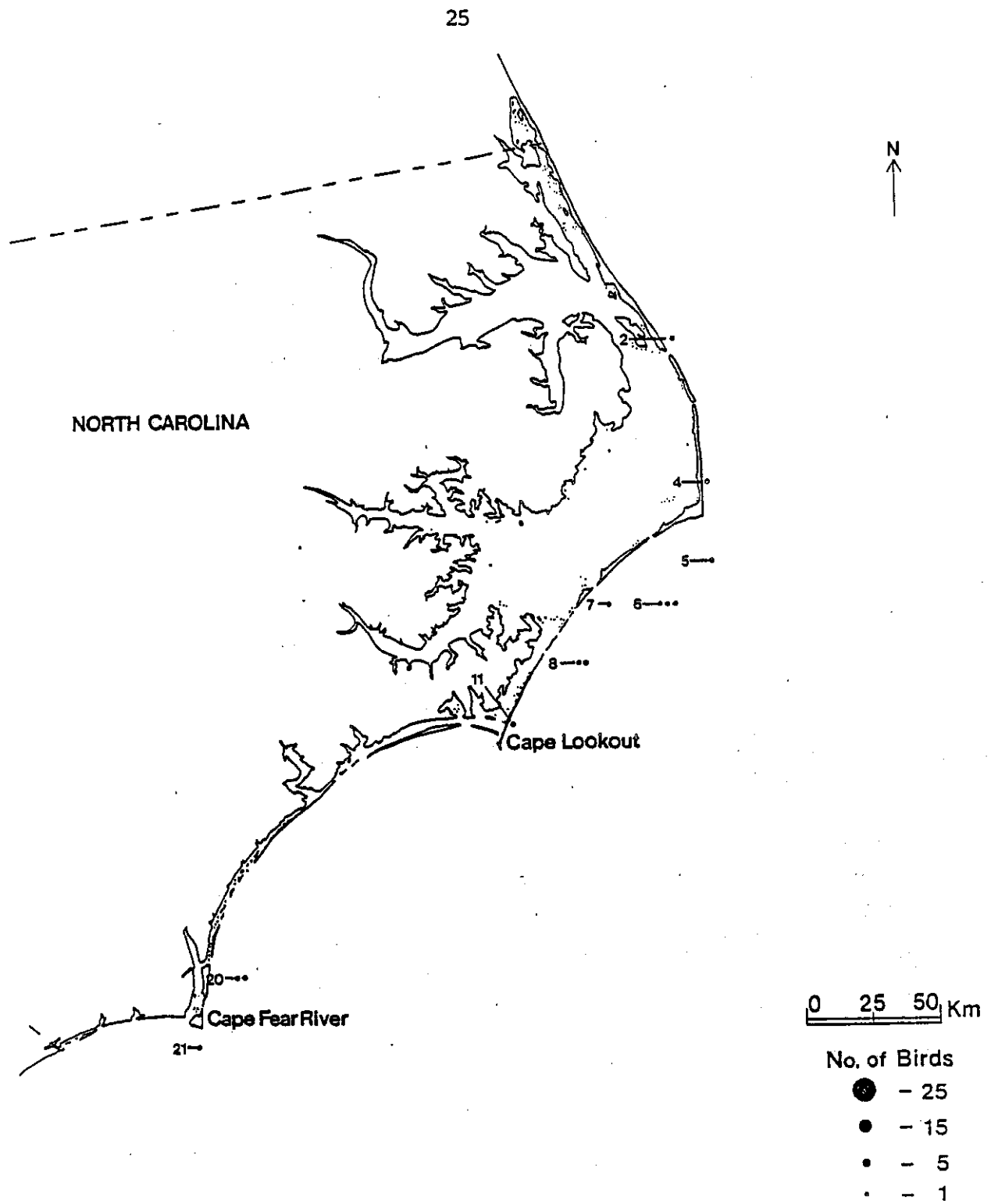


Fig. 4 .North Carolina, recoveries of 24- month-old and older pelicans.

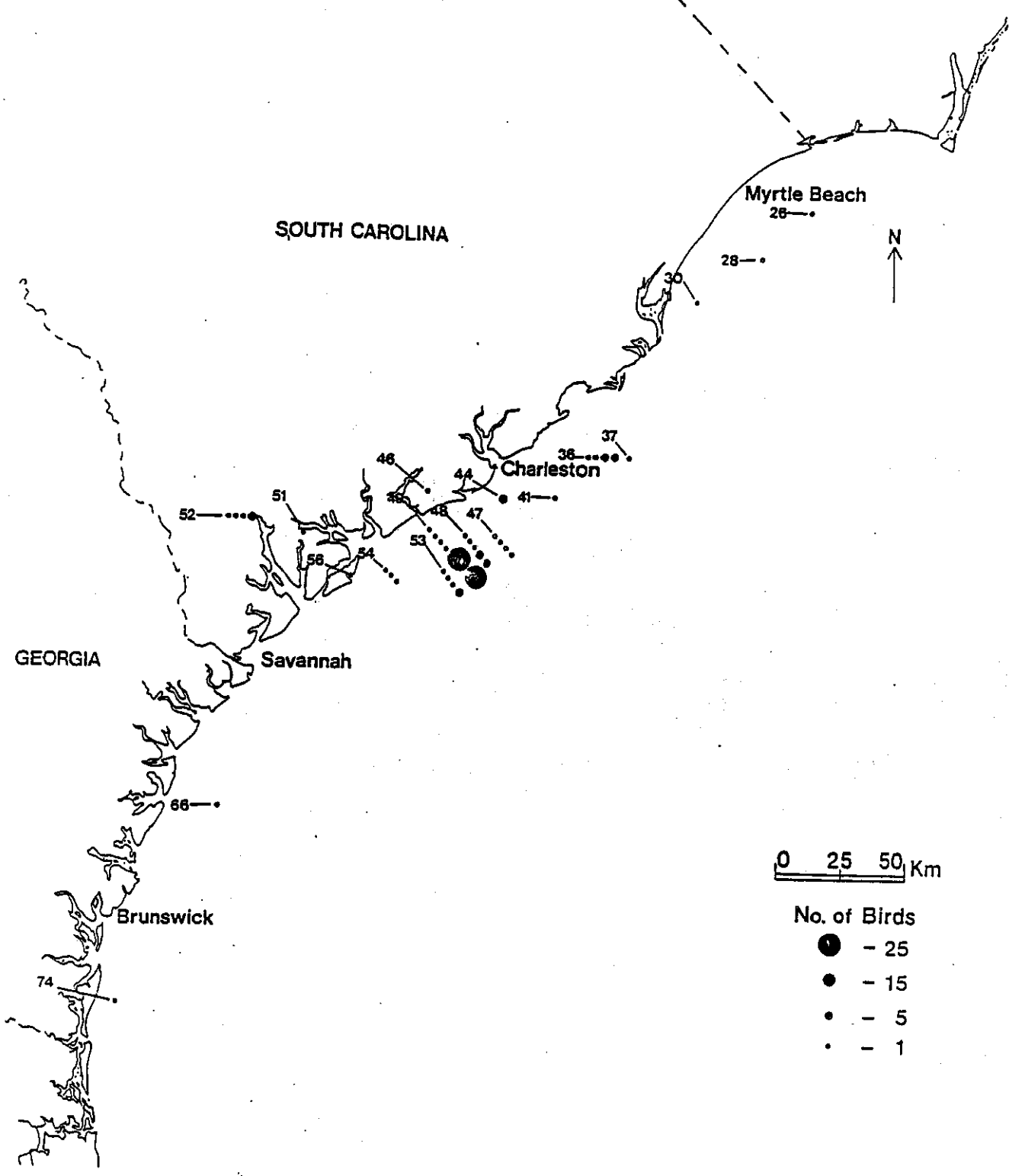


Fig. 5 South Carolina and Georgia, recoveries of 0- to 2- month-old pelicans.

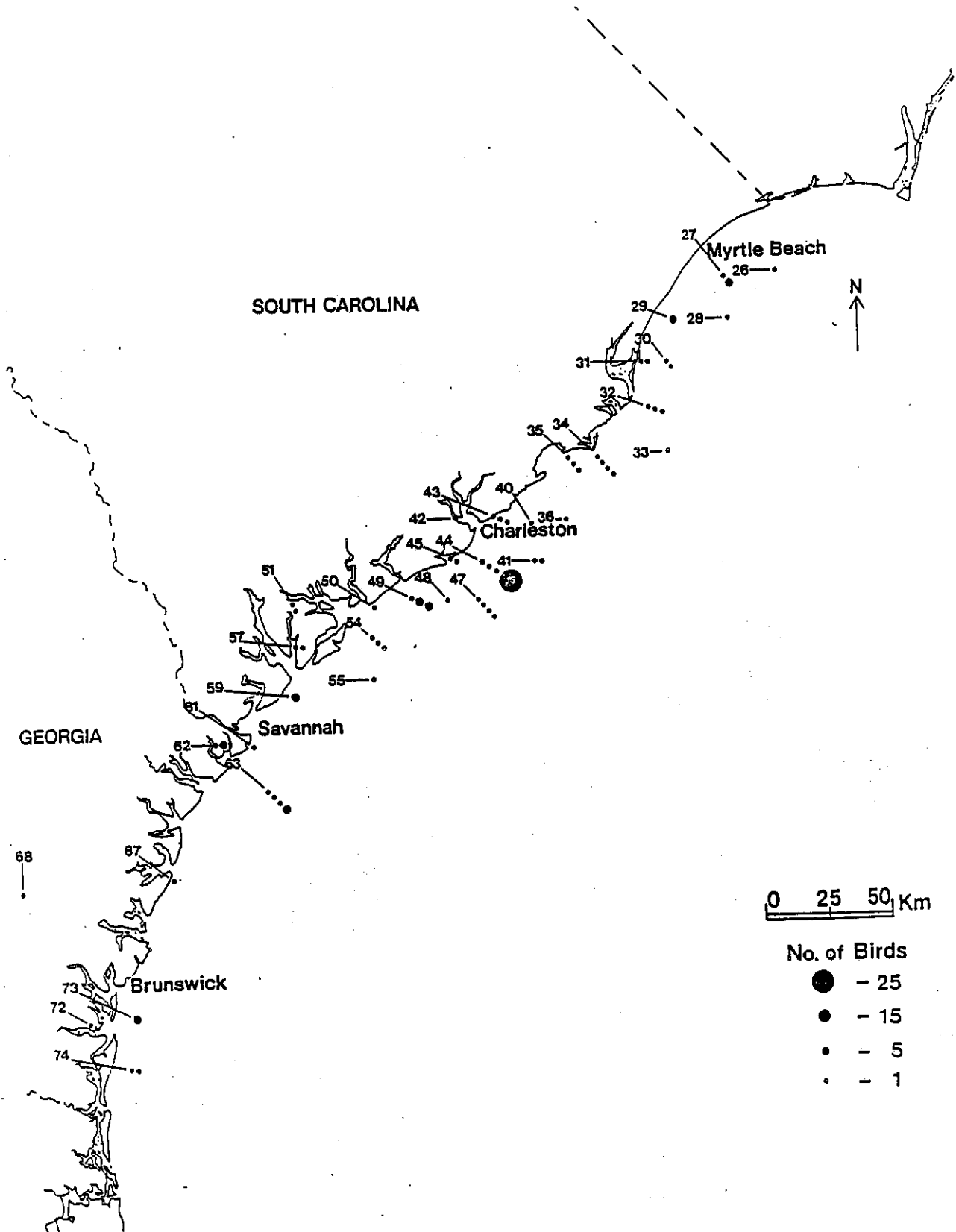


Fig. 6 South Carolina and Georgia, recoveries of 3- to 11- month-old pelicans.

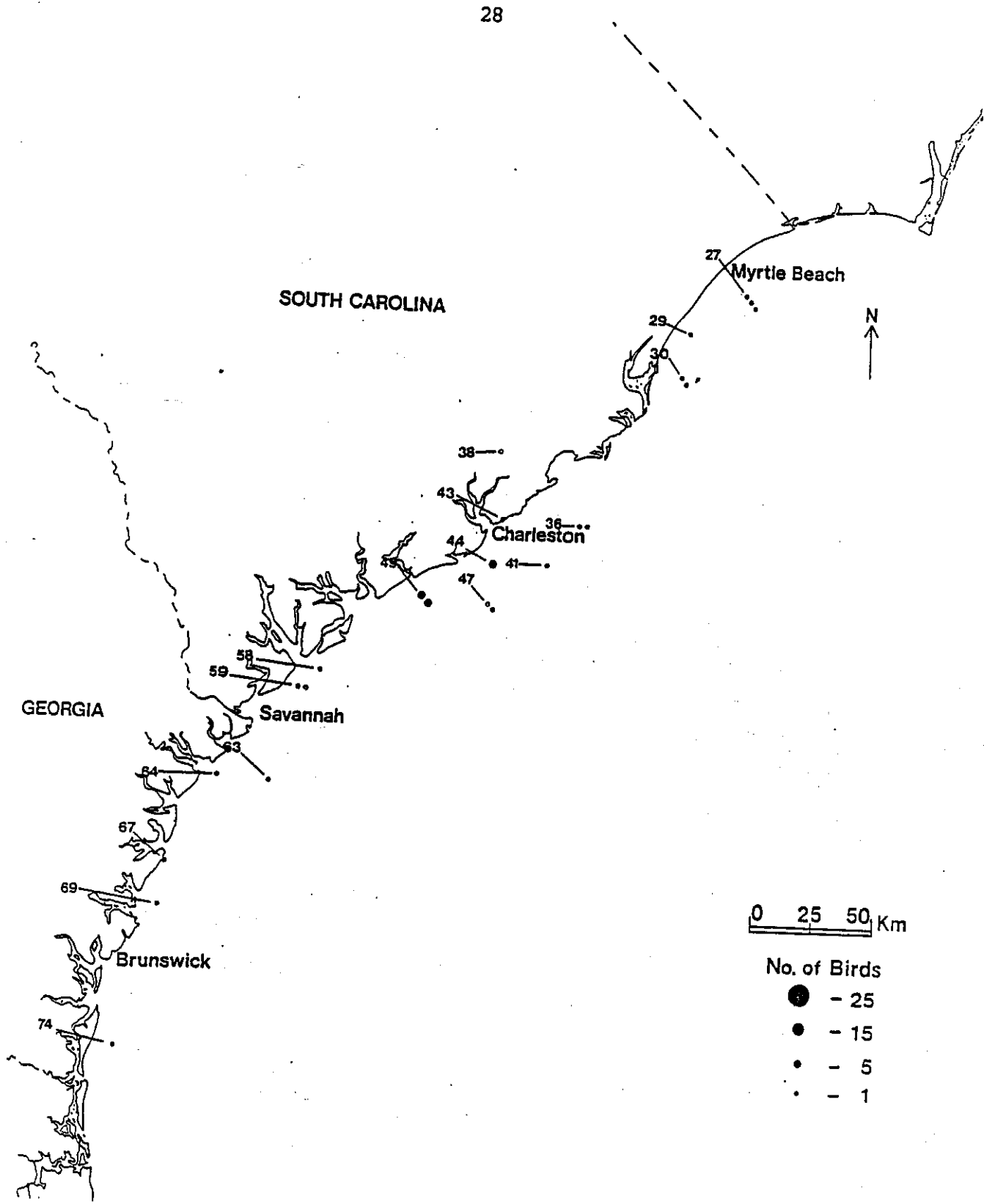


Fig. 7 South Carolina and Georgia, recoveries of 12- to 23- month-old pelicans.

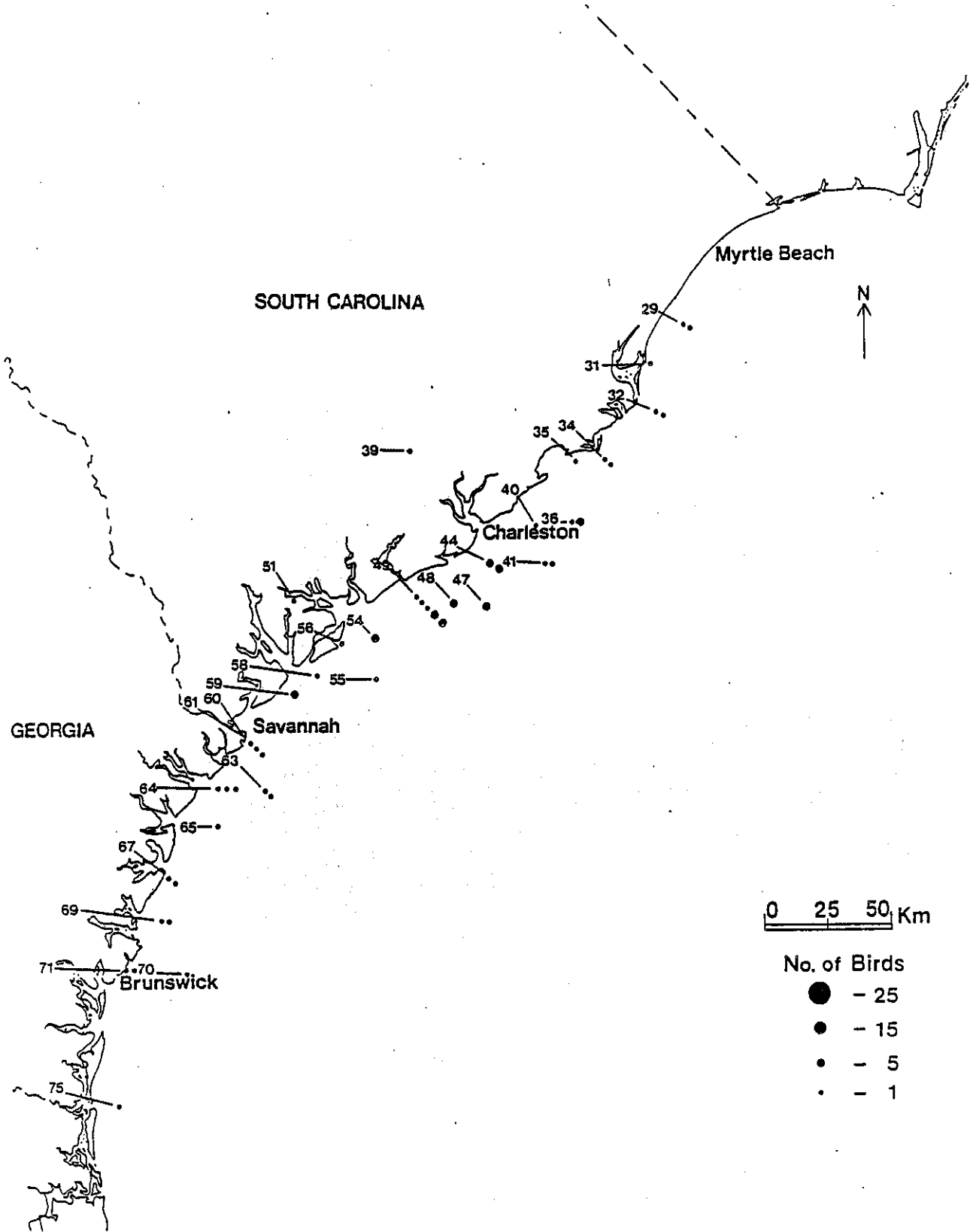


Fig. 8 South Carolina and Georgia , recoveries of 24- month-old an older pelicans.

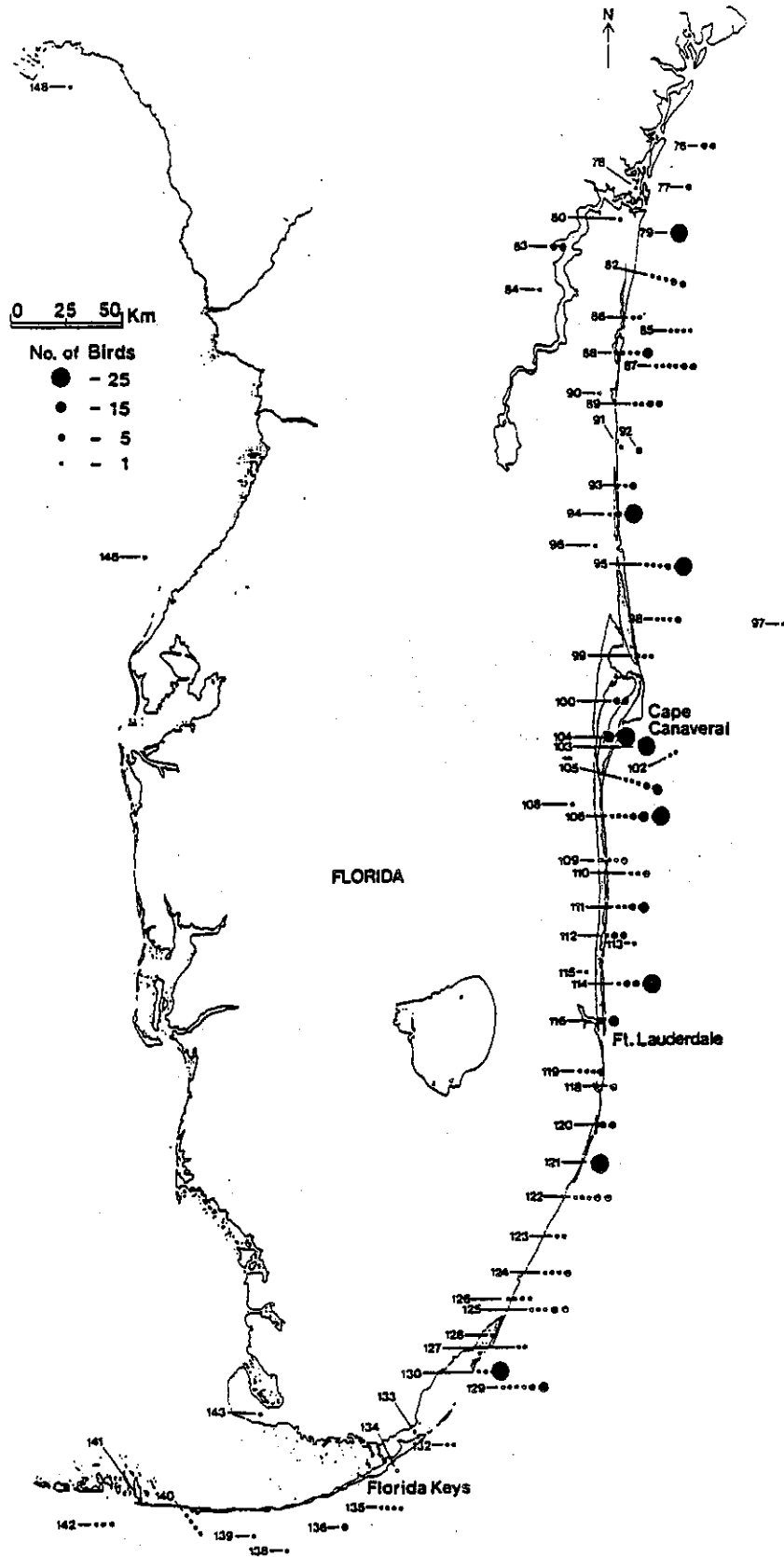


Fig. 9 Florida, recoveries of 3- to 11- month-old pelicans.

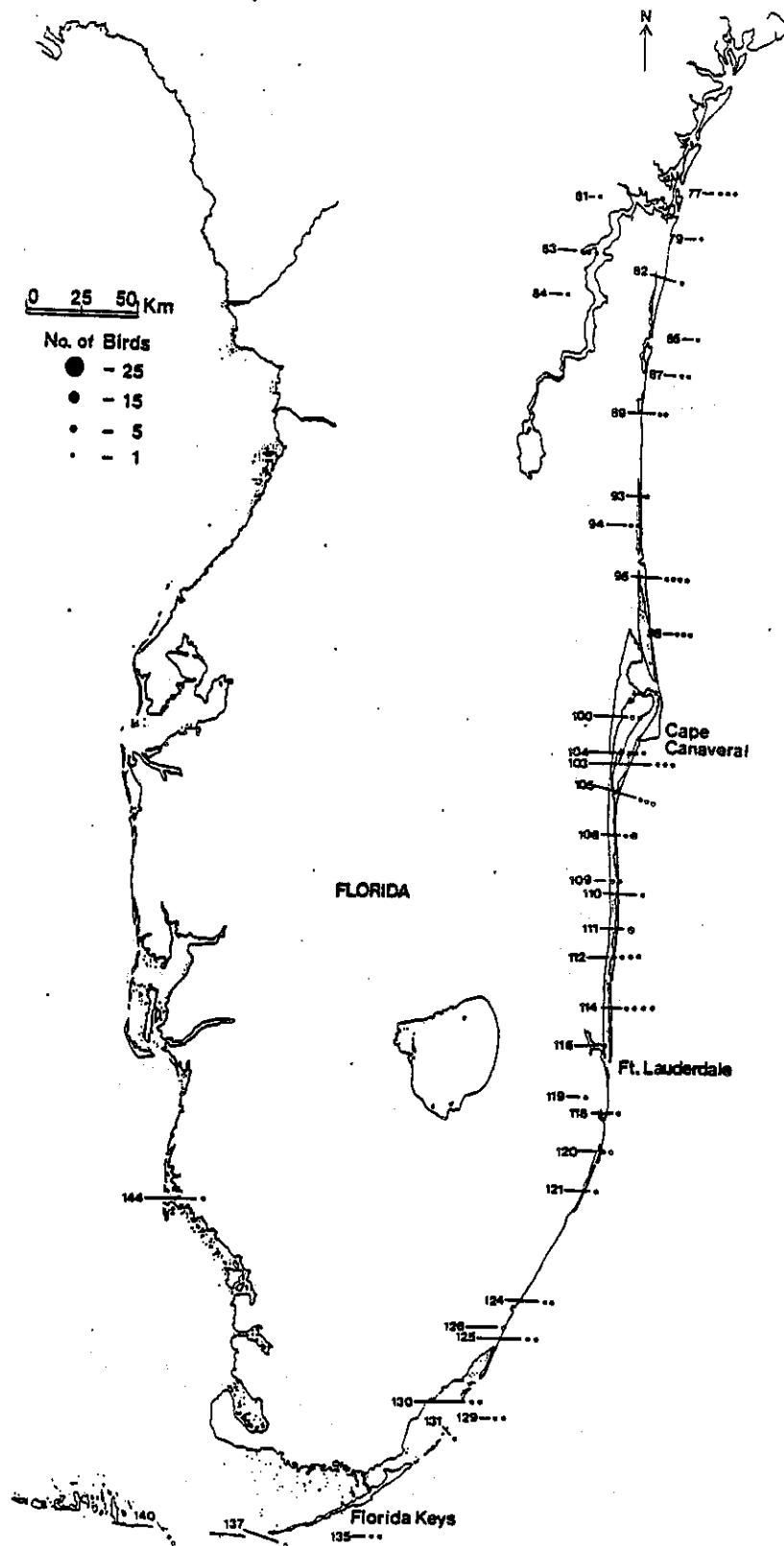


Fig. 10 Florida, recoveries of 12- to 23- month-old pelicans.

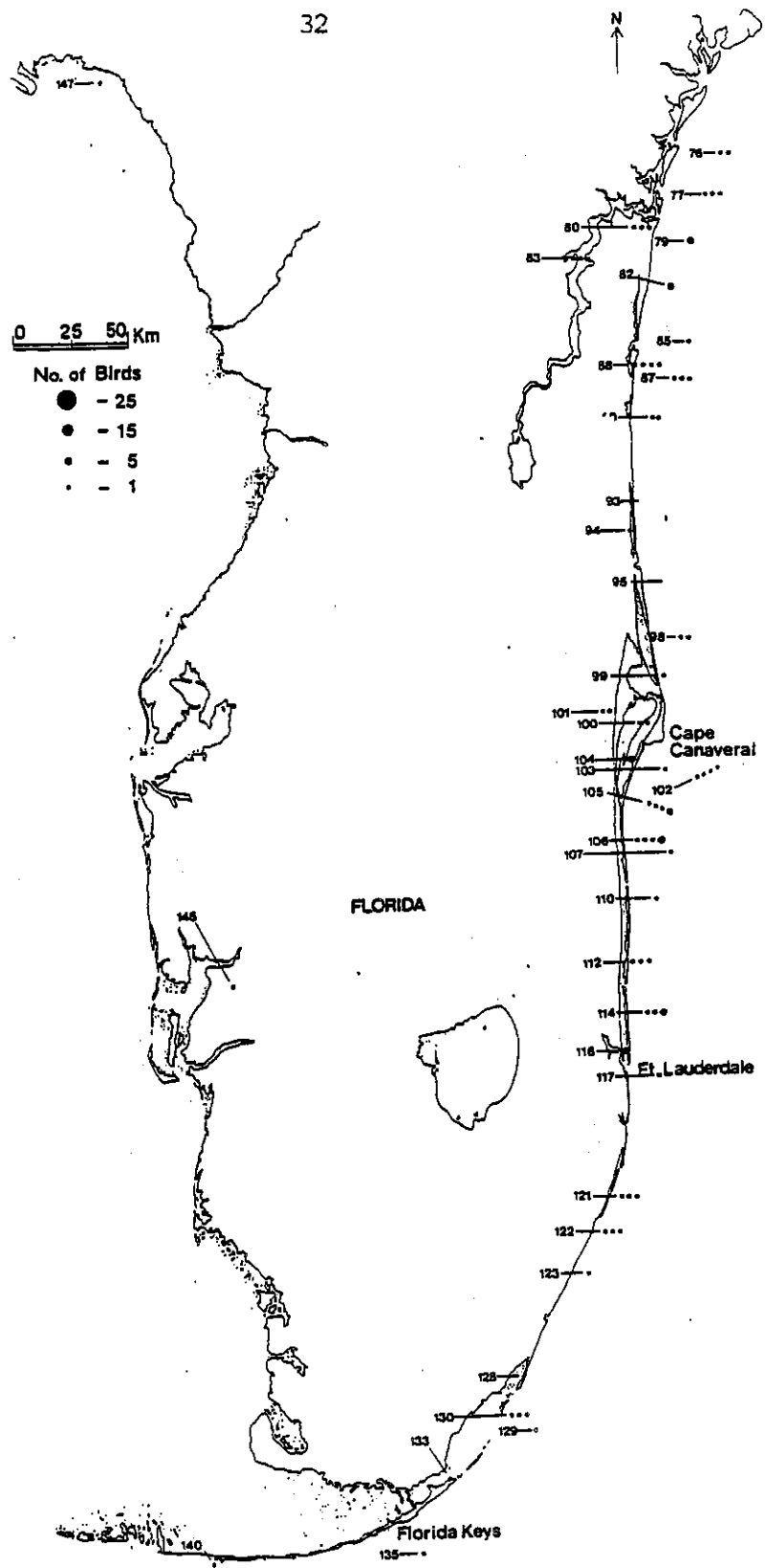


Fig. 11 Florida, recoveries of 24-month-old and older pelicans.

Time of Recovery.- There were 1,206 band recoveries where the time of recovery was reported. The highest recovery rate was in January (n=212), followed by December (n=211), February (n=191) and March (n=123). The lowest band recovery rates were in May (n=37) and September (n=32) (Table 4).

Table 4. Number of Bands Recovered from South Carolina-Banded Pelicans by Month Recovered (1931-1980).

Recovery Month	Number Recovered
January	212
February	191
March	123
April	87
May	37
June	58
July	56
August	88
September	32
October	42
November	69
December	<u>211</u>
Total	1,206

Time of Recovery by Region.- A comparison of band recoveries from within South Carolina by month to recoveries reported outside of the state shows recovery rates are higher outside of South Carolina from October through May, and higher within South Carolina from June through September (Table 5).

These data suggest most South Carolina hatched pelicans spend their winters outside of the state. However, recoveries were reported within the state during every month, so all pelicans do not leave South Carolina during the winter.

Most band recoveries outside of South Carolina were reported from the east coast of Florida. Band recoveries were highest in Florida in the fall, winter and spring, and highest in South Carolina in the summer. The times and rates of band recoveries by region indicate pelicans hatched in South Carolina largely winter in Florida and spend their summers in South Carolina (Fig. 12).

Mortality.- Reported causes of mortality are often vague, such as "found dead", and unreliable, so this aspect of the data on recoveries cannot be emphasized. However, some implications may be drawn.

Of all bird recoveries in Florida, 80.3% were first-year birds. Of all birds recovered in South Carolina, 71.5% were first-year birds. The combined mortality rates of first-year birds for both states is 78% (n=626/803).

Mortalities occur with the greatest frequency among first year birds in Florida in December and January (Fig.13).

Band returns substantiate high juvenile mortality rates which tend to level off after the birds are 4 years of age (Fig. 14). However, care must be taken when drawing conclusions from band returns concerning life expectancy because of unknown factors, such as lost bands.

Table 5. A Comparison of Recoveries in South Carolina to Recoveries Outside of South Carolina by Recovery Month (1931-1980).

Recovery Month	S.C. Recoveries	Outside Recoveries
January	25	187
February	15	176
March	14	109
April	26	61
May	11	26
June	33	25
July	45	11
August	77	11
September	23	9
October	12	30
November	11	58
December	<u>14</u>	<u>197</u>
	306	900 =*1,206

* 19 recoveries had no month recorded and, therefore, were not included in the total.

* Includes birds recovered under all conditions.

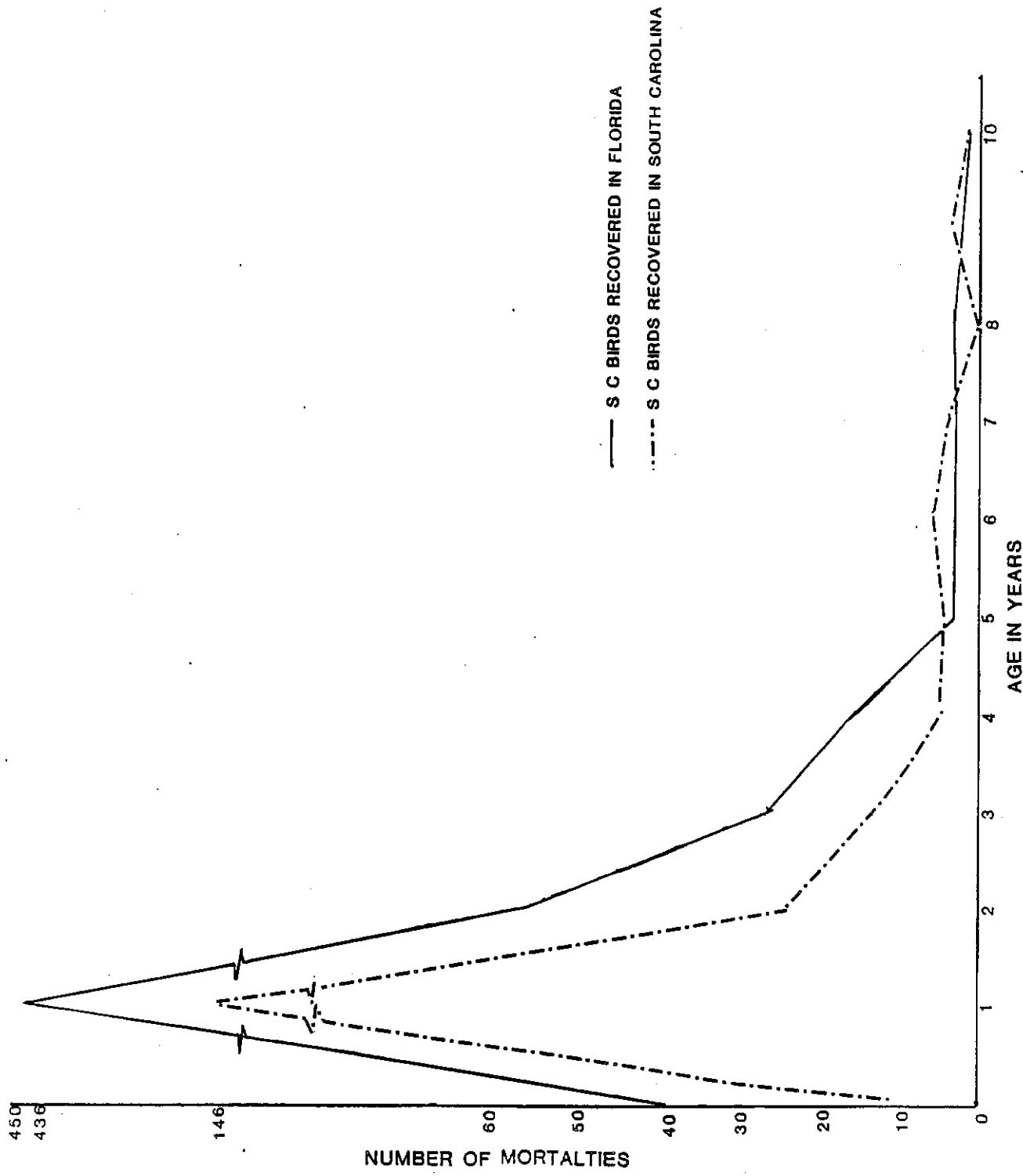


FIG. 12 A comparison of band recovery rates of South Carolina banded pelicans in South Carolina and Florida by age class.

$\frac{1340}{17603}$

7.61% recovery rate

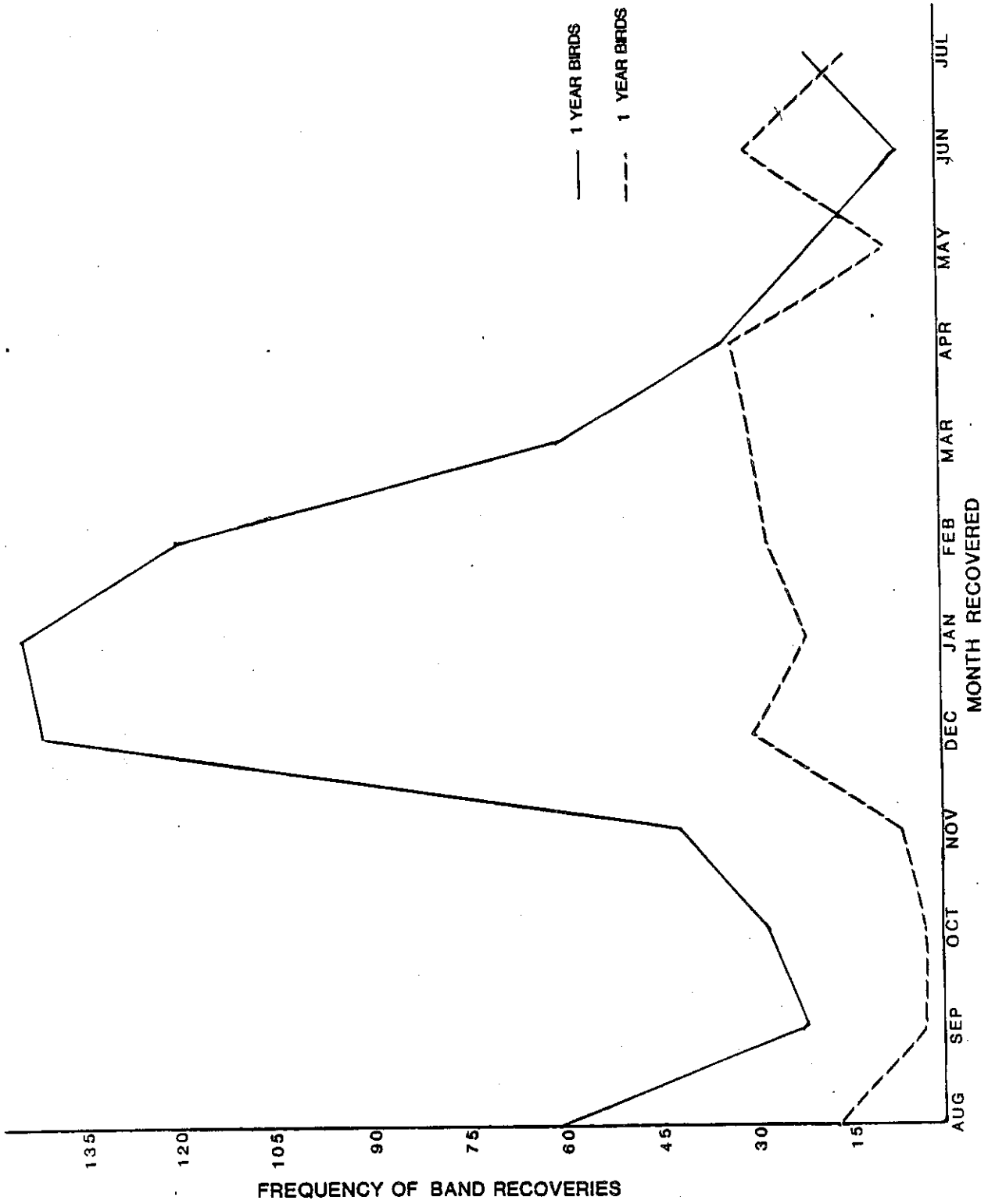


Fig. 13 A comparison of band recoveries of South Carolina-banded pelicans during and after their first year by month recovered

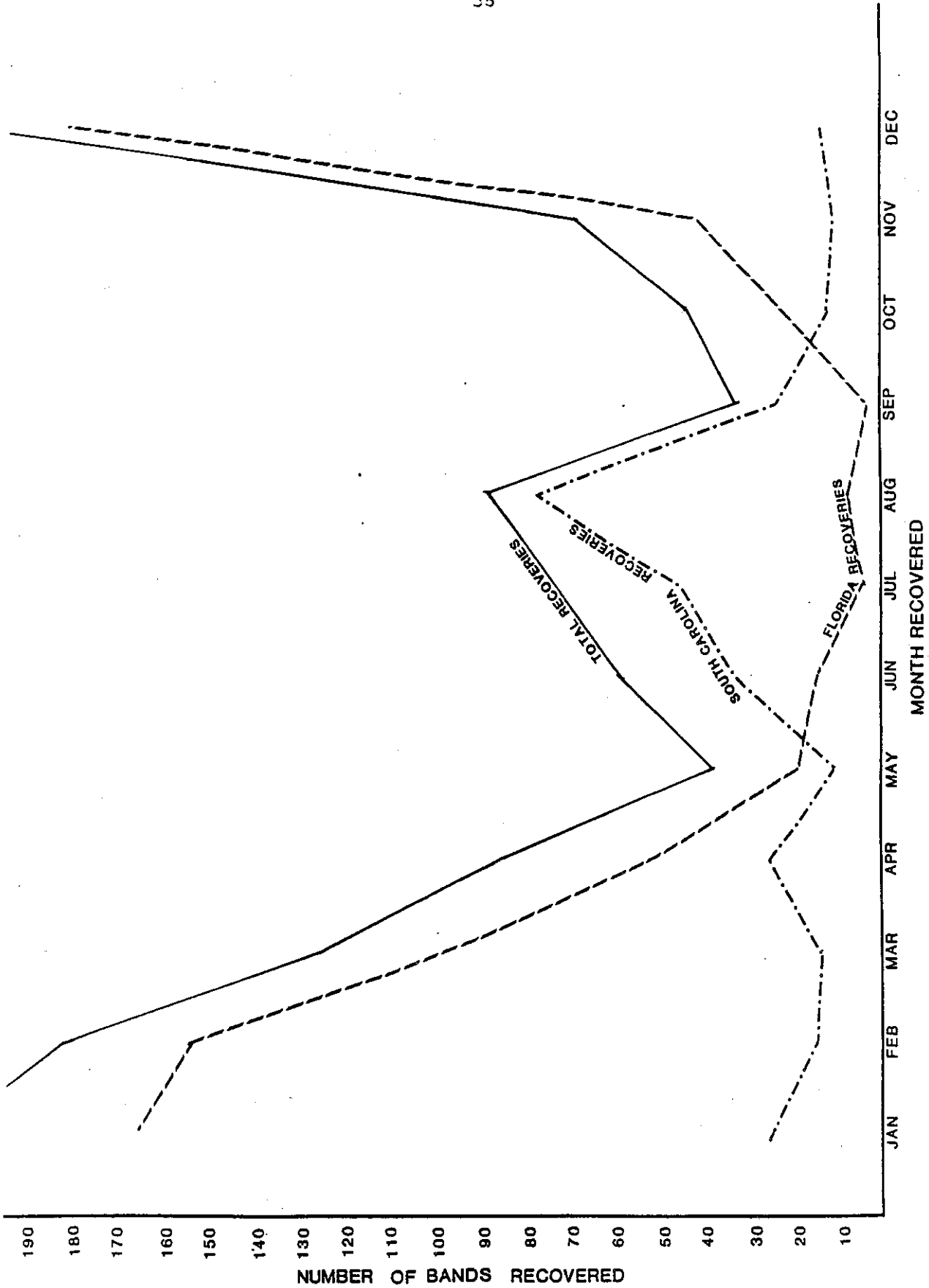


Fig.14 A comparison of band recoveries of South Carolina-banded pelicans in South Carolina and Florida by month recovered.

Mark Adults

Feasibility of rocket-netting adult pelicans on loafing areas.

A. Influence of tides - The effects of tides were important considerations in the selection of rocket-netting locations and on pelican behavior and movements. The mean tide range in the study area was about 3.8 feet, and the spring tide range was about 4.4 feet (Nat. Ocean Survey, 1980).

The tide stage (low and high tides) had an important effect on the dispersal of loafing birds. Pelicans were less concentrated and their selection of loafing sites less predictable near low tide when numerous sandbars were exposed. Conversely, near high tide, when fewer areas were exposed, they were more concentrated and predictable in their selections of places to loaf.

Some sites were more suitable for rocket-netting than others because of the tides. Sandbars that were exposed briefly during low tide, but completely flooded at high tide, were frequently used by pelicans for loafing. However, we found it difficult to operate the rocket-net in these areas because timing was critical. The exposure time of most sandbars was insufficient to perform the following tasks: 1) set up the rocket-net system, 2) move away and allow birds to come in, 3) make a capture attempt, 4) perform the banding and marking operations, and 5) remove the capture equipment before it was awash. Further, sandbars of this type were seldom found near concealment.

Loafing sites on the lower strands of beaches appeared to be most promising for capturing pelicans. The lower strand is exposed by a normal low tide, but flooded by a normal high tide, and is typically associated with an upper strand and dune system just landward of it.

The rocket-net was positioned on the upper strand, just beyond the reach of high tide, and adjacent to a loafing site. From the nearby dune system, we could watch the capture site and detonate the rockets without being observed.

Certain aspects of the pelicans' behavior indicated the tide might be advantageous in moving birds within firing range of the rocket-net. When pelicans loafed, the flock would often disperse along the wash line near the edge of the water. The flock would move with the wash line as it moved landward due to the rising tide. On numerous occasions flocks of two or three pelicans to as many as 175 loafed near the rocket-net site. They would gradually move up the beach toward the net during the flood tide. The flock size would increase and decrease as birds came in and left. However, on only three occasions did even the nearest fringes of the flock move within range of the rocket-net. They appeared apprehensive of the net.

B. Timing- At morning's first light, pelicans flew north along the coast toward Winyah Bay. Shortly thereafter, flocks began loafing on or near their usual locations. Flock numbers increased and diminished as pelicans continually came in and left. Pelicans loafed during all stages of high and low tides

and during all times of the day. Pelicans were more concentrated and predictable in their selection of loafing sites during high tide. This behavior did not appear to be affected by the time of day. Rocket-netting attempts were timed to coincide with times near high tide.

When the rocket-net was set up where pelicans were already loafing, the birds would become frightened and fly away, often not returning before the net had to be removed. When the rocket-net was fired in the late evening, efforts were hampered by the birds' restlessness at that time of day. They were most apt to fly away at the slightest disturbance in the evenings. On the other hand, when the rocket-net was set up prior to daylight, when pelicans were not around, the birds were less wary and more apt to follow their usual behavioral patterns.

The tide phase (neap and spring tides) was an important consideration when selecting a time and a site for rocket-netting. There are areas not usually covered by tides that are inundated by spring tides. Spring tides can rise very rapidly, especially when pushed by an onshore wind. Under these circumstances, a rocket net and all the accompanying paraphernalia could become suddenly awash in breaking waves. Therefore, the most suitable time to net the birds was not when the tides were in the spring phase.

C. Rallying- When the rocket-net was set up where pelicans were already loafing, the birds would move, usually to a site nearby. In a situation like this, we tried to roust

them from their alternate loafing sites back to their original site.

Two methods were tried to drive the pelicans back to the capture site. First, we walked slowly toward the flock from a direction that would allow us to herd them toward the net. Our approach was indirect, casual, and nonthreatening. The birds became watchful, then alert, and finally, by twos and threes on the near side of the flock, they would fly. Usually they would either fly along the beach to the other side of the flock or go beyond the waves and alight on the water. When approached in an unhurried manner, a flock was sometimes moved several hundred yards. However, we were never able to move them to a position that would permit a capture attempt.

The other method used entailed approaching them in a boat until they flew. Their reactions to this type of harrassment were varied. Most often they would fly back and forth between two or three loafing sites. Seldom would they go to the intended location, and if they did they were unwilling to come close enough to the rocket-net for us to capture them.

D. Dummy Rockets - The pelicans' reluctance to approach the rocket-net may have been due to their unfamiliarity with the apparatus. The rocket-launchers and rockets are very conspicuous when placed on the stark beach .

In an attempt to get the birds accustomed to the rocket-netting paraphernalia, we constructed three sets of dummy rockets and launchers. The dummy sets were placed just

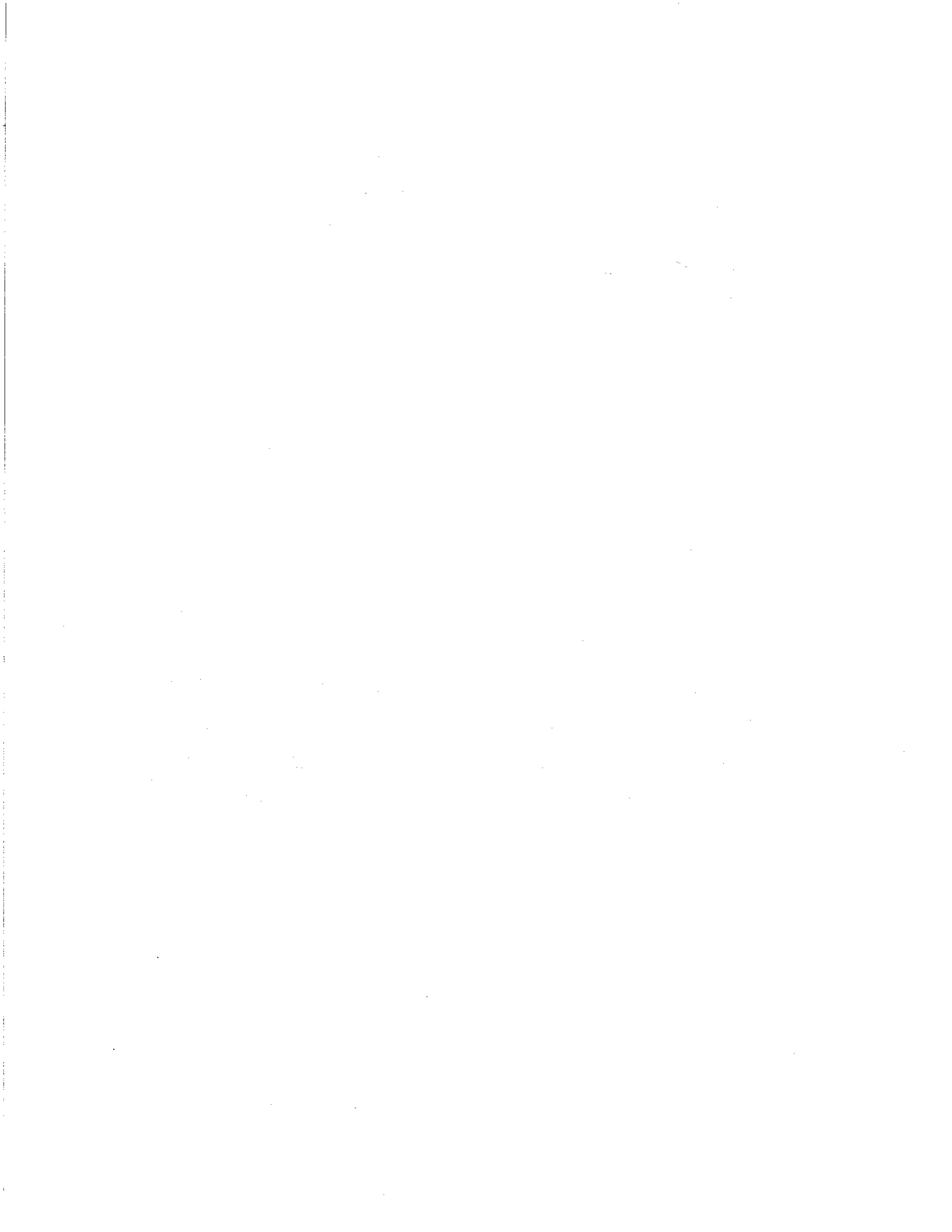
beyond the reach of the tide on three frequently used loafing sites. When loafing pelicans appeared to be no longer wary of them, they were replaced by the real rocket-net system. When this was done, the birds would again draw back and avoid coming too near the rocket-net. Apparently they distinguished between the dummy and the real system very easily.

E. Decoys- Because the pelicans were frequently attracted to areas where other pelicans were already loafing, attempts were made to attract them to the rocket-net areas with wooden decoys.

Silhouette decoys have been used successfully by goose hunters to attract Canada, Blue and Snow Geese. Life-sized, silhouette decoys were designed, constructed from plywood, and painted to resemble pelicans.

The decoys were placed on sites frequented by loafing pelicans, without the distraction of the other rocket-netting apparatus. Pelicans appeared to be attracted to the decoys. However, when they came within close range (usually directly above the decoys), they looked carefully but moved on. Apparently the decoys were not realistic enough, but we still found this behavior encouraging.

A three-dimensional, full-sized decoy was carved and painted to resemble an adult pelican in summer plumage. This decoy was tried once by itself and again with the silhouette decoys. From a distance, the pelicans found the decoys attractive. As they flew nearer, however, they appeared to



recognize the decoys and flew away without alighting.

Pelicans are very specialized feeders. They depend on their very keen eyesight to locate their food. Perhaps this enabled them to easily detect that the decoys were not real birds.

F. Baiting- Cannon and rocket-nets have been used successfully to capture many species of animals. In South Carolina they have been used regularly to capture wild turkeys (Meleagris gallopavo), white-tailed deer (Odocoileus virginianus) and waterfowl. In most cases the bait attracted the subject animals to within range of the netting system.

Suggestions that bait might attract pelicans were considered. We observed commercial fishermen cleaning noncommercial fish from their nets, and on the beach without attracting pelicans. Pelicans will take handouts of fish around fishing piers and marinas but are probably conditioned to accept food in this manner. Many gulls (Larus sp.), terns (Sterna sp.) and occasionally a few pelicans follow shrimp boats and feed on some of the noncommercial species thrown overboard after each tow. In certain areas, they also follow crab fishermen as they visit their crab pots.

We selected one of the birds' regular loafing spots on the south tip of North Island for a bait site. Menhaden (Brevoortia tyrannus), a common food item was used as bait. These bait fish were placed above the wash line of the waves at a location near the loafing areas. Pelicans, terns and gulls

were in the baited area, but they neither ate any of the bait placed on the beach nor appeared to find the bait attractive. Indications were that it is not feasible to rocket-net pelicans on loafing areas.



MARK AND MONITOR JUVENILES

Sighting Returns

From 1978 through 1984 there were 413 sighting returns of pelicans that were specially marked as juveniles in South Carolina rookeries. There were several instances where different observers reported the same pelicans at the same locations. The most frequently reported observations were of wing-marked pelicans (n=387), but often observers noted when a bird was also banded. In most instances observers failed to report or reported incomplete marker numbers. However, the color of the marker and its location on the bird were frequently reported. The only sightings of interlocking bands were from our banding personnel who were looking for marked pelicans while conducting other surveys. Colored leg markers were also seldom reported and apparently were lost at a high rate. The colored wing markers were probably reported most frequently because they are easily seen. Their visibility was especially useful during aerial coastal surveys. These colored wing markers were helpful in determining early post-fledgling movement patterns.

Survival of these marked pelicans and/or their markers was low after the first winter. However, a general picture of juvenile movement patterns emerged from reported sightings.

Movements of Marked Juvenile Pelicans

The marked juveniles were observed shortly after fledging (August) in

flocks with adults both north and south of the rookeries along the coast. A few (n=11) were reported as far north as the Cape Fear River in North Carolina. In late August sightings made during coastal surveys and other sighting reports indicated a general movement south along the South Carolina coast. In September most South Carolina coastal flight survey observations of marked juveniles were from the southern portion of the South Carolina coast. Most reports received from Georgia indicated marked juveniles moved along the Georgia coast in September and October. Sighting reports made in November and December were mostly from the northern or central east coast of Florida. Late winter and early spring reports indicated sightings were more numerous from the central east coast of Florida to the Florida Keys. In the spring most reports were still from Florida. Our earliest sighting of marked juveniles along the South Carolina coast was in May. Some marked juveniles remained in Florida during their first summer.

Nesting Sightings of Marked Pelicans of Known Age

There were 23 reported sighting recoveries of marked pelicans in South Carolina rookeries from which year class could be determined by their markers. One marked pelican nested the summer after it hatched or at about one year of age. Two pelicans with markers nested as 2-year-olds, ten as 3-year-olds, six as 4-year-olds and one as a 5-year-old. The 5-year-old had also nested as a 3-year-old. Three marked pelicans loafed on the rookeries but did not associate with a nest.

The one juvenile that nested was one of 41 marked pelicans of the same

year class reported during the nesting season in South Carolina, while the single marked 5-year-old observed nesting was the only marked pelican seen in its year class that year (1984). Pelicans in juvenile plumage were observed nesting, but they were estimated to represent less than .05 percent of the overall nesting effort each year.

Rookery Selection by Marked Pelicans

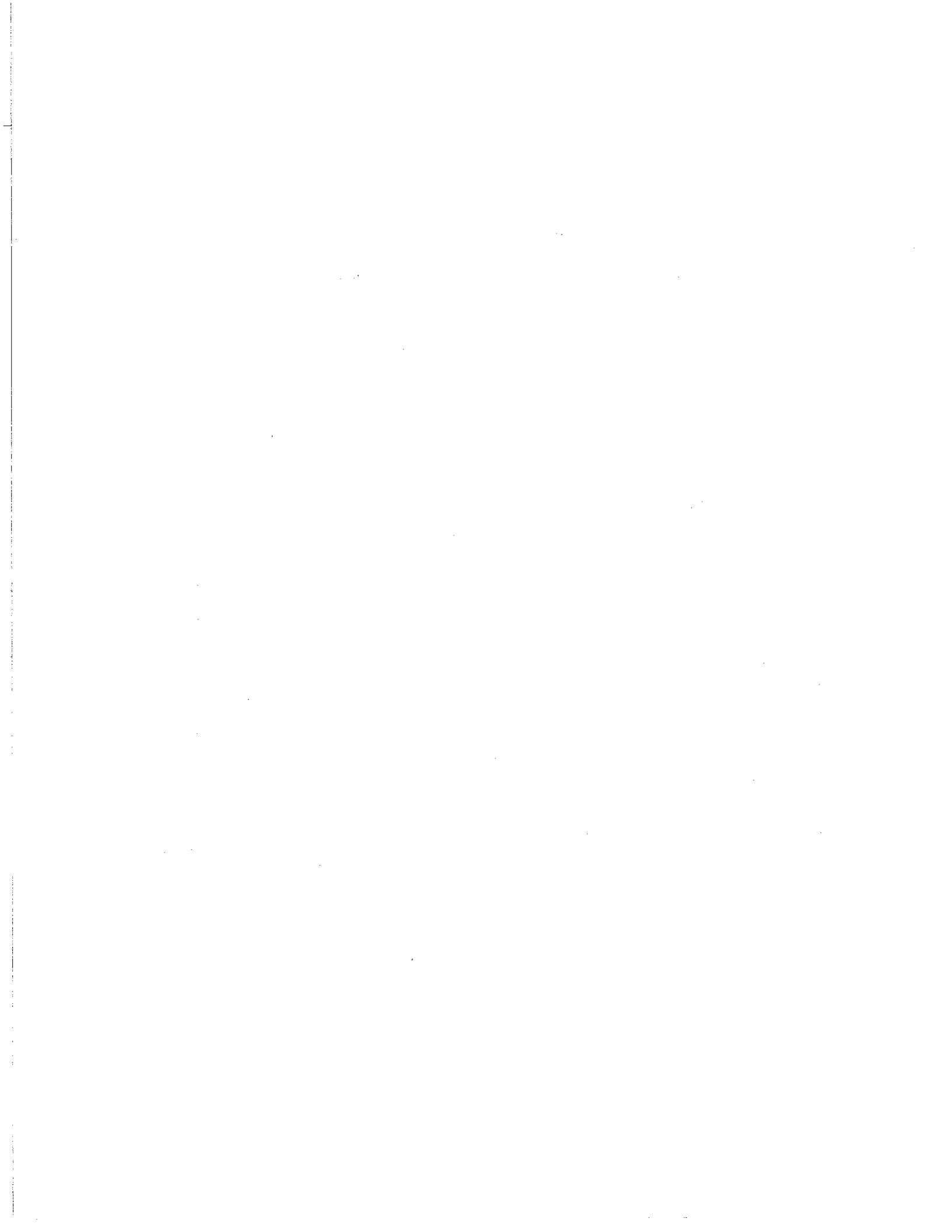
The markers seen in 63 sightings indicated the rookeries where the pelicans hatched. These sightings substantiated the belief the pelicans that nested on Deveaux Bank moved as a group to Bird-Key Stono when Deveaux Bank washed away in 1980. The 34 pelicans observed nesting on Bird-Key Stono, whose natal rookeries were known, either hatched on Deveaux Bank or Bird-Key Stono. There were two marked pelicans not associated with a nest that were observed loafing on Bird-Key Stono. These birds hatched on Marsh Island.

On Marsh Island there were 27 observations of pelicans whose markers determined natal rookeries. Twenty-six of the pelicans were associated with a nest, and they all hatched on Marsh Island. The remaining pelican was not associated with a nest, and it hatched on Bird-Key Stono.

Seasonal Distribution, Abundance, Nesting Effort and Reproductive Success

Seasonal Abundance.-Formerly, the Eastern Brown Pelican was thought to be a summer resident only. The first midwinter record was established at Folly Island, on January 25, 1932 (Sprunt and Chamberlain, 1949).

In 1948, local chapters of the Audubon Society in South Carolina began



taking an annual bird population census during the Christmas season. When the number of birds seen on these "Christmas counts" is divided by a unit of effort, such as party hours spent afield, and the counts are averaged over 3-year periods, some indication of population trends may be obtained.

An analysis of the Audubon Christmas bird counts indicates almost no pelican sightings in midwinter until 1956. Three-year averages of pelicans counted since then indicate continuous midwinter sightings from 1956 until the present.

Aerial surveys to determine the seasonal abundance of pelicans utilizing South Carolina coastal waters (1978-1980) indicated variations in numbers and in age class compositions. (Fig. 15,16,17) The number of pelicans observed was lowest in January and February during each of the three survey years. During January, February and March pelicans in residence were predominantly adults. In April large numbers of adults returned to South Carolina. Pelican numbers peaked in May, June and July. June usually was the month with the highest counts if nestlings were not included. Although counts indicated only slightly lower numbers during August, September and October, there was apparently a large exodus of adults as the population was comprised of a relatively high ratio of juveniles. From November through February, numbers in the state declined.



S.C. COASTAL PELICAN SURVEY - 1978

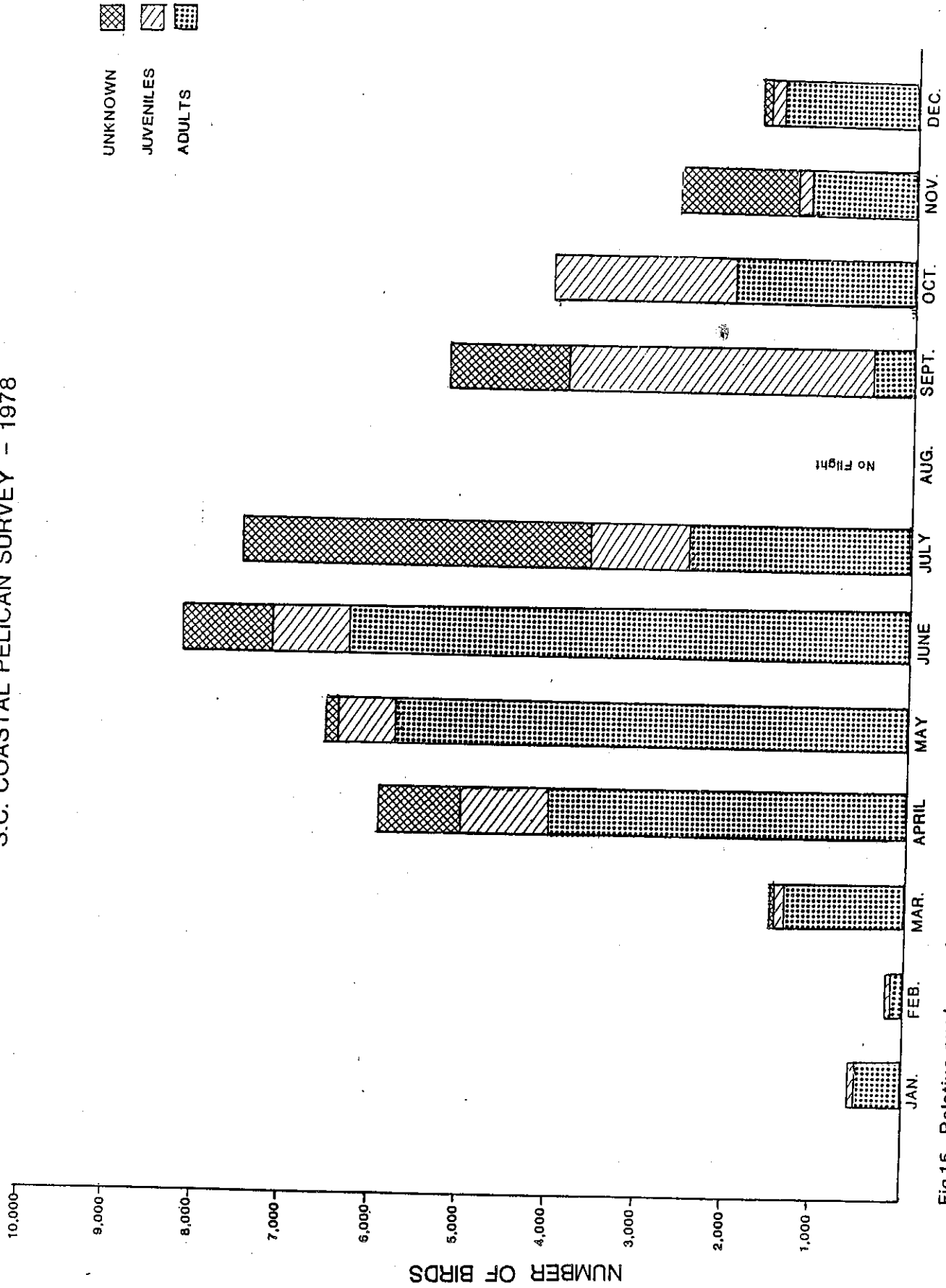


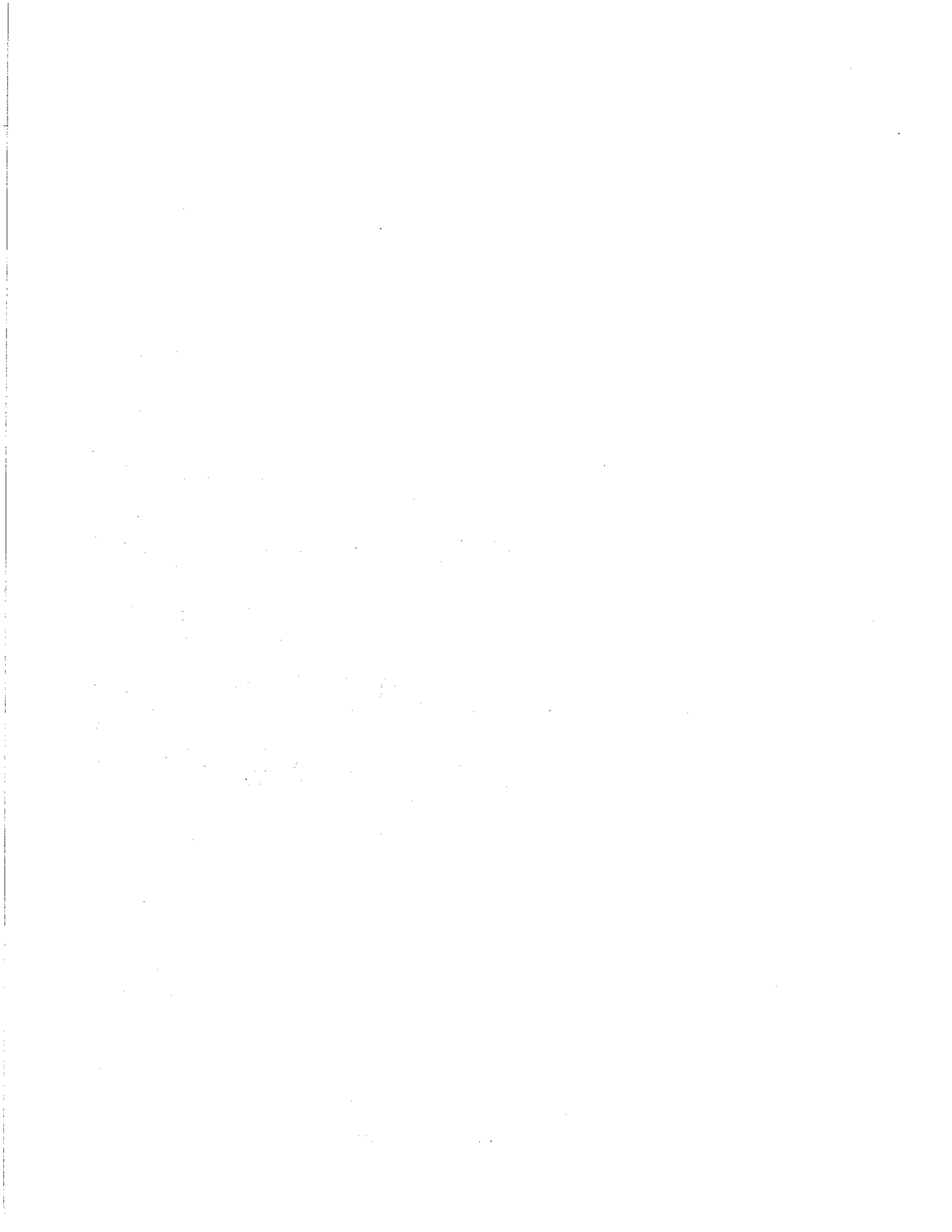
Fig.15 Relative numbers of pelicans present in South Carolina by month - 1978



S.C. COASTAL PELICAN SURVEY - 1979



Fig.16 Relative numbers of pelicans present in South Carolina by month - 1979



S.C. COASTAL PELICAN SURVEY - 1980

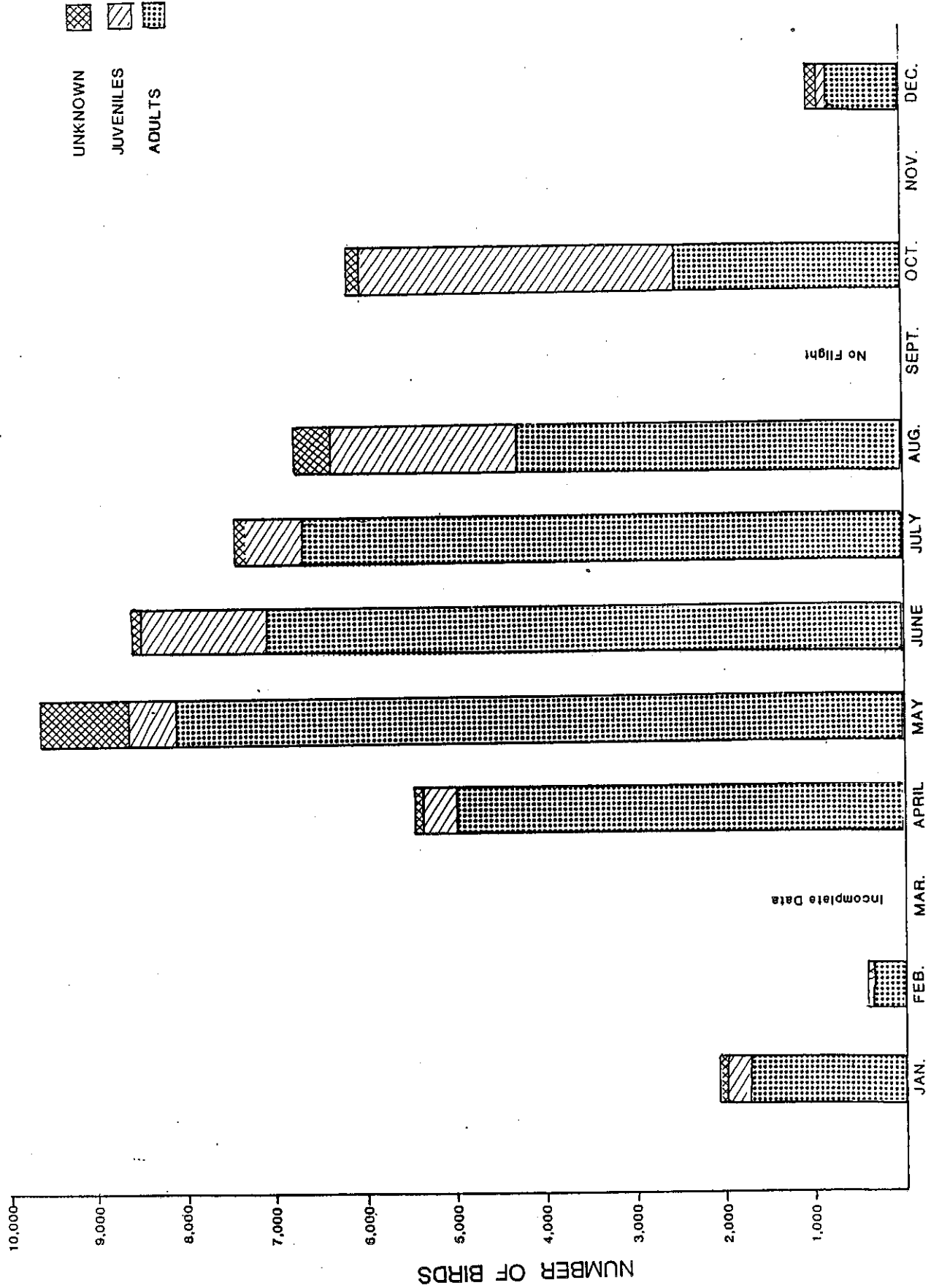


Fig.17 Relative numbers of pelicans present in South Carolina by month - 1980

Seasonal Distribution -In January pelicans were evenly distributed along the South Carolina coast from Murrells Inlet to the Savannah River jetties. Most of the pelicans observed in the state during this time were adults (Fig. 18). The lowest numbers observed each year were during February (Fig. 19). During this time of year, pelicans were often located around tidal creeks, marinas and fish houses, sometimes accepting handouts. In March the number of pelicans began to increase along the South Carolina coast south of Charleston, and to some extent in the Bulls Bay area (Fig. 20). Pelican numbers steadily increased from March through July (Fig. 20-24). The highest numbers during those months were near the rookeries. As the hatchlings' demands for food increased, large numbers of adults moved near the sounds and bays along the entire coast (Fig 23-25). In September pelican numbers began to diminish, and there appeared to be a southward movement (Fig. 26). The number of pelicans continued to diminish during the fall and winter as they moved south. (Fig. 18,19,27,28,29). Apparently many adults move south first, leaving a high ratio of juveniles in the state during late summer and early fall (Fig. 28).

Fig. 18 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in January.

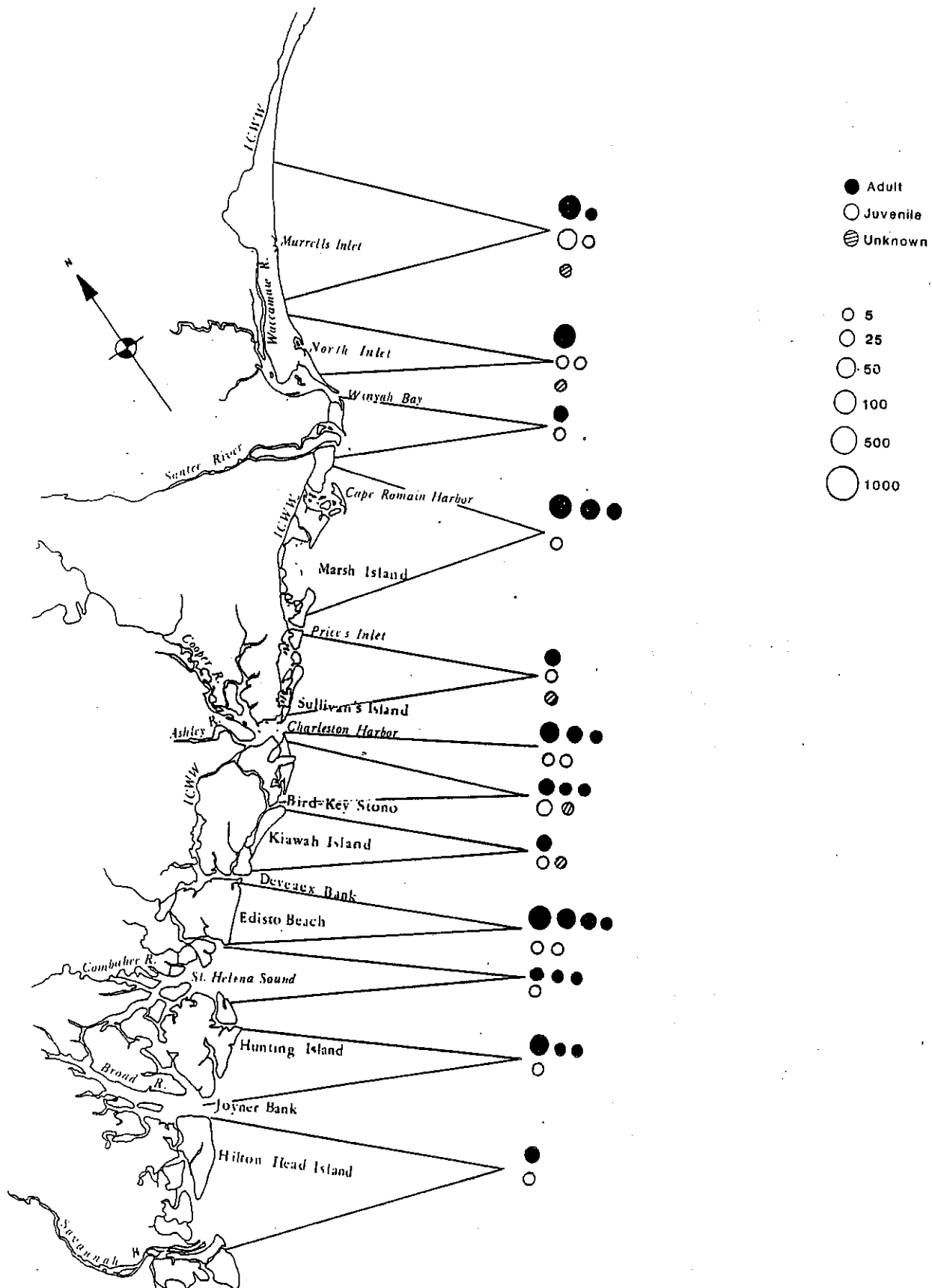


Fig. 19 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in February.

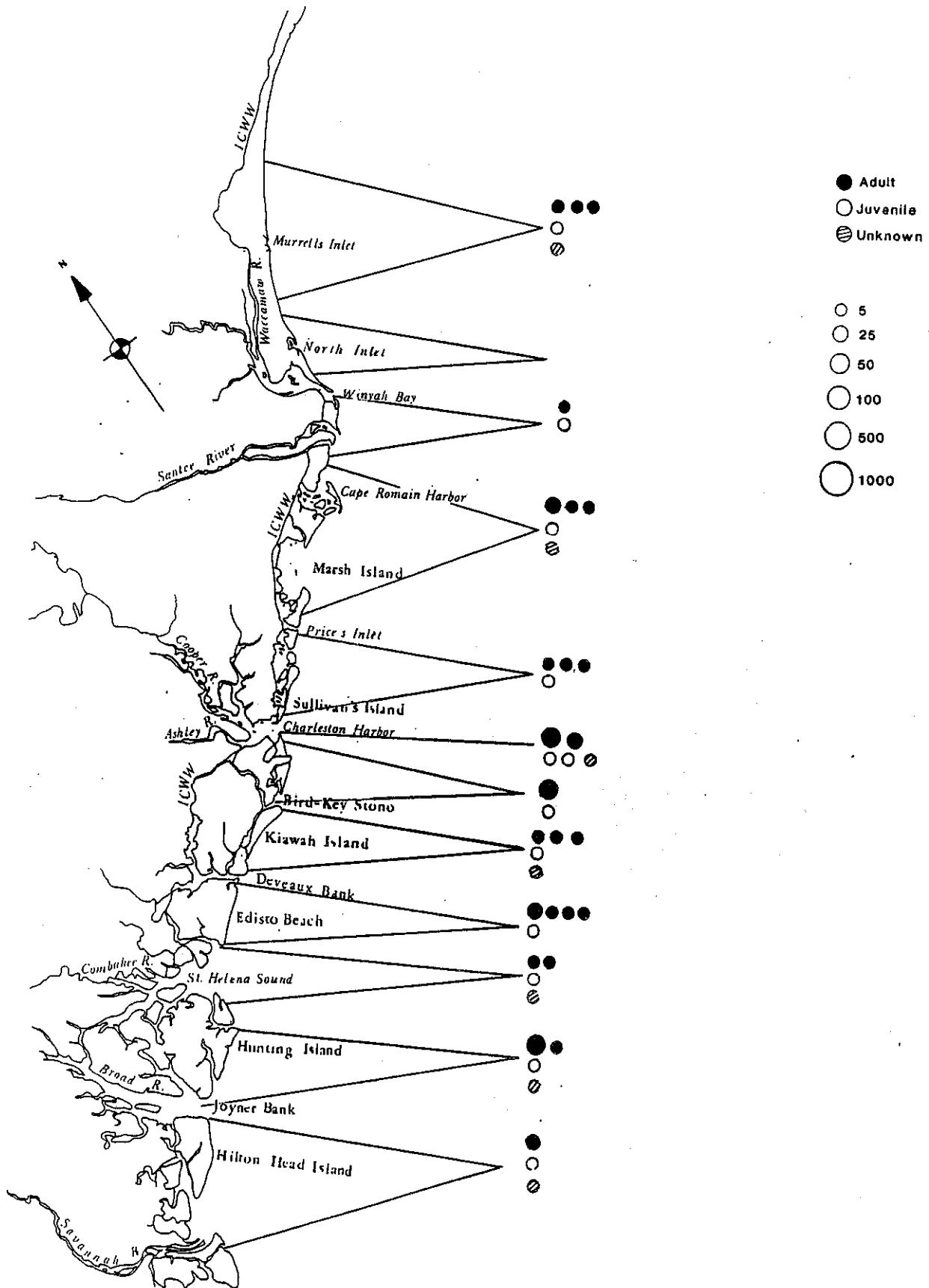
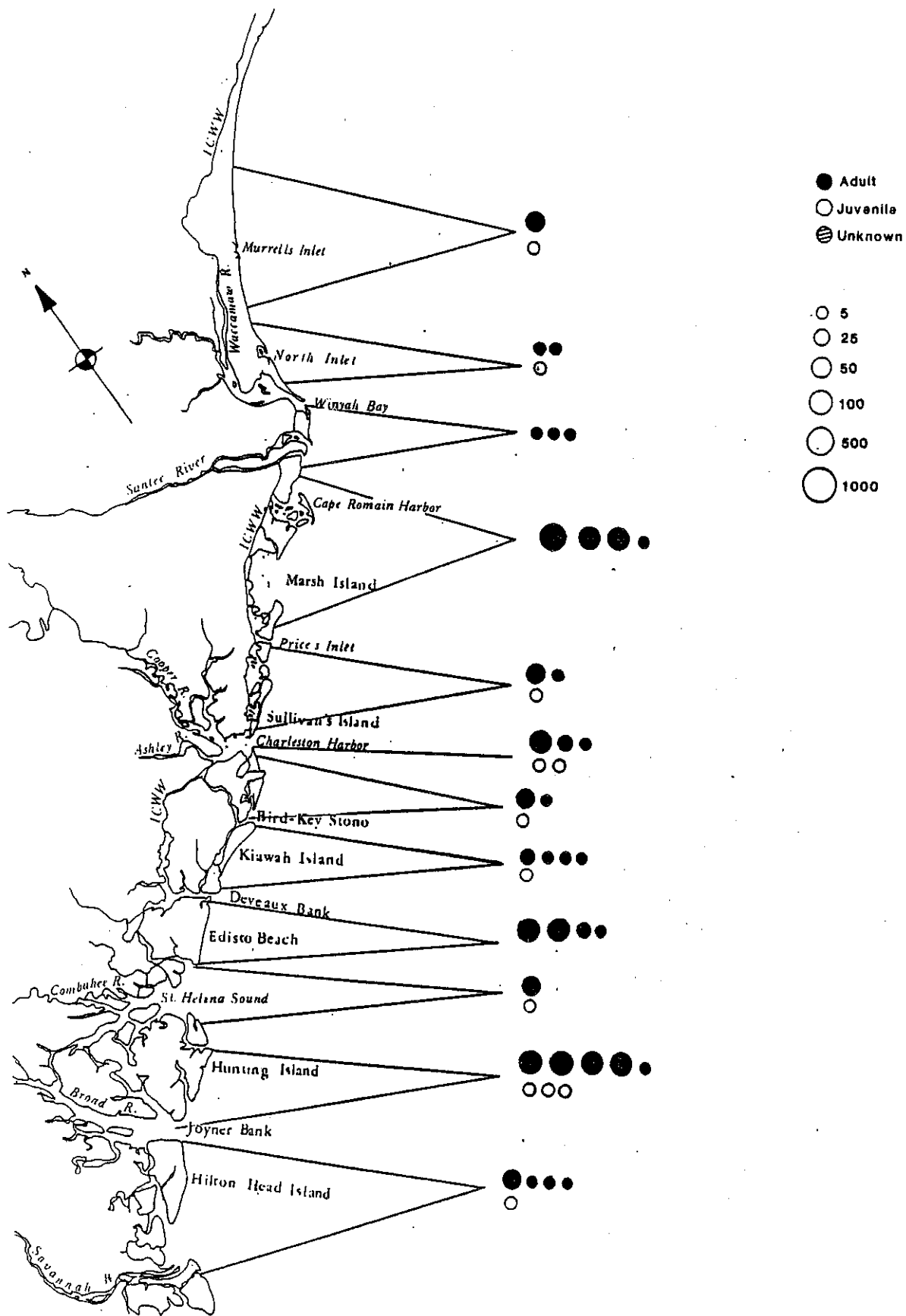


Fig. 20 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in March.



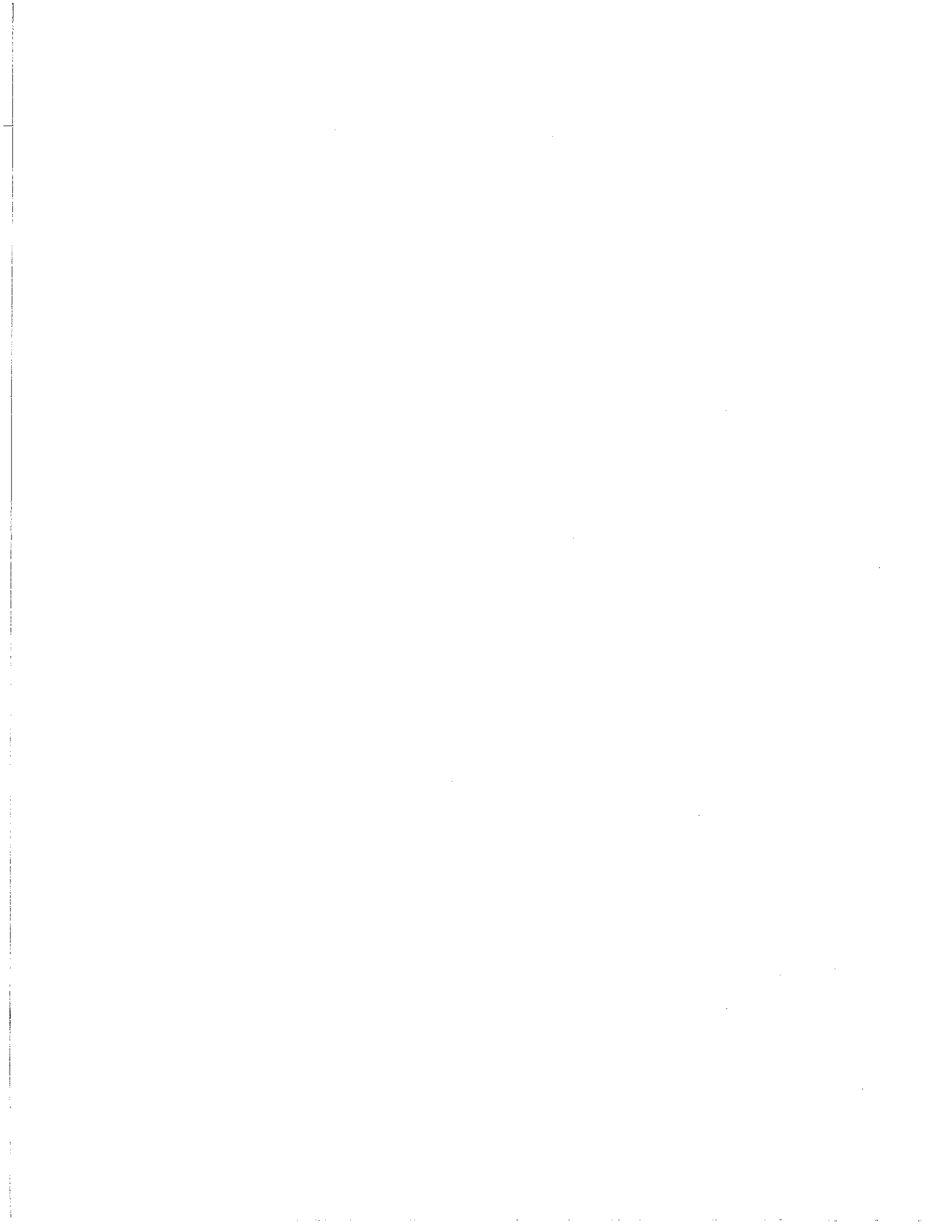


Fig. 21 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in April.

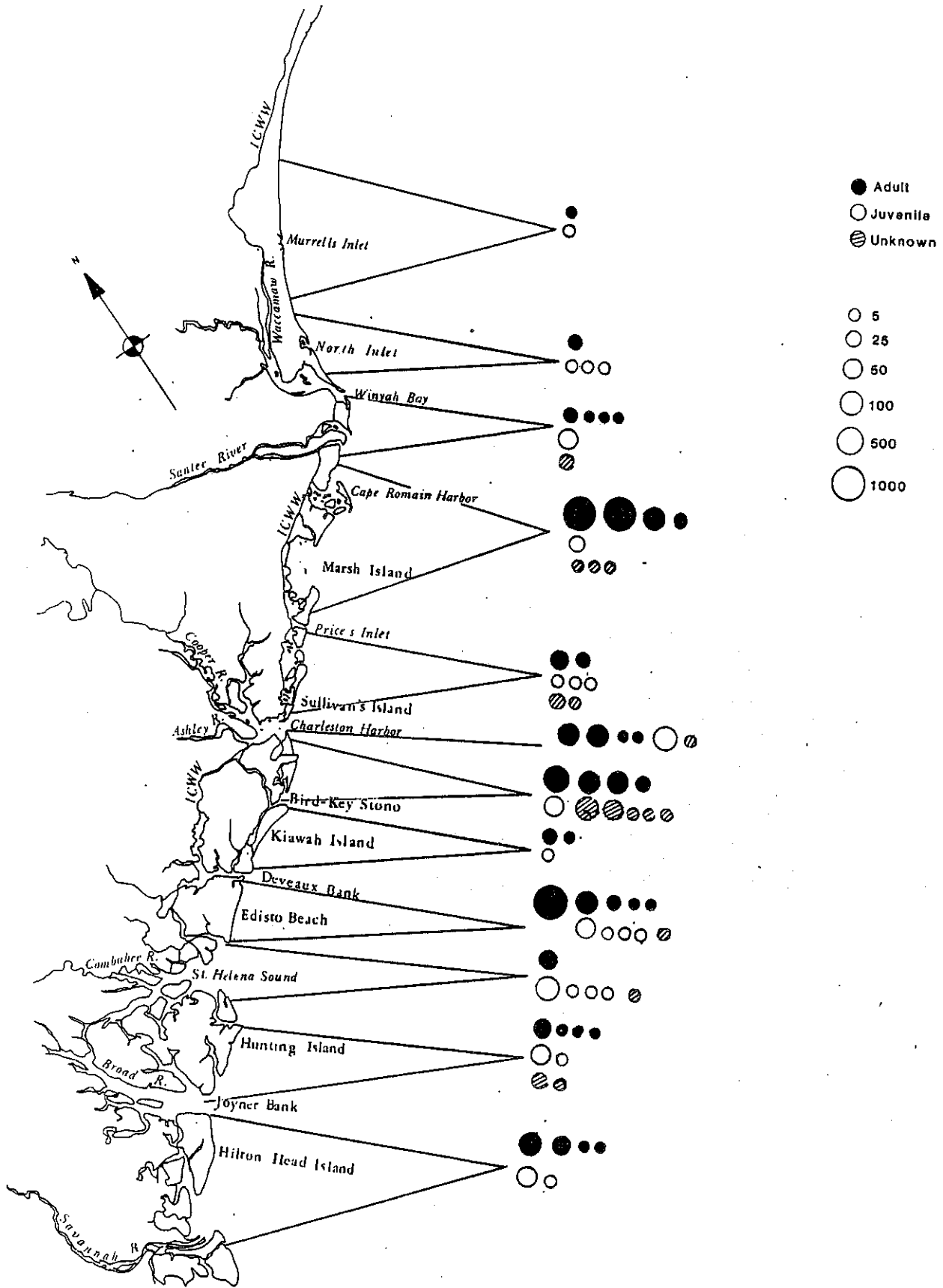




Fig. 22 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in May.

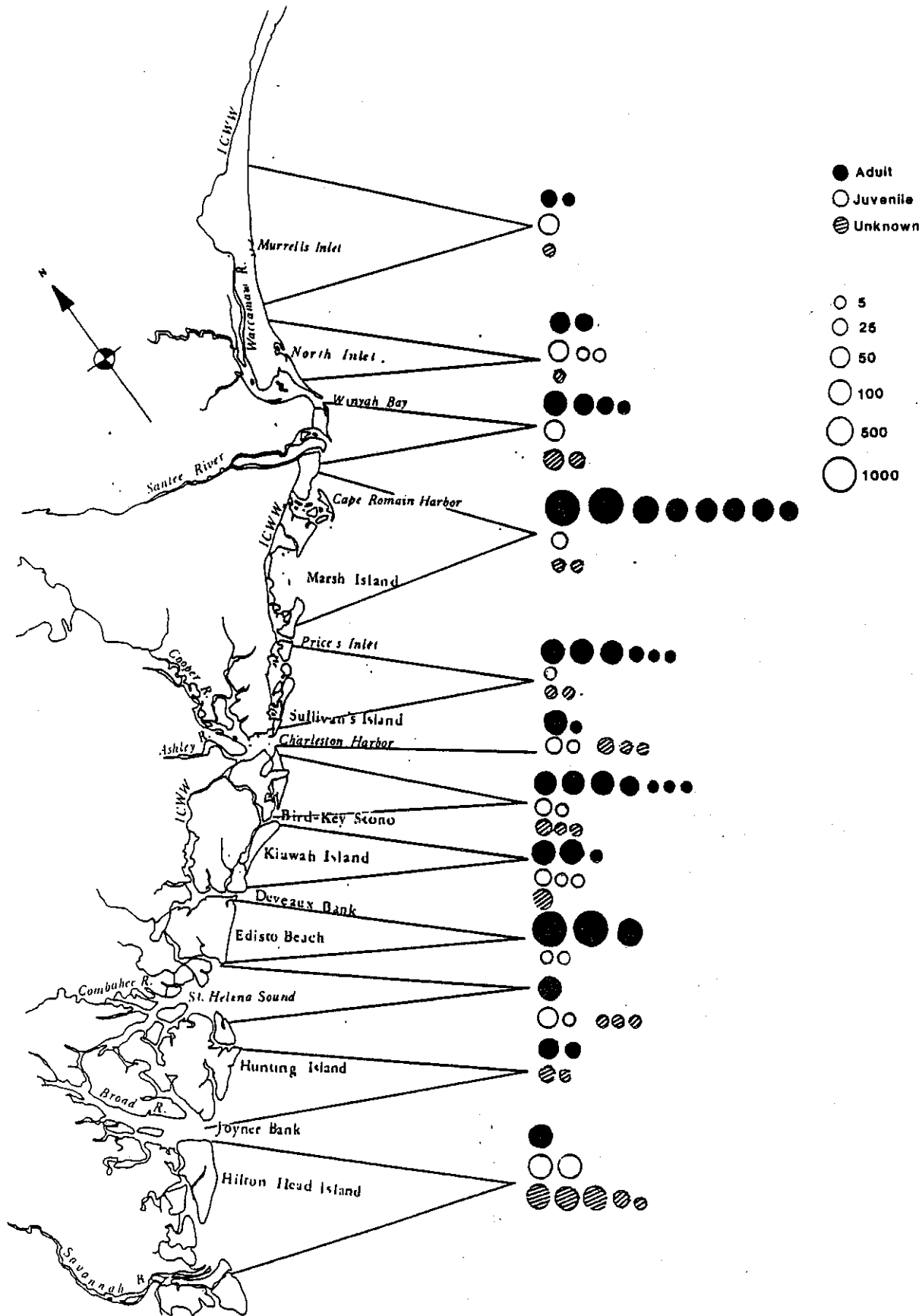


Fig. 23 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in June.

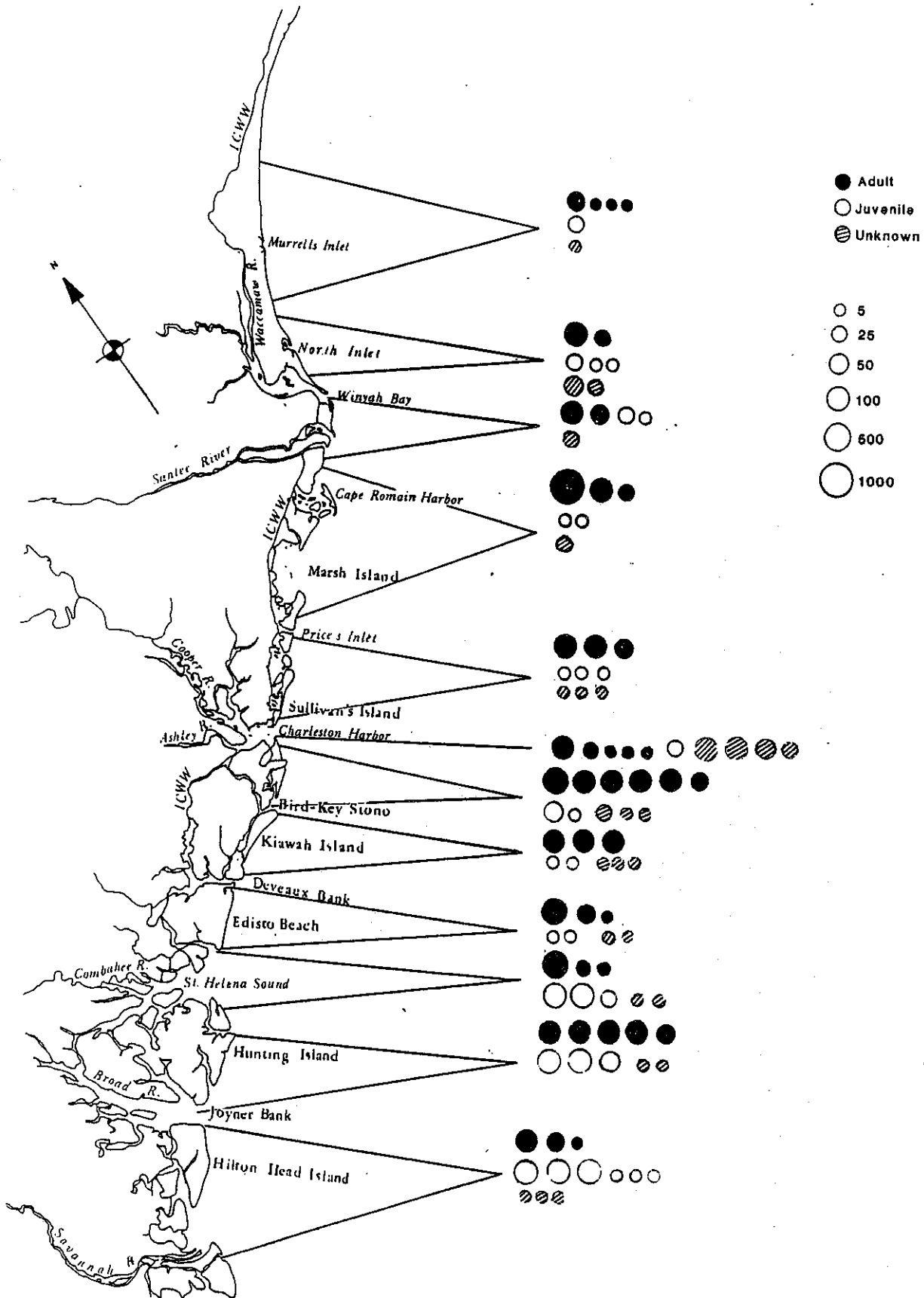
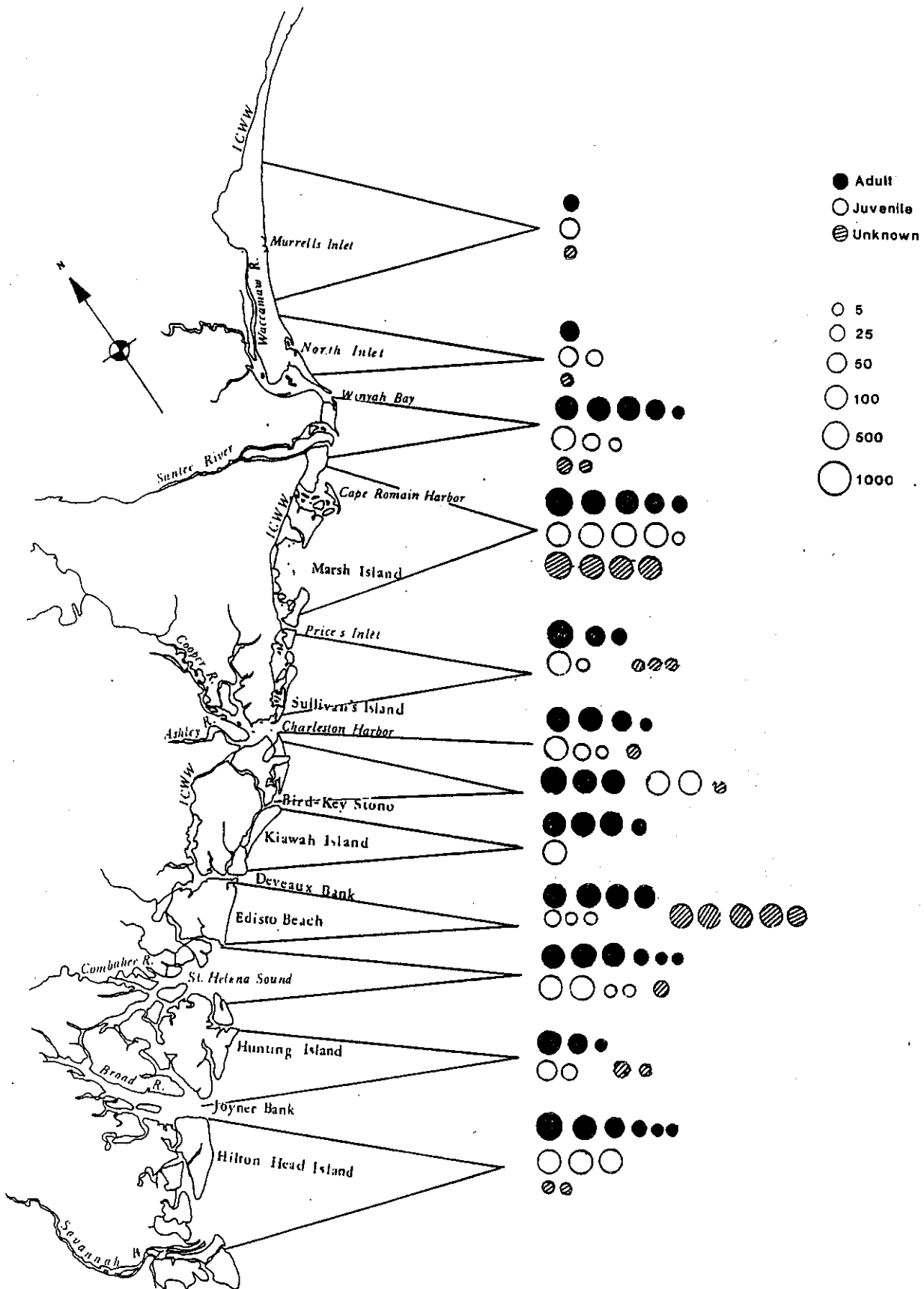


Fig. 24 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in July.



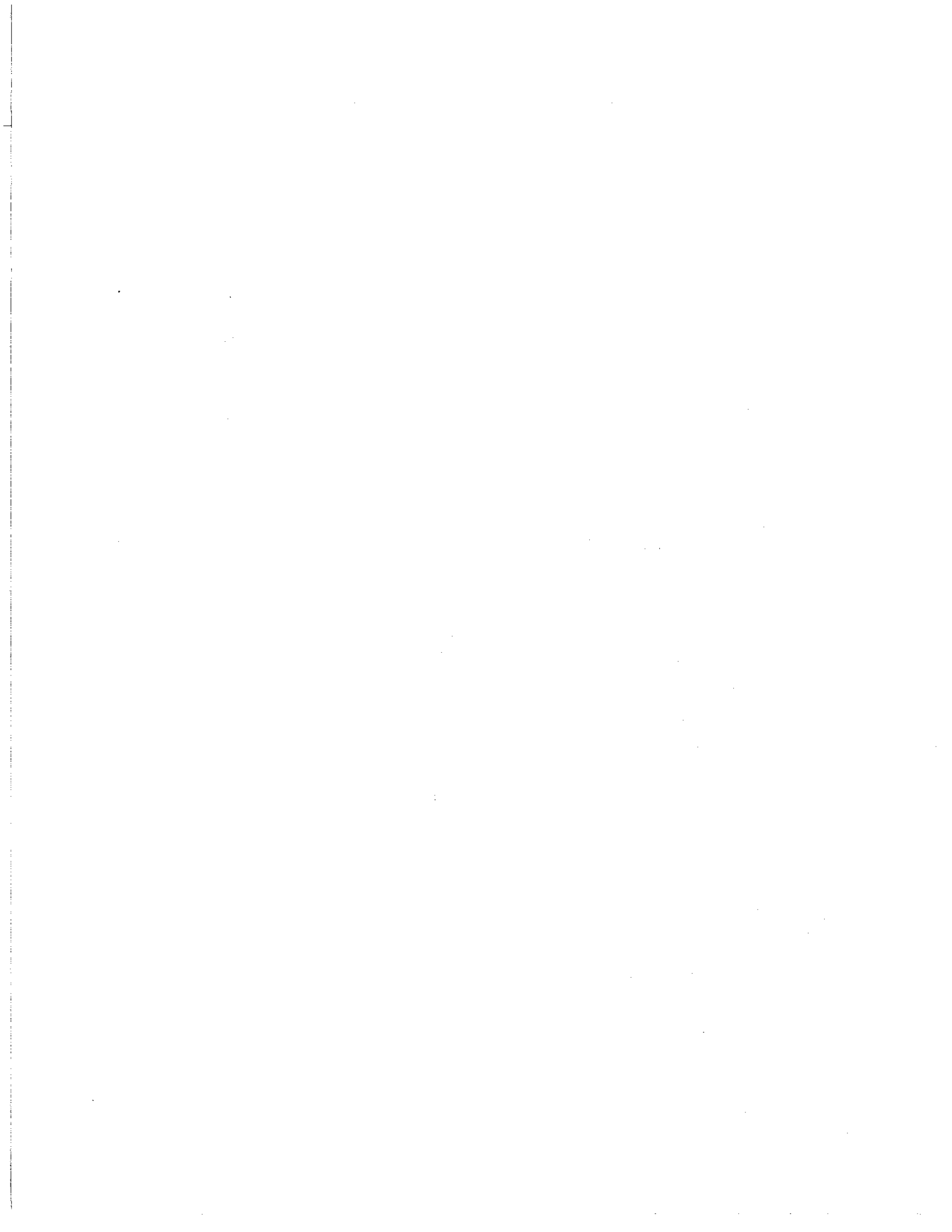


Fig. 25 Average (1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in August.

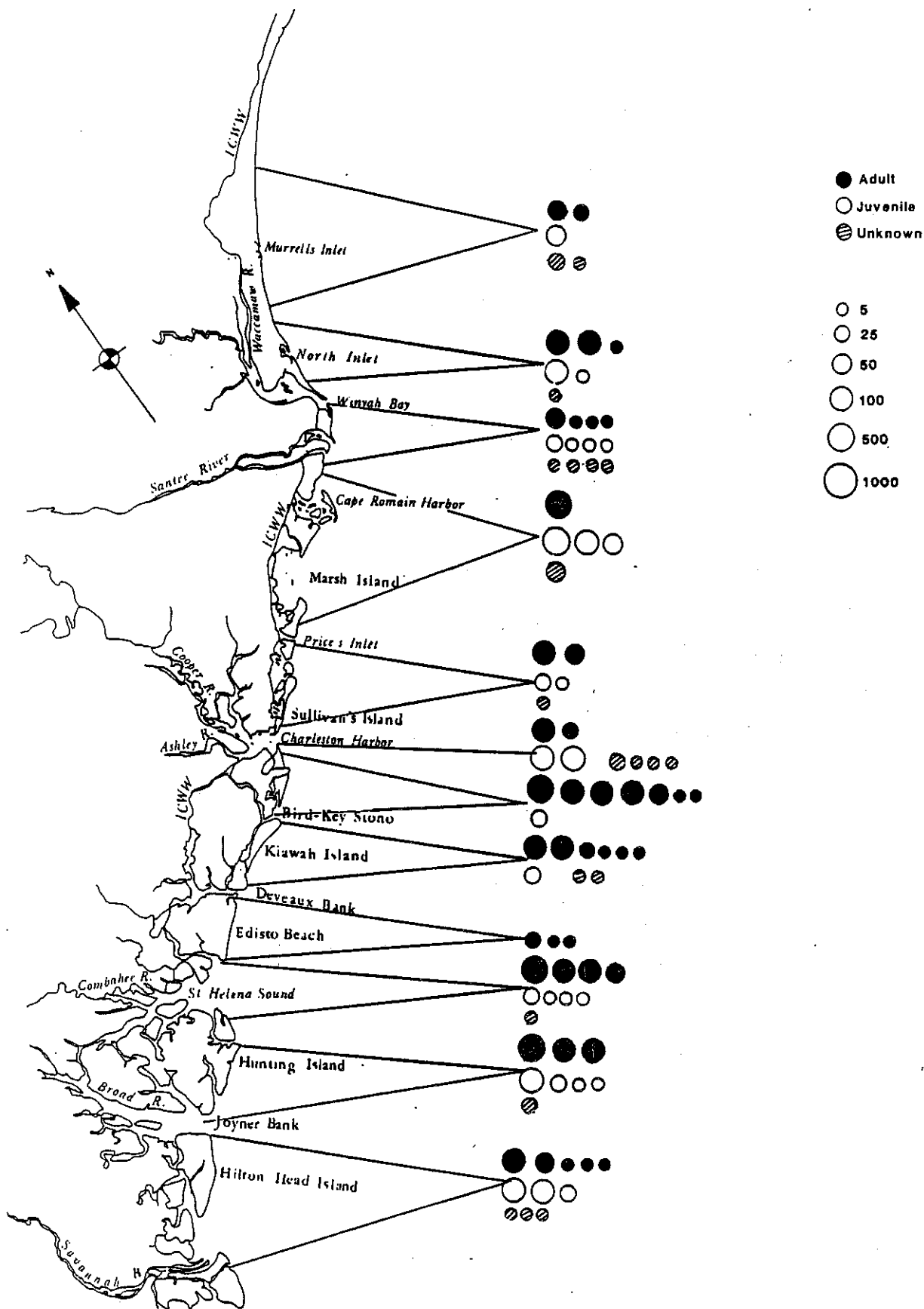




Fig. 26 Average (1976,1979.) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in September.

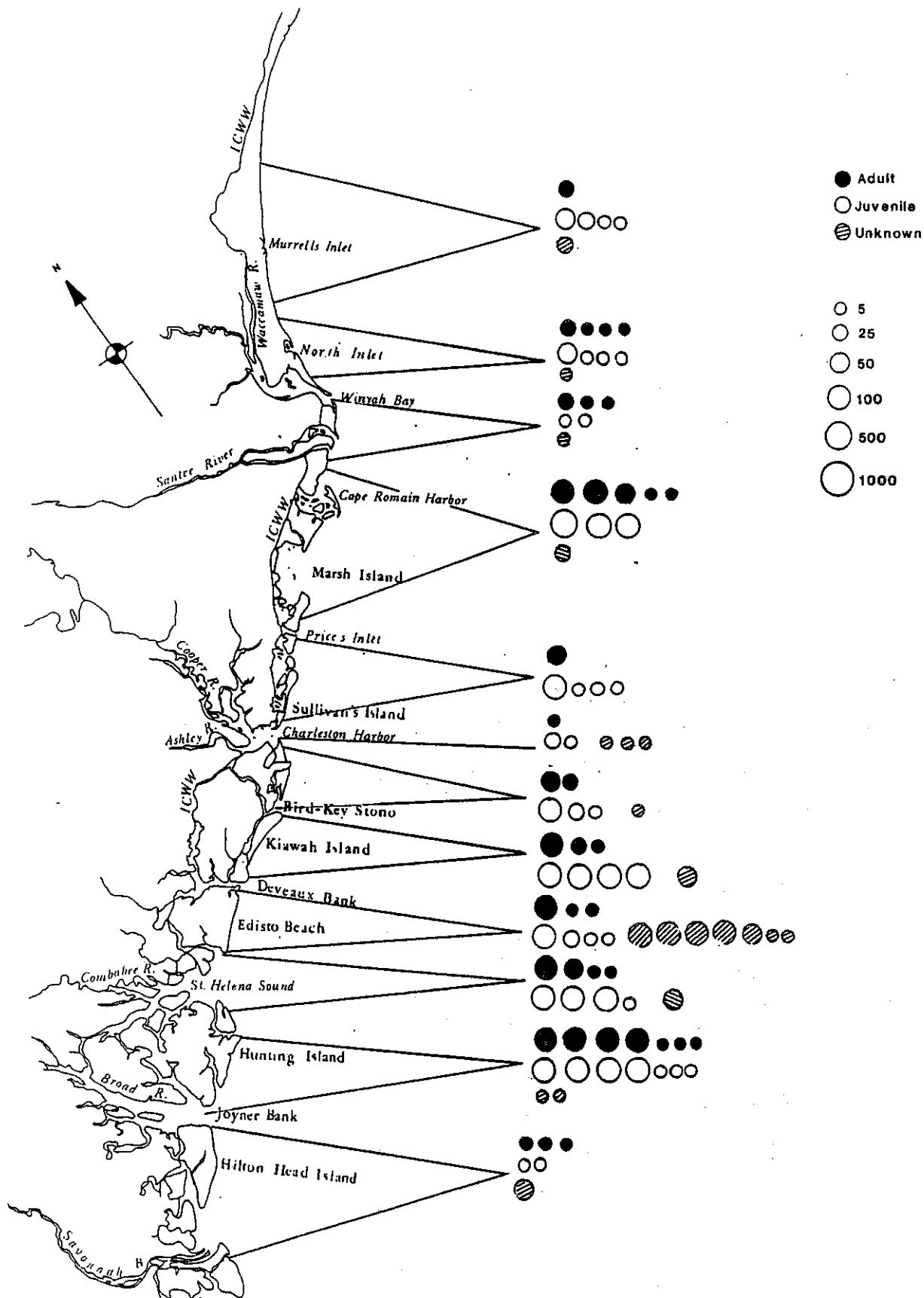
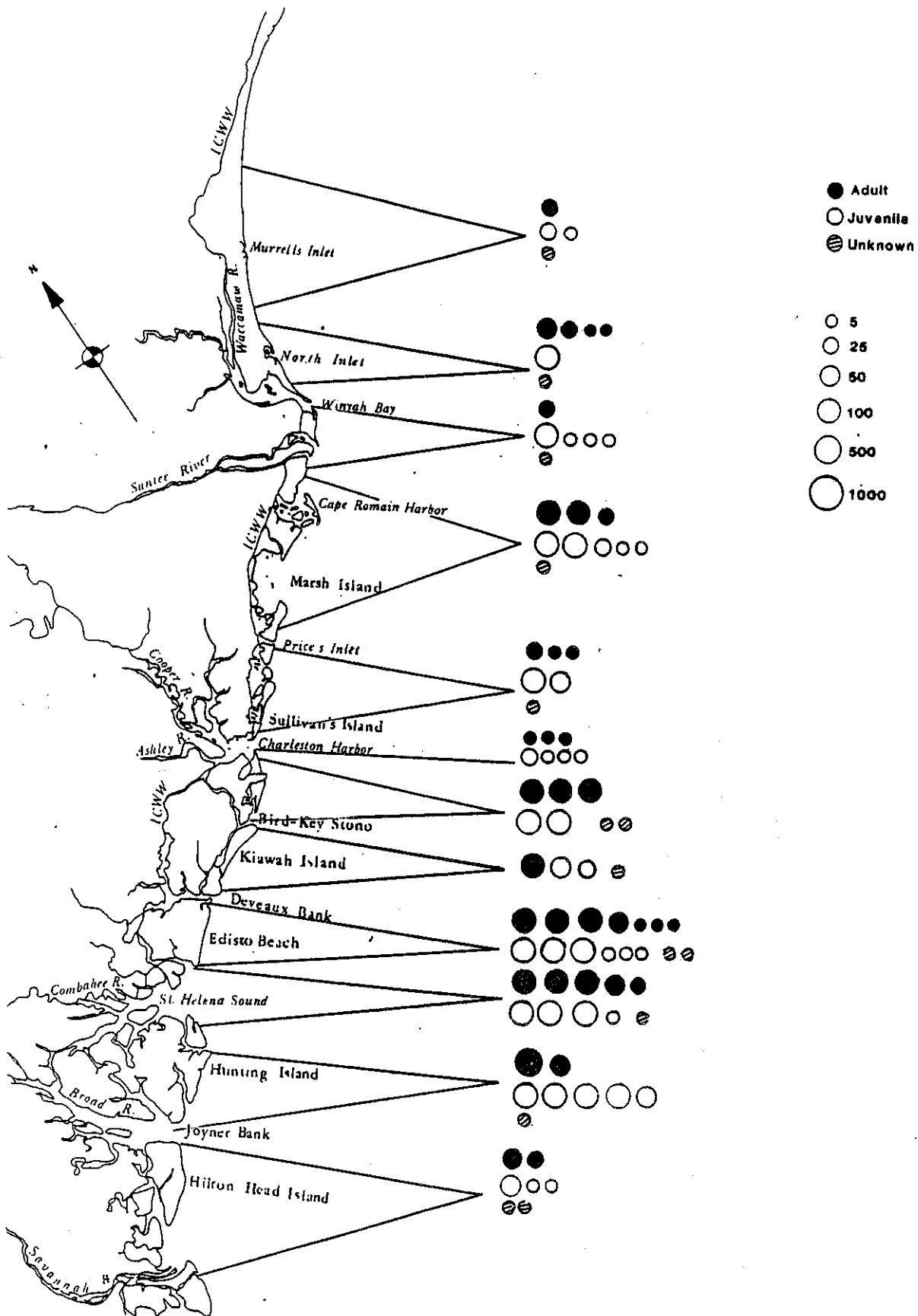




Fig. 27 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in October.



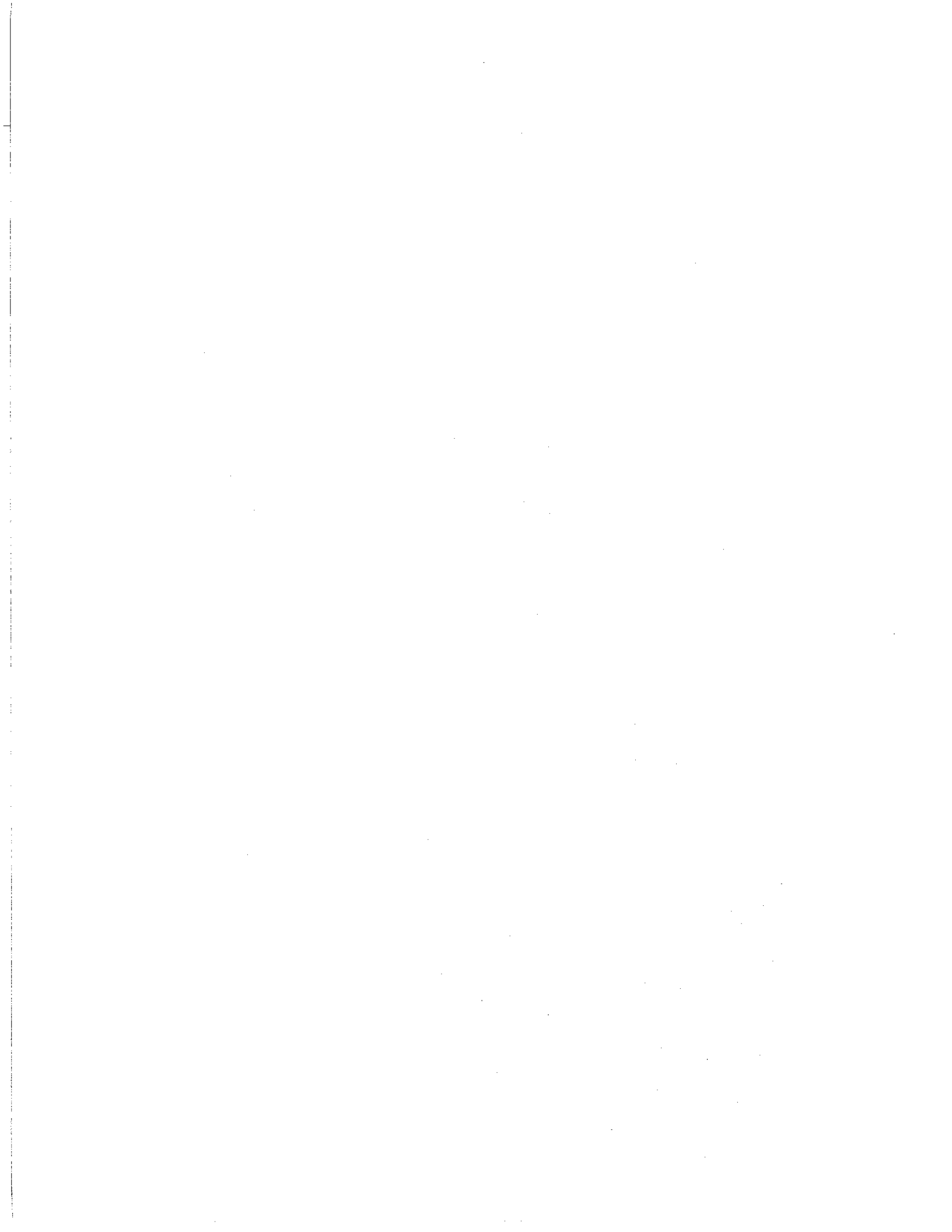
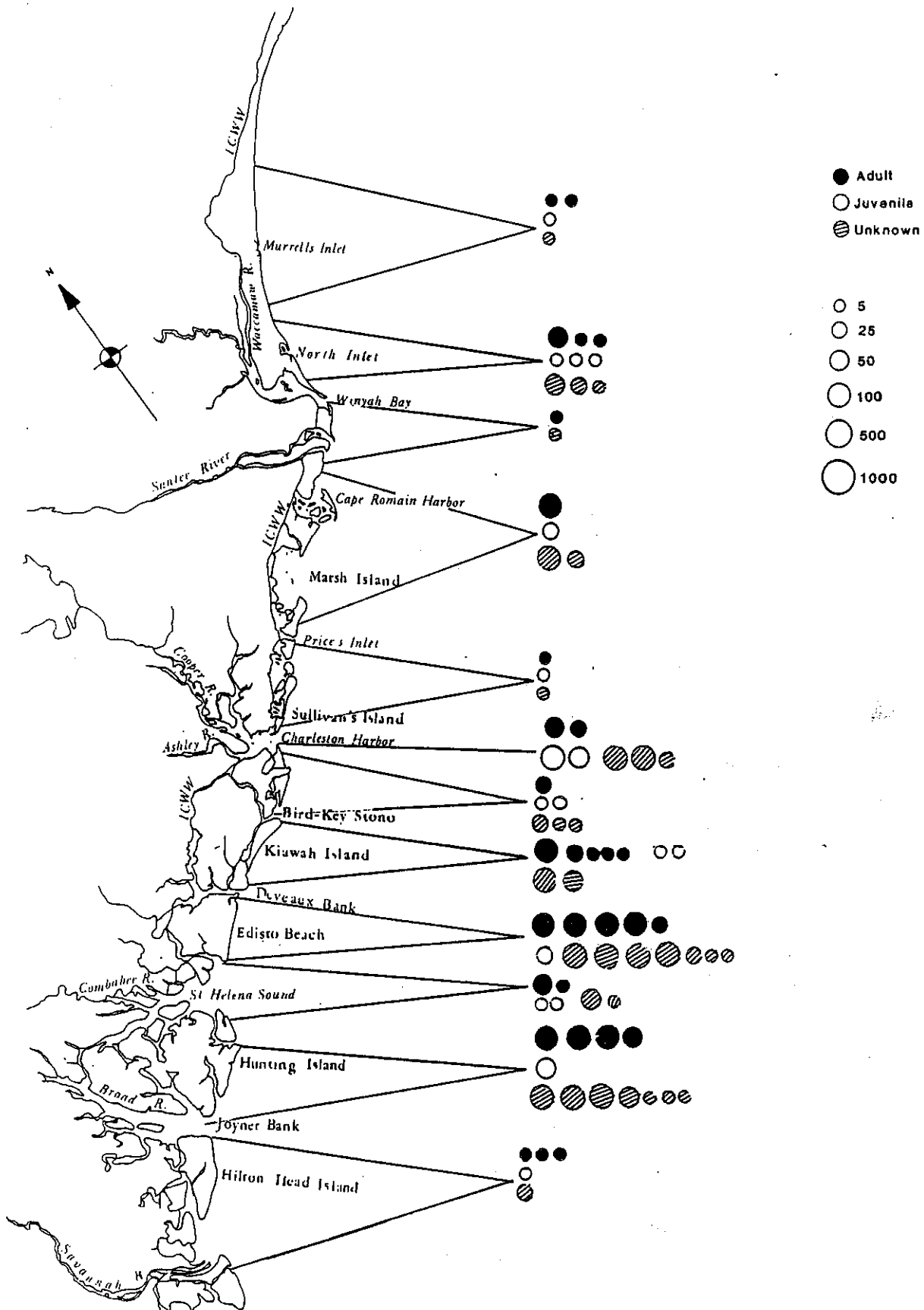


Fig. 28 Relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in November, 1979.



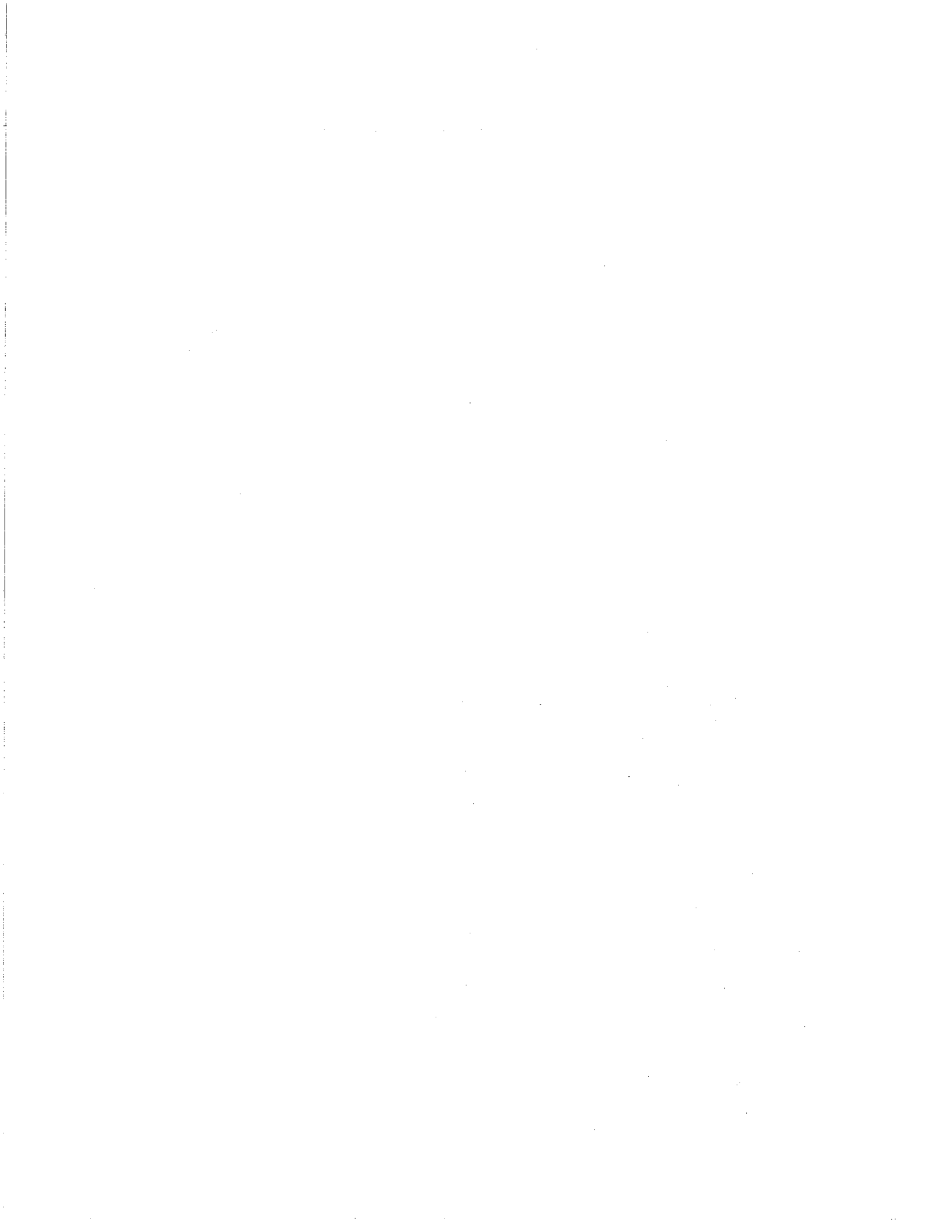
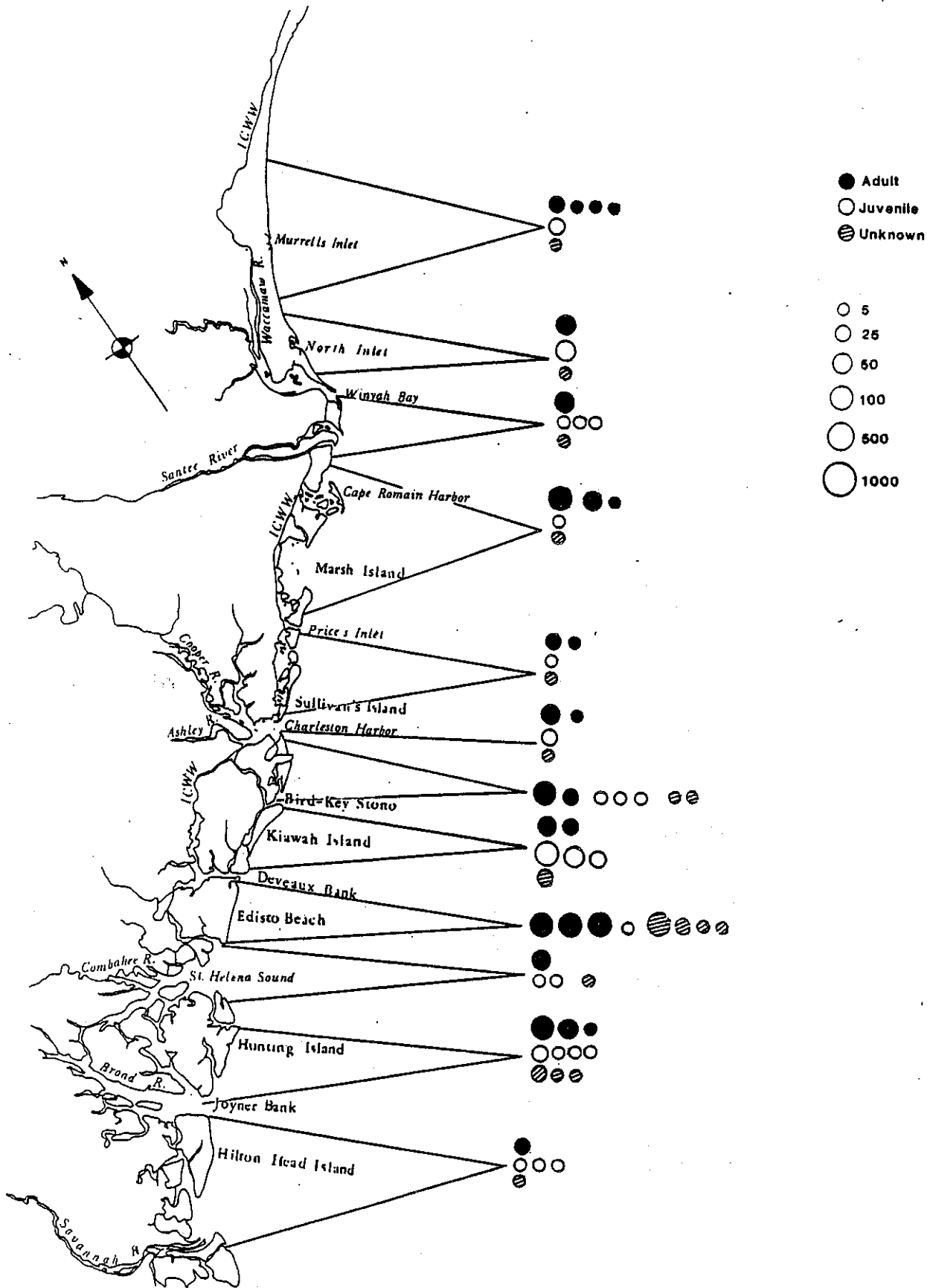


Fig. 29 Average (1978,1979,1980) relative densities and distribution of the Eastern Brown Pelican on the coast of South Carolina in December.



Nesting Effort and Reproductive Success - Pelican nesting effort and fledgling success have been monitored to some degree since 1940 in the Cape Romain National Wildlife Refuge.

Pelican nesting and fledgling counts in South Carolina were confined to the Bulls Bay rookeries until the early 1960s. More extensive counts were made in the 1960s that include all the pelican rookeries in the state. These counts were done by different individuals, and there were no standardized methods of counting or record keeping. In the 1970s more attention was given to a standard method of counting the South Carolina pelicans' nesting and fledging success.

Pelican nest counts were made by the South Carolina Wildlife and Marine Resources Department from aerial photographs taken from various types of rotary-wing aircrafts at different altitudes. Counts were also made of nests during rookery walk-through observations. The aerial photographic counts and ground walk-through counts were about equally accurate.

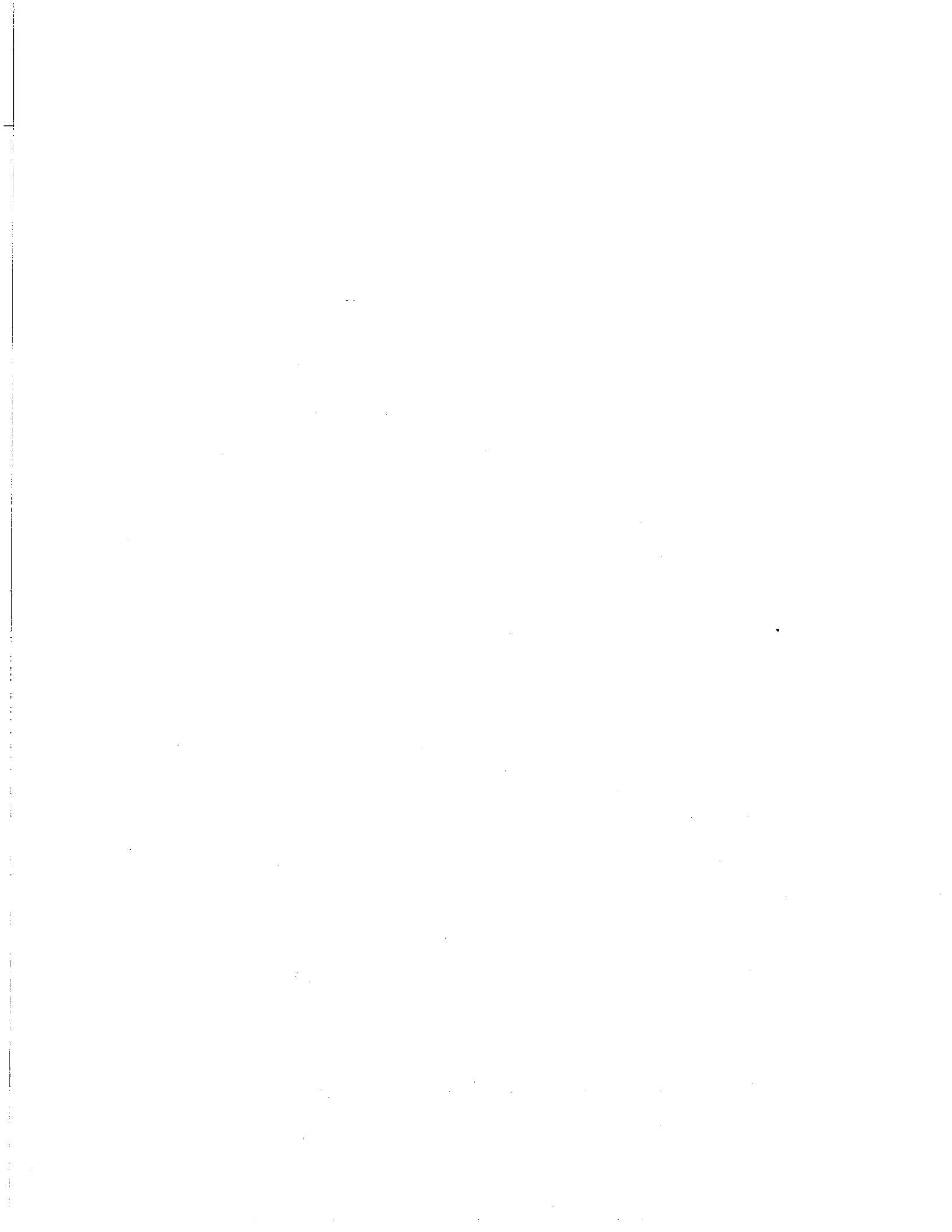
The aerial photography method appeared to cause less disturbance to nesting pelicans than the ground counts when the photography was conducted above 200 feet. Effects of disturbance from ground counts appeared to be minimized if counts were conducted during the cooler times of the day.

Pelican nesting counts conducted in South Carolina since 1970 (n=1116) have shown a general increase in the pelican nesting effort in South Carolina from that time until the present (n=5100) (Table 6).

Fledgling success has also shown a similar increase during the same period. The lowest fledgling success was in 1970 (n=945) and the highest in 1984 (n=6700) During the summer of 1983 a coastal storm caused nesting areas to erode and high fledgling mortality (Table 6).

Table 6 . Pelican Nesting Efforts and Fledgling Success in South Carolina Rookeries 1970-1984.

Rookery	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Cape Romain															
Bulls Bay															
# Nests	637	1094	763	836	920	921	1440	1678	3244	2463	2725	2815	3402	2880	2300
# Fledge	500	949	514	1082	825	530	1399	2400	4541	2872	1974	2585	2611	1540	2500
Deveaux Bk.															
North Edisto															
River															
# Nests	479	375	652	810	750	1500	1100	1698	1274	1773					
# Fledge	445	400	456	1644	800	1300	1738	635	1800	843					
Bird-Key															
Stono															
# Nests											2621	2971	3251	2039	2600
# Fledge											4150	4039	3700	917	4400
Totals															
# Nests	1116	1469	1415	1640	2070	2031	2540	3376	4518	4236	5346	5786	6653	4919	5100
# Fledge	945	1349	970	2726	1625	1830	3137	3035	6341	8715	6124	6624	6311	2457	6700



DISCUSSION

Capturing and banding large numbers of adult pelicans on sites away from rookeries proved to be both difficult and unrewarding. The rocket-net system can be most effective when used under the following conditions: 1) It is set up and left on the site until the animals become accustomed to it, 2) it is well-disguised, 3) animals can be lured to the capture site by bait or the animals' presence in a relatively small area can be predicted in a narrow time range. None of these criteria were met in our attempts to capture loafing pelicans during this study. The tide, waves and wind shifted the sand on most loafing areas used by pelicans (excluding rookeries) in South Carolina, making it infeasible to leave the rocket-net set up for more than several hours. Therefore, it had to be set up and removed daily. Probably this kept it from being in a specific location long enough for the birds to accept it as part of the landscape. The stark beach terrain made camouflaging the rocket-net system difficult.

We believe the rocket-net could be used successfully to catch adult pelicans in the rookeries, but we decided not to try this method since the species was endangered at that time.

We were successful in marking and banding preflight pelicans in the rookeries. However, large numbers had to be marked because of the low first year survival rates of pelicans and high predicted losses of the marking devices before the birds became adults.

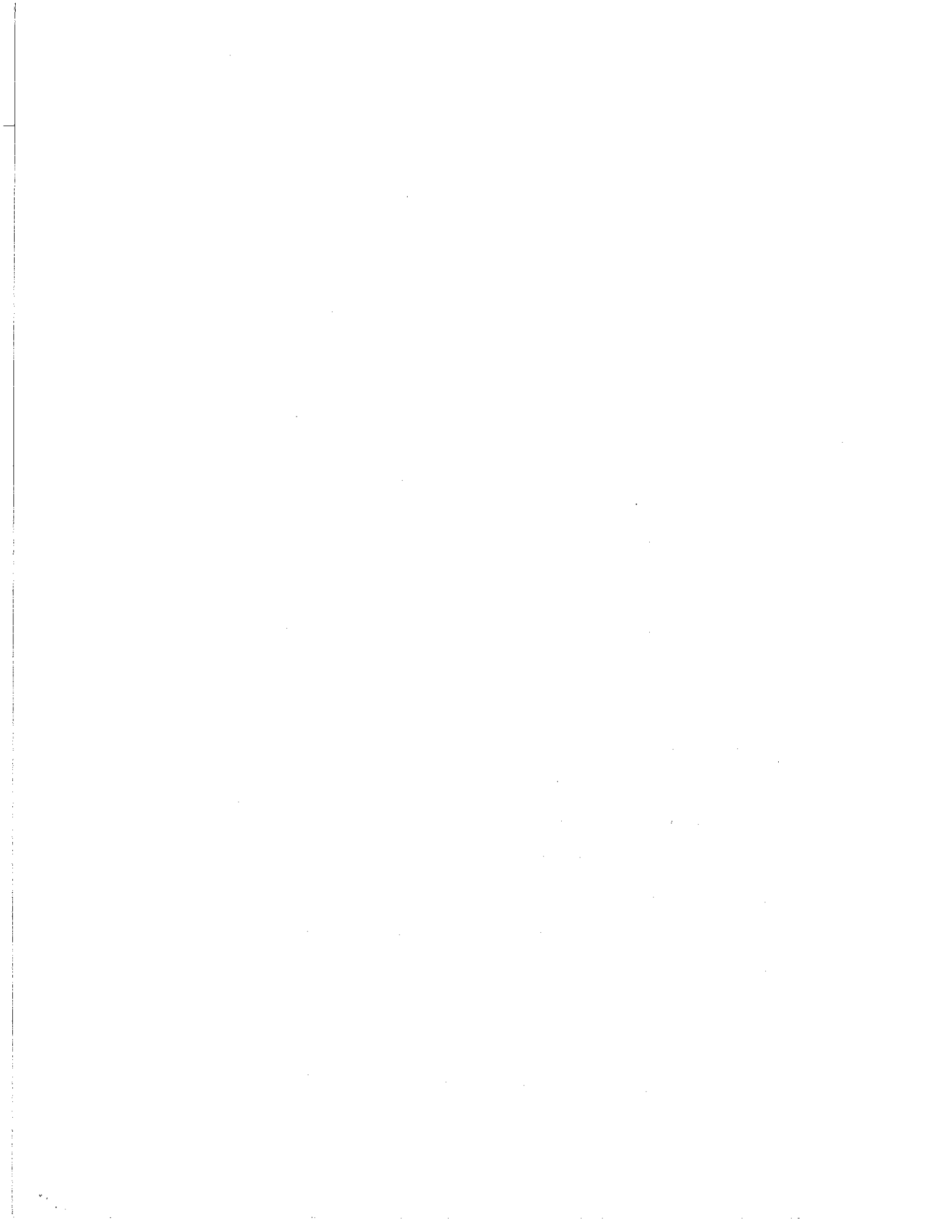
The trends from marked pelican recoveries, banding analyses and monthly aerial surveys were consistent and indicated a similar pattern of seasonal

abundance in South Carolina, direction of movements, season of mortality, and age that mortality most often occurs.

Most pelicans banded in South Carolina were recovered in the winter of their first year on the east coast of Florida. The highest mortality rates are in December, January, February and March, and the lowest are in May, September and October. The band recovery rate in South Carolina exceeds recoveries outside the state during June, July, August and September. These trends indicate pelicans, in this age class, spend their summers in South Carolina primarily to nest. In early fall they move south, and they winter primarily in Florida. They begin to move back into South Carolina in the spring and their numbers peak in May, June and July.

A pattern of similar movements emerged from returns on marked juveniles. After fledging, there was a gradual movement away from the rookeries to points north and south along the coast. Later they move southward. The earliest sightings of wing markers in Florida was in mid-September. In late fall, winter and spring, most sightings were in Florida. Sightings during the summer months were more numerous in South Carolina. Limited sighting recoveries of pelicans that retained their markers until they reached nesting age indicated an extremely high fidelity to their natal rookeries. From sightings of birds marked to indicate their rookery of origin, it appeared that pelicans utilizing the Deveaux Bank rookery moved as a group to Bird-Key Stono when the Deveaux Bank washed away.

Seasonal population trends that were determined from coastal aerial surveys complemented information obtained from band and marker recoveries. After nesting duties are completed in late summer, adults begin moving



south, and total numbers in the state begin to drop. Sometimes in early fall there was a greater number of juveniles in the state than adults. In December, January and February pelican numbers continue to decline. However, a small number, mostly adults, remains in the state. In March the number of pelicans in South Carolina begins to increase and continues to do so until midsummer.

Apparently South Carolina is primarily a nesting area for the brown pelican. Areas further south, especially Florida, are wintering areas. An abundant food source for nesting pelicans in South Carolina's near-shore waters is indicated by the large size of the South Carolina pelican rookeries.

The number of nesting pelicans reached a low point in the late 1960s. Earlier counts are not comparable because there is no indication that records of statewide counts were kept. From the early 1970s to 1984, the number of pelican nests in South Carolina generally continued to increase. A review of pelican nesting efforts in both North Carolina (James Parnell pers. comm.) and Florida (Steve Nesbitt pers. comm.) indicates increased nesting in South Carolina has not been at the expense of these other states. North Carolina's nesting pelican population has continued to increase along with South Carolina's and is presently at an all-time high. Nesting in Florida has also been up, though not as drastically as in South Carolina and North Carolina.

Pelican reproductive success has steadily increased in South Carolina since 1970, except for losses of nests and prefledglings caused by natural weather perturbations. The number of nesting pairs has increased from 1,116 in 1970 to 6,653 in 1982. Thus it is easy to be optimistic about the

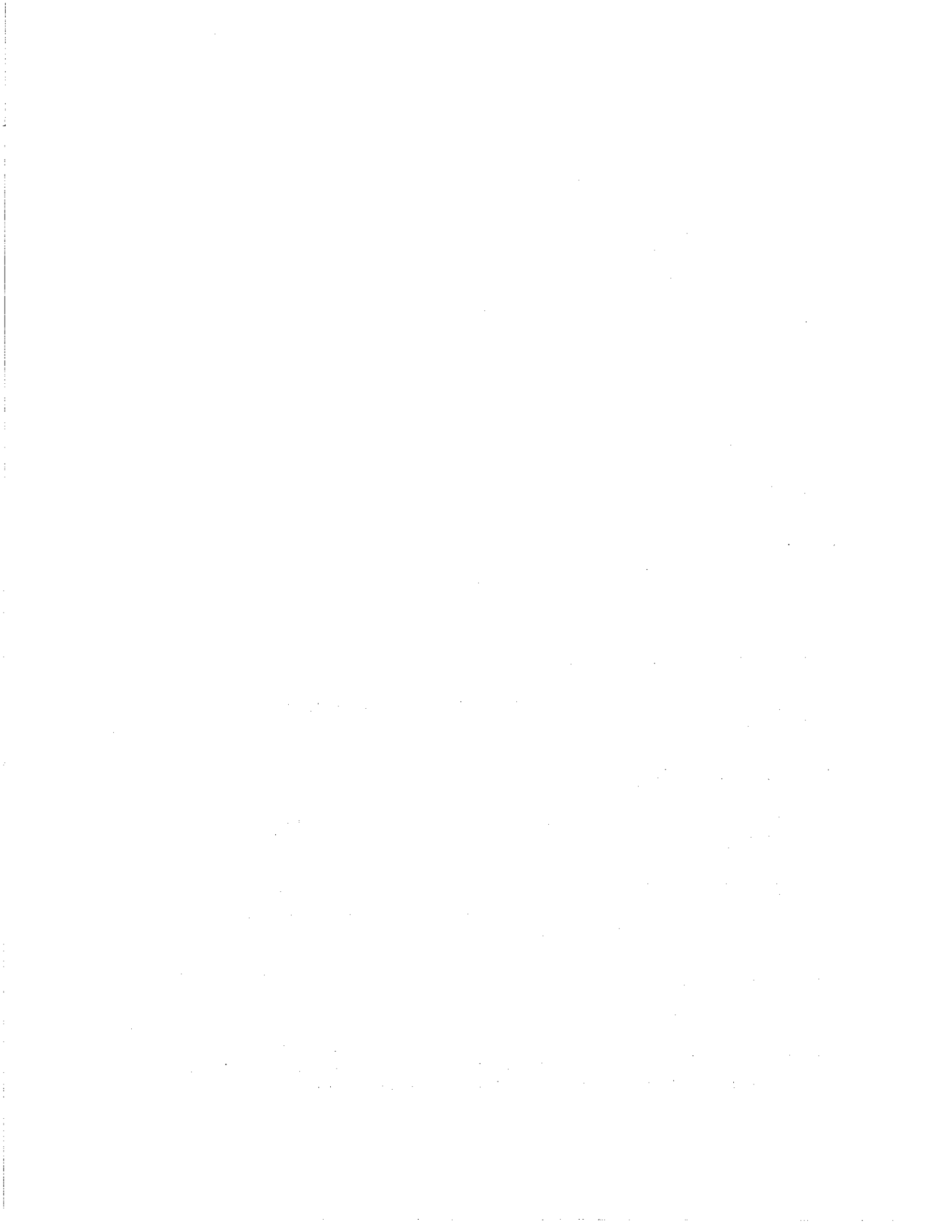
immediate future of brown pelicans in South Carolina. The increase in nesting alone indicates the brown pelican is doing extremely well as a breeder in South Carolina. However, their nesting is limited to three existing coastal island sites. In the winter and spring of 1982-1983, approximately three-fourths of the nesting area of one of these rookeries was lost due to erosion. A significant reduction in fledgling production during the summer of 1983 resulted.

Pelicans normally are ground nesters on small, isolated coastal islands in South Carolina. Severe erosion from storm tides is a continued threat to these islands. Fortunately the nesting habitat on Bird-Key Stono was restored. Dredging spoil was deposited on the island through the cooperative efforts of the South Carolina Wildlife and Marine Resources Department and the U.S. Army Corps of Engineers.

There is a strong need to continue monitoring pelican population levels and reproductive success in South Carolina. This would ensure our awareness of population trends and rookery conditions and our ability to react to any new problems.

Literature Cited

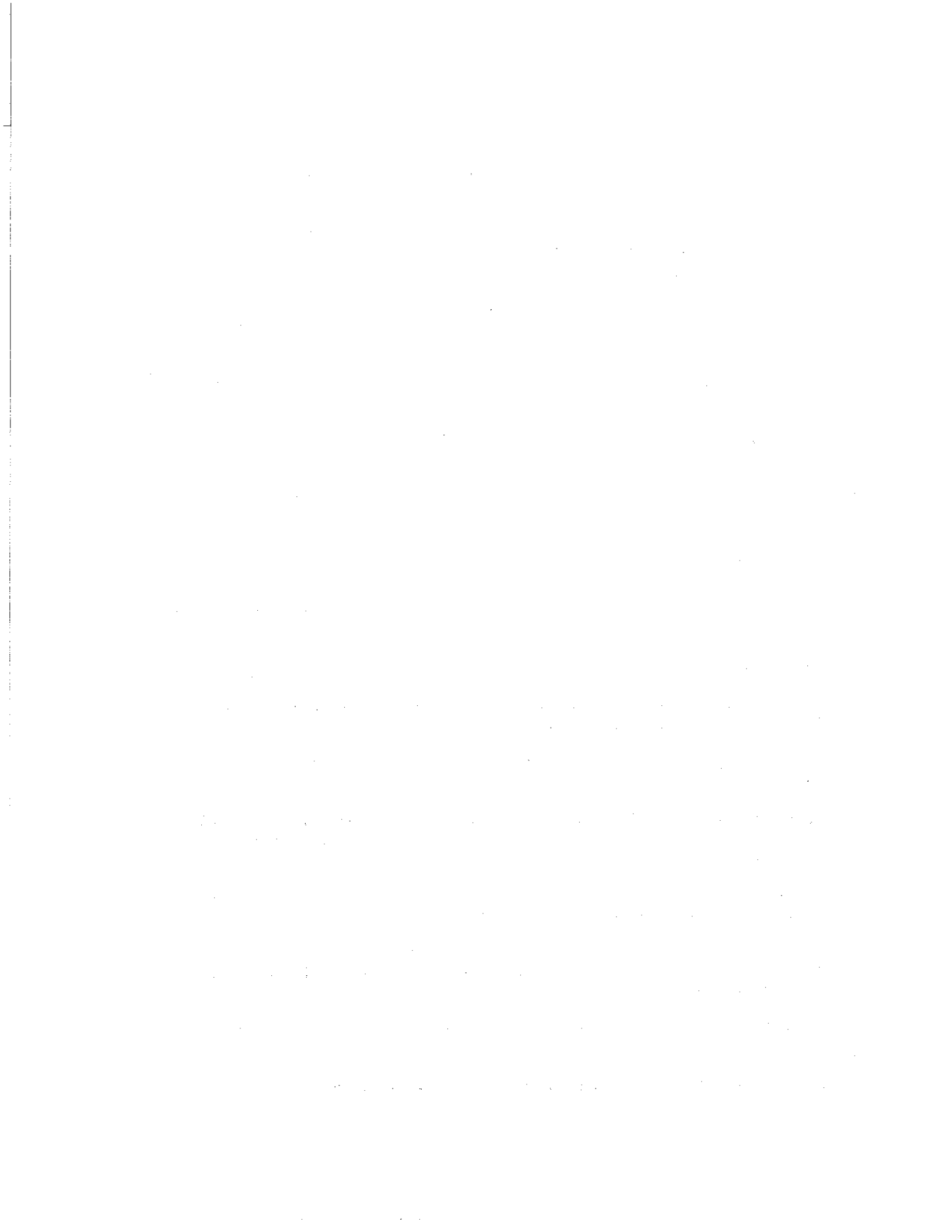
- Anderson, A. 1963. Patagial tags for waterfowl. *J. Wildl. Mgmt.* 27:284-288.
- Beckett, T.A., III. 1966. Deveaux Bank - 1964 and 1965. *Chat* 30:93-100.
- Blank, T.H. and J.S. Ash. 1956. Marker for game birds. *J. Wildl. Mgmt.* 20:328-330.
- Blus, L.J., T.G. Lamong, and S. Burkett, Jr. 1979. Effects of organochlorine residues on eggshell thickness, reproduction and population status of Brown Pelicans (*Pelecanus occidentalis*) in South Carolina and Florida, 1969-76. *Pesticides Monitoring J.* 12:172-184.
- Cely, John E. and Philip M. Wilkinson. 1981. Identification and qualitative evaluation of priority threatened and endangered species habitats. Study completion report. S.C. Wildl. and Marine Res. Dept., Columbia. 85pp.
- Downing, R.L. and C.M. Marshall. 1959. A new plastic tape marker for birds and mammals. *J. Wildl. Mgmt.* 23:223-224.
- Hanson, Bruce. (Pers. Com.) Northern Prairie Research Station. Manitoba, Canada.
- Knowlton, F.K., E.D. Michael, and W.C. Glazener. 1964. A marking technique for field recognition of individual turkeys and deer. *J. Wildl. Mgmt.* 28:167-170.
- Labisky, Ronald F. and Stuart H. Mann. 1962. Backtag Markers for Pheasants. *J. Wildl. Mgn.* 26:393-399.
- National Ocean Survey, 1980. NOAA-NOS Technical Service Publication. Office of Program Development and Management. Rockville, Md. 35pp.
- Nesbitt, S.A. 1979. An evaluation of four wildlife materials. *Bird-Banding* 50:159.
- Schreiber, R.S. 1976. Movements of color marked Brown Pelicans. *Bird-Banding* 47:101-111.
- Sprunt, Alexander Jr. and E.B. Chamberlain. 1949. South Carolina bird life. Univ. So. Car. Press.



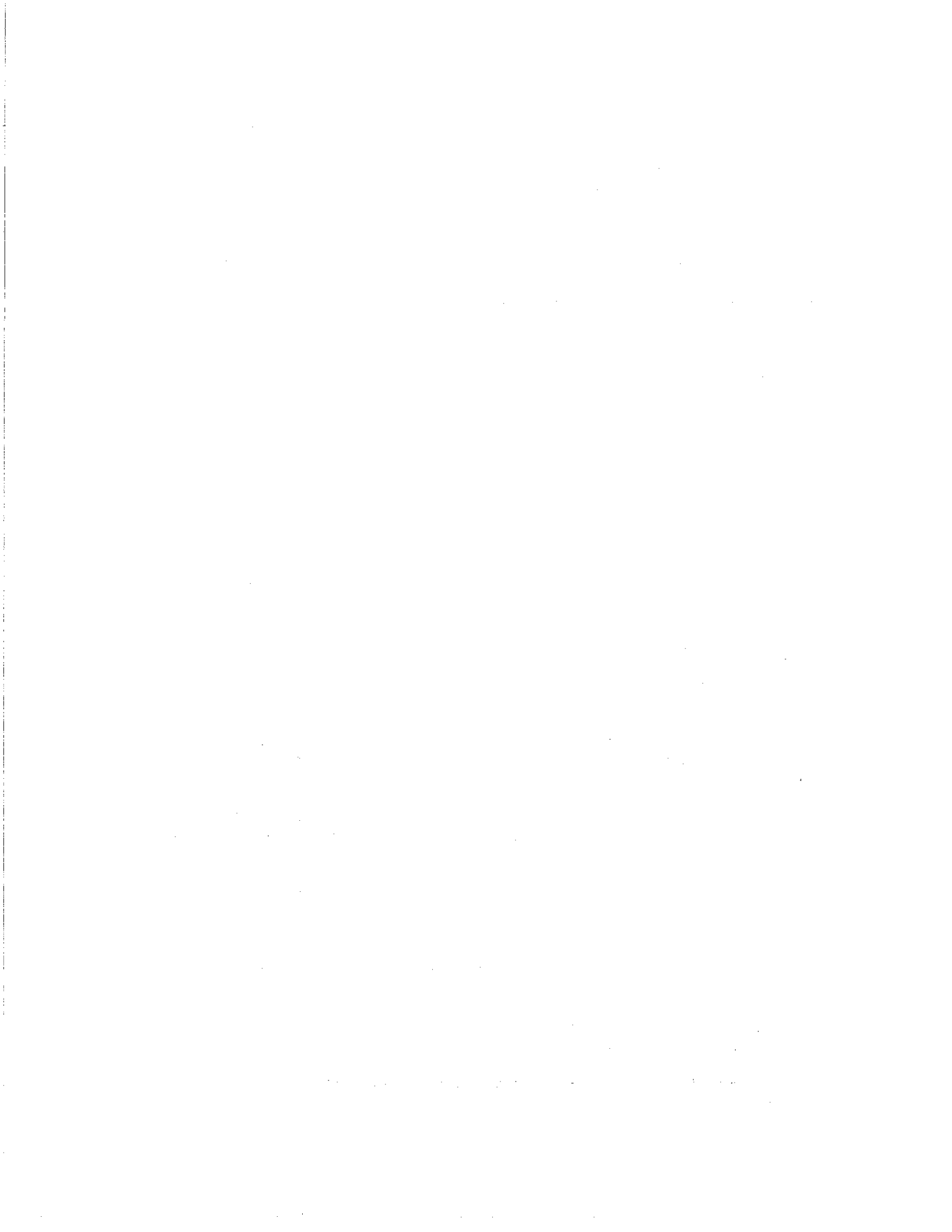
APPENDIX I

A Partial Pelican Bibliography

- Ainley, D. G. 1972. Brown pelicans in north-central coastal California. Calif. Birds 3:59-64.
- Alexander, W. B. 1968. Pelicans with plumage mainly brown and primaries black. pp. 190-191. In: From birds of the ocean. New York, G. P. Putnam's Sons.
- Allen, Robert P. 1934. Inspection of Gulf Coast sanctuaries. Bird-Lore 36(5):338-342.
- _____. 1934. Report of R.P.A., sanctuary director. Bird-Lore 36(6):413-421.
- _____. 1936. With the Audubon wardens. Bird-Lore 38(4):295-297.
- _____. 1937. Our Texas sanctuaries. Bird-Lore 39(4):302.
- _____. 1937. The sanctuary scene. Bird-Lore 39(2):143-145.
- _____. 1950. Florida region. Audubon Field Notes 4(5):271.
- _____. 1952. Bird colonies along the Texas coast. Audubon Magazine 54(4):254-259, 270-272.
- American Ornithologists' Union. 1957. Checklist of North American birds. Fifth edit., Amer. Orn. Union, Baltimore, Md., xxiii + 691 pp.
- _____. 1968. Report of committee on conservation, 1967. Auk 85:117-126.
- Anderson, Daniel William. 1967. An exploration of pesticides in cormorants and pelican populations. M.S. thesis, Univ. Wisc.
- _____, Joseph J. Hickey, Robert W. Risebrough, Donald F. Huges, and Robert E. Christensen. 1969. Significance of chlorinated hydrocarbon residues to breeding pelicans and cormorants. Can. Field-Nat. 83(2):91-112. April-June, 1969.
- _____ and Joseph J. Hickey. 1970. Oological data on egg and breeding characteristics of brown pelicans. Wilson Bul. 82(1):14-28. Mar.1970.
- _____, J. R. Jehl, Jr., R.W. Risebrough, L.A. Woods, Jr., L.R. Deweese, and W.G. Edgecomb. 1973. Brown pelicans: Improved reproduction off the southern California coast. Science. Vol. 190, p.806.



- Anderson, Daniel William, and Irene T. Anderson. 1976. Distribution and status of brown pelicans in the California current. *Am. Birds* 30(1):3-12.
- _____, Ronald M. Jurek, and James O. Ronald. 1977. The status of brown pelicans at Anacapa Island in 1975. *Calif. Fish Game* 63(1):4-10. Jan. 1977.
- Audubon, John James. 1951. Audubon centennial stamps. *Audubon Magazine* 53(2):102. From: *The Birds of America*. 7:192-193. New York, George R. Lockwood & Son.
- Bailey, Alfred M. and Earl G. Wright. 1931. Birds of southern Louisiana. *Wilson Bull.* 43(2):114-142.
- Baird, S. F., T. M. Brewer, and R. Ridgway. 1884. The water birds of North America. Vol. II. pp. 132, 143. Little, Brown, and Co., Boston.
- Baker, John H. 1940. The director reports to you. *Bird-Lore* 42(3):273-285.
- _____. 1940. The director reports to you. *Bird-Lore* 42(4):365-366.
- _____. 1940. Great water birds go hungry. *Bird-Lore* (5):439-440.
- Baldrige, Alan. 1973. The status of the brown pelican in the Monterey region of Calif. past and present. *Western Birds*, Vol.4(4), pp.93-100.
- Baldwin, William P. 1946. Brown pelican colony on Cape Romain Refuge increases. *Auk* 63(1):103-104.
- _____. 1946. Laughing gull robs brown pelican. *Auk* 63(1) 96-97.
- Balsh, Martha Hatch, L. Charles Stodart, and David F. Balsh. 1977. Simple technique for analyzing bird transect counts. *Auk* 94(3):606-607. July 1977. WR 167.
- Bartholomew, G. A., Jr. and W. R. Dawson. 1954. Temperature regulation in young pelicans, herons, and gulls. *Ecology* 35:466-472.
- Bartholomew, George A., Robert C. and Eugene C. Crawford, Jr. 1968. Patterns of panting and gular flutter in cormorants, pelicans, owls, and doves. *The Condor* 70:31-34.
- Bailey, Alfred M. 1945. Birds of the Louisiana Gulf Coast. *Audubon Magazine* 47(3):166-172.
- Bean, Norton M. 1954. Aesop's fable reenacted. *Everglades Natural History* 2(3):167.



- Beckett III, Theodore A. 1966. Deveaux Bank - 1964 and 1965. The Chat Vol.30(4)Dec. 1966.
- Beckett, Ted. 1973. Brown pelican on Deveaux Bank. The Chat Vol.37(4)Dec. 1973, pp. 108.
- Bedord, G. A. 1931. Descriptions of three new species of *Tetro pthalmus* (mallophage) found on pelicans. Parasitology 23:236-242.
- Benedict, F. G. and E. L. Fox. 1927. Gaseous metabolism of large wild birds. Proc. Amer. Philos. Soc. 66:511-534.
- Bent, Arthur C. 1910. Report of Arthur C. Bent on the Breton Island Reservation. Bird-Lore 12(6):280-282.
- Bent, A.C. 1922. Life histories of North American petrels and pelicans and their allies. U.S. Nat'l Mus. Bull. 121:294-306.
- Berger, D .D. and H. C. Mueller. 1960. Band retention. Bird-Banding 31(2):90-91.
- Blake, Charles H. 1948. More data on the wing flapping rates of birds. Condor 50(4):148-151.
- Blus, L. J. 1970. Measurements of brown pelican eggshells from Florida and South Carolina. Bio Science 20(15):867-869.
- _____, R. G. Heath, C. D. Gish, A. A. Belisle, and R. M. Prouty. 1971. Eggshell thinning in the brown pelican: Implication of DDE. Bio Science 21:1213-15.
- _____, Burkett S. Neely, Jr., Andre A. Belisle, and Richard M. Prouty. 1974. Organochlorine residues in brown pelican eggs: Relation to reproductive success. Environ. Poll. (7) (1974)-(c) Applied Science Publishers Ltd., England. 1974. Printed in Britain.
- _____, A. A. Belisle, and R. M. Prouty. 1974. Relations of brown pelicans to certain environmental pollutants. Pestic. Monet. J. Vol.7, No 3/4. March 1974. pp. 181-194.
- _____, Ted Joanen, Ted Belisle, A. Andre, and R. M. Prouty. 1975. The brown pelican and certain environmental pollutants in Louisiana. Bull. Env. Contamination and Toxicology. Vol. 13, No.6, 1975.
- _____ and Julie A. Keahey. 1978. Variation in reproductivity with age in brown pelican. The Auk 95:128-143. January 1978.
- _____, Thair G. Lamont, and S. Burkett, Jr. 1979. Effects of organochlorine residues on eggshell thickness, reproduction and population status of brown pelican (*Pelecanus occidentalis*) in South Carolina and Florida, 1969-76. Pesticides Monitoring J. 12(4):172-184. March 1979.

- Blus, L.J. 1979. Organochlorine residues in six species of estuarine birds, South Carolina, 1970-1975. *Pesticides Monitoring J.* Vol.13, Sept. 1979, No.2. pp. 56-60.
- _____, L. McNease Cromartie, and T. Joanen. 1979. Brown Pelican: Reproductive success and organochlorine residues in Louisiana, 1971-1976. *Bull. Environ. Contam. Toxicol.* 22:128-185.
- _____, R.C. Stendell, S.N. Wiemeyer, H. M. Ohlendorf, J.A. Kerwin, and L.F. Stickel. In Press. Impact of estuarine pollution on birds. EPA Conference on Estuary Pollution Control. P 184-Gallery 70.
- Bogart, David E. 1953. Brown pelican falls prey to wildcat. *Everglades Natural History* 1(2):76-77.
- Bond, R. M. 1942. Banding record of California brown pelicans. *Condor* 44:116-121.
- _____. 1948. Returns of banded California brown pelicans. *Condor* 50(2):89.
- Bond, Eugene W. 1954. Banding pelicans on Hall Island. *Fla. Nat.* 27(2):39-41.
- Brodhead, Mrs. Lucas. 1910. Notes on birds on the Florida Keys. *Bird-Lore* 12(5):189-190.
- Brookfield, Charles M. 1949. Florida region. *Audubon Field Notes* 3(5):234.
- _____. 1950. Florida region. *Audubon Field Notes* 4(1):11.
- _____. 1951. Florida region. *Audubon Field Notes* 5(4):252
- _____. 1952. Florida region. *Audubon Field Notes* 6(4):243-244.
- Brownie, C., Da. R. Anderson, K.P. Burnham, and D.S. Robson. 1978. Statistical inference from band recovery data- a handbook 1978. 212p. illus. U. S. Dept. of Int. Fish and Wildlife Service Resource Pub. No. 131.
- Burleigh, T. D. 1944. The bird life of the Gulf Coast region of Mississippi. *Occ. Pap. Mus. Zool., Louisiana State Univ.*, No.20, pp. 329-490.
- _____. 1958. Georgia birds. Univ. Oklahoma Press, Norman, Okla. xxxix + 746 pp., 35 pls.
- Burton, P. J. K. 1977. Lower jaw action during prey capture by pelicans. *Auk* 94(4):785-786. Oct. 1977.

Butler, P. A. 1961. Effects of pesticides on commercial fisheries. Proc. of the Gulf and Caribbean Fisheries Institute. 13th Annual Session, pp. 168-172.

_____ and P. F. Springer. 1963. Pesticides, a new factor in coastal environments. N. A. Wildl. and Nat. Res. Conf., 18th. pp. 378-390.

Camp, R.D. 1922. Guarding the great Texas heronry. Bird-Lore 24(5):319-322.

Campbell, William M. and John Mark Dean. 1975. Environmental inventory of Kiawah Island, South Carolina. Env. Res. Center, Inc. Columbia, S.C.

Chamberlain, B.R. 1952. Southern Atlantic coast region. Audubon Field Notes 6(5):278-279.

_____. 1953. Southern Atlantic coast region. Audubon Field Notes 7(1):11-12.

_____. 1954. Southern Atlantic coast region. Audubon Field Notes 8(3):244-246.

_____. 1955. Southern Atlantic coast region. Audubon Field Notes 9(3):238-250.

_____. 1956. Southern Atlantic coast region. Audubon Field Notes 10(3):243-244.

_____. 1956. Southern Atlantic coast region. Audubon Field Notes 10(4):323-325.

_____. 1957. Southern Atlantic coast region. Audubon Field Notes 1(1):15-18.

_____. 1957. Southern Atlantic coast region. Audubon Field Notes 11(5):396.

_____. 1958. Southern Atlantic coast region. Audubon Field Notes 12(5):404.

_____. 1959. Southern Atlantic coast region. Audubon Field Notes 13(5):424.

_____. 1960. Southern Atlantic coast region. Audubon Field Notes 14(5):442.

_____. 1961. Southern Atlantic coast region. Audubon Field Notes 15(5):459.

_____. 1962. Southern Atlantic coast region. Audubon Field Notes 16(1):19.

- Chamberlain, B. R. 1962. Southern Atlantic coast region. Audubon Field Notes 16(3):320.
- _____. 1962. Southern Atlantic coast region. Audubon Field Notes 6(5):446.
- Chapman, Frank M. 1914. The roseate spoonbill. Bird-Lore 16(3):214-217.
- _____. 1918. Down the coastline to Cuba. Bird-Lore 20(6):393-397.
- _____. 1924. Editorial. Bird-Lore 26(3):207.
- Cody, Martin L. 1973. Coexistence, coevolution and convergent evolution in seabird communities. Ecology 54(1):31-44. Winter 1973. Wr 149:101.
- Cole, L.C. 1954. The population consequences of life history phenomena. Quart. Rev. Biol. 29(2):103-137.
- Cooke, May Thacher. 1937. Some longevity records of wild birds. Bird-Banding 8(2):52-65.
- _____. 1942. Returns from banded birds. Bird-Banding 13(1):34-37.
- _____. 1943. Returns from banded birds: Some miscellaneous recoveries of interest. Bird-Banding 14(3):67-74.
- Cope, O.B. 1966. Contamination of the freshwater ecosystem by pesticides. J. Appl. Ecol. 3 (suppl). pp. 33-44. June.
- Cottam, Clarence and F.M. Uhler. 1937. Birds in relation to fishes. U.S. Dept. of Agri. Wildlife Research and Management Leaflet, BS-83.
- Cottam, Clarence. 1952. Coastal marshes adversely affected by drainage. Fla. Nat. 25(2):49.
- Courtney, Charles H. 1973. Helminth parasites of the brown pelican in Florida and Louisiana. M.S. Thesis Univ. Fla. 78 p. WR 150:88.
- Courtney, Charles and John V. Ernst. 1975. EIMERIA PELECANI, Sp. N. From the brown pelican from Florida. J. Parasitol 61 (6):1081-1082. Dec. 1975. (Auburn Univ., Auburn, Ala.)
- Cunningham, Richard L. 1964. Florida region. Audubon Field Notes. 18(1):24.
- Davis, E. W. 1934. Bird-Banding. Fla. Nat., 8(1):5-8.
- Deevey, E. S., Jr. 1947. Life tables for natural populations of animals. Quart. Rev. Biol. 22(4):283-314.

- Denton, J. Fred, E. B. and B. R. Chamberlain. 1950. Southern Atlantic coast region. Audubon Field Notes. 4(5):270.
- Edwards, Helen M. 1932. Brown pelican and catfish. Bird-Lore 34(5):332.
- Evenden, F. G. 1968. Report of committee on conservation, 1968. Auk 85: 669-677.
- _____. 1969. Report of committee on conservation, 1969. Auk 86: 738-744.
- Farner, D. S. 1952. The use of banding data in the study of certain aspects of the dynamics and structures of avian populations. Northwest Sci. 26 (2,3,4):41-50, 79-94, 119-114.
- _____. 1955. Bird banding in the study of population dynamics. In: Recent studies in avian biology (Ed. A. Wolfson). pp. 397-449.
- Finley, W.L. 1907. Among the pelicans. Condor 9:35-41.
- Fogarty, Michael Jr., Stephen Nesbitt, and Carter R. Gilbert. 1980. Diet of nestling brown pelicans in Florida. Wildlife Research Laboratory, Gainesville, FL. p.6 (Unpublished).
- Forbush, Edward Howe. 1929. Birds of Massachusetts and other New England states. Massachusetts: Norwood Press. pp. 166-170.
- Friedmann, H., L. Griscom, and R. T. Moore. 1950. Distributional checklist of the birds of Mexico. Pacific Coast Avifauna. Mo.29, part 1, 202 pp.
- Gaddy, L. L., Ann Stark, and Richard Stalter. 1979. A floristic study of Deveaux Bank. Bull. of the Academy of Sci. Meeting, 1979. Environmental Studies Program, St. Johns University. p.51.
- Gardiner, K. W. 1973. Flying fisherman. Oceans 6:56-59.
- Gibbs, M. 1894. Nesting habits of the brown pelican in Florida. Oologist 1:31-84.
- Goldman, L. C. 1951. South Texas region. Audubon Field Notes 5:298-300.
- _____ and Frank G. Watson. 1952. South Texas region. Audubon Field Notes 6(3):202-206.
- _____. 1952. South Texas region. Audubon Field Notes 6:289-291.
- Gress, Franklin. 1970. Reproductive status of the brown pelican in 1970, with notes on breeding biology and natural history. 1970. Calif. Dep. Fish Game Wildl. Manage. Adm. Dep. Mo. 70-6, 21 p., July 1970. WR 147:94.
- Grimes, S.A. 1943. Birds of Duval County. Fla. Nat. 16(3):29-36.

- Gunter, Gordon. 1958. Feeding behavior of brown and white pelicans on the Gulf Coast of the U.S. Proc. La. Acad. Sci. 21:34-39.
- Hadley, Alden H. 1927. Commercial fisheries vs. fish-eating birds. Bird-Lore 29(5):387-388.
- _____. 1928. Seabirds increasing on the Louisiana Coast. Bird-Lore 30(1):93.
- _____. 1929. Texas makes forward step. Bird-Lore 31(4):309.
- _____. 1931. List of birds sanctuaries. Fla. Nat. 5(1):11-13.
- Hall, C. E., J. E. Hildebrand, R. T. Binhammer, and O. Hall. 1959. The birds of Galveston Island. Texas J. Sci. 11(1):93-109.
- Hall, E. R. 1925. Pelicans versus fishes in Pyramid Lake. Condor 27:147-160.
- Harris, Lucien, Jr. 1933. A trip to the Brevard Reserve. Fla. Nat. 6(2):28-30.
- Hartman, Frank A. 1946. Adrenal and thyroid weights in birds. Auk 63(1):42-64.
- _____. 1946. Notes on the pathology of a loon and a pelican. Auk 63(4):588-589.
- Hartman, Frank A. 1951. A preliminary study of the avian adrenal. Auk 68 (2)202-209.
- _____. 1955. Heart weight in birds. Condor 57(4):221-238.
- Hedgepeth, Joel W. 1948. On the shores of Laguna Madre, Texas. Audubon Magazine 50(2):100-107.
- Henny, C. J. 1972. An analysis of the population dynamics of selected avian species with special reference to changes during the modern pesticide era. U.S. Fish and Wildlife Serv. Bur. Sport Fish Wildl., Wildl. Res. Dep. 1, 99 pp.
- Hiatt, Benjamin C. 1931. The brown pelican in Eastern Florida. Bird-Lore 33 (6):305-387.
- Hickey, J. J. 1952. Survival studies of banded birds. U.S. Dept. Interior, Fish and Wildlife Ser., Spec. Sci. Rep., Wildlife No. 15, 177 pp.
- _____ and D.W. Anderson. 1966. An exploration of pesticide residues cormorant and pelican populations. Final report to U.S. Fish and Wildlife Service, 1 March, 28 pp. mimeo.

- Hickey, J. J. and D. W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. *Science* 162:271-273.
- Howell, A.H. 1928. *Birds of Alabama*. Birmingham Printing Co., Birmingham, pp.40-41.
- _____. 1932. *Florida bird life*. Coward-McCann, Inc., New York. xxiv + 579 pp., figs. 1-72, 58 pls.
- Howell, Joseph. 1941. Early nesting at Cape Sable, FL *Auk* 58(1):105-106.
- Hudley, Margret H. and Frances Hames. 1960. Birdlife of the lower Florida Keys. *Fla. Nat.* 33(1):15-24, 56.
- Huizinga, Harry W. 1971. Contracaeciasis in pelicaniform birds. *J. Wildl. Dis.* 7(3):198-204. July 1971. (Ill. State Univ., Normal)
- Imhof, Thomas A. 1962. Central southern region. *Audubon Field Notes* 16(1):45.
- _____. 1962. *Alabama birds*. Univ. Alabama Press, Tuscaloosa xxx + 591 pp., figs. 1-103, 43pls.
- _____. 1963. Central southern region. *Audubon Field Notes* 17(4):411.
- _____. 1964. Central southern region. *Audubon Field Notes* 18(4):458.
- _____. 1965. Central southern region. *Audubon Field Notes* 19(4):483.
- _____. 1966. Central southern region. *Audubon Field Notes* 20(4):516.
- _____. 1967. Central southern region. *Audubon Field Notes* 21(4):515.
- _____. 1968. Central southern region. *Audubon Field Notes* 22(4)535.
- James, Douglas. 1960. The changing seasons. *Audubon Field Notes* 14(3):287.
- _____. and Frances Douglas. 1961. Central southern region. *Audubon Field Notes* 15(5):473.
- _____. 1964. Central southern region. *Audubon Field Notes* 18(1):46.
- _____. 1966. Central southern region. *Audubon Field Notes* 20(1):60

- James, Douglas. 1967. Central southern region. Audubon Field Notes 21(3):427. James, Frances C. 1968. Central southern region. Audubon Field Notes 22(3) 446.
- Jehl, J. R. Jr. 1969. Is thirty millions years long enough? Pacific Discovery 23(1):16-23.
- _____. 1969. The brown pelican, a vanishing American. Environment Southwest. June, p.4.
- _____. 1973. Studies of a declining population of brown pelicans in Northwestern Baja, Calif. Condor 75(1):69-70. Spring 1973.
- Keith, J. O. 1966. Insecticide contaminations in wetland habitats and their effects on fish-eating birds. J. of Appl. Ecol. 3(suppl.):71-85.
- _____. Leon A. Woods, Jr. and Eldridge G. Hunt. 1970. Reproductive failure in brown pelicans on the Pacific Coast. Trans. 35th N. Am. Wildlife Natural Resources Conf., pp. 56-63.
- Knouff, R. A. and F. A. Hartman. 1951. A microscopic study of the adrenal of the brown pelican. Ant. Record 109:161-187, 4 plates.
- Kroegal, Warden. 1910. Reservation notes. Bird-Lore 12(1):50.
- Kuerzi, Richard G. 1938. Some notes on the birds of St. Lucie County, Fla. Fla. Nat. 12(1):11-15.
- Lanham, U. N. 1947. Notes on the phylogeny of the pelecaniformes. Auk 64:65-70.
- Lasiewski, Robert, C. and William R. Dawson. 1967. A re-examination of the relation between standard metabolic rate and body weight in birds. Condor 69(1):13-23.
- Lawrence, J. M. and R. W. Schreiber. 1974. Organic material and calories in the egg of the brown pelican, Pelecanus occidentalis. Comp. Biochem. Physiol. 47A:435-440.
- Laycock, O. 1974. Hang on pelican! Audubon 76(3):2-17.
- Leatherman, Kenneth. 1945. On the pastures of the sea. Audubon Magazine 47(5):264-272.
- Lehman, William C. 1938. Report on Tampa Bay rookeries. Fla. Nat. 12(2):40.
- Lincoln, Frederick C. 1936. Returns of banded birds: Third paper. Bird-Banding 7(4):139-148.
- Longstreet, R. J. 1924. The new brown pelican rookery on the Florida east coast. Wilson Bul. 36(2):65-68.

- Longstreet, R. J. 1931. The case of the brown pelican. Fla. Woods and Waters. Spring:19-20.
- _____. 1932. Society keeps warden at pelican rookery. Fla. Nat. 6(1):22.
- _____ and E. M. Davis. 1936. Movements of the eastern brown pelican. Fla. Nat. 9:(4)68-76.
- _____. 1937. Tarpon Springs rookeries protected. Fla. Nat. 11(1):12-13.
- _____. 1941. Report of Pelican Island, 1940. Fla. Nat. 14(3):73.
- _____. 1941. East coast brown pelicans moving again. Fla. Nat. 15(1):19-20.
- _____. 1942. Note on Brevard Reserve. Fla. Nat. 15(4):58.
- _____. 1944. The movements of the Florida east coast pelican. Proc. Fla. Acad. Sci. 7(2-3):185-189.
- _____. 1945. Second pelican banding report 1936-1944, Mosquito Lagoon Rookery (Brevard Reserve). Fla. Nat. 18(2):26-35.
- _____. 1953. Ornithology of the Mosquitoes, Part 2. Fla. Nat. 26(4):175-183.
- Lowery, George H., Jr. and Robert J. Newman. 1954. The birds of the Gulf of Mexico. In: Gulf of Mexico, its origin, waters and marine life. U.S. Fish & Wildlife Serv., Fishery Bul. 89:519-540.
- _____. 1960. Louisiana birds. Louisiana State Univ. Press, Baton Rouge, Louisiana.
- Malcomson, Richard O. 1960. Mallophaga from birds of North America. Wilson Bul. 72(2):182-197.
- Mason, C. Russell. 1937. Checklist of Seminole County (FL) birds. Fla. Nat. 11(1)15-32.
- _____. 1945. Pelican travel. Bird-Banding 16(134-143).
- _____. 1967. Brown pelican lives to good old age. Fla. Nat. 40(4):152.
- Matthews, Downs. 1979. Raising pelicans for the pelican state. Ford Times. January, 1979, pp. 45-49.
- May, John, B. 1916. A Maine pelican. Bird-Lore 18(4):247.

- Mendenhall, Vivian M. and Richard M. Prouty. 1978. Recovery of breeding success in a population of brown pelicans. Preceedings of Colonial Waterbird Group. pp. 65-70.
- Meyerriecks, A. J. and Robert. 1965. Brown pelican is victim of gull piracy. Nat. Hist. Vol. 74:32-35.
- Mills, H. R. 1934. Report on Tampa Bay rookeries. Fla. Nat. 8(1):1.
- _____. 1952. Death in the Florida marshes. Audubon Magazine 54(5):285-291.
- Murphy, R. C. 1936. Oceanic birds of South America: Vol. II-II. Amer. Mus. Nat. Hist., New York.
- National Audubon Society. 1948. 48th Christmas bird count. Audubon Field Notes II(2):68.
- _____. 1949. 49th Christmas bird count. Audubon Field Notes III(3):85.
- _____. 1950. 50th Christmas bird count. Audubon Field Notes Vol. IV(2):98.
- _____. 1951. 51st Christmas bird count. Audubon Field Notes Vol. V(2):97. (Apr.)
- _____. 1952. 52nd Christmas bird count. Audubon Field Notes Vol. VI(2):95. (Apr.)
- _____. 1953. 53rd Christmas bird count. Audubon Field Notes Vol. VII(2):101. (Apr.)
- _____. 1954. 54th Christmas bird count. Audubon Field Notes Vol. 8(2)
- _____. 1955. 55th Christmas bird count. Audubon Field Notes Vol. 9(2):129.
- _____. 1956. 56th Christmas bird count. Audubon Field Notes Vol. 10 (2):124.
- _____. 1957. 57th Christmas bird count. Audubon Field Notes Vol. 11(2):127.
- _____. 1958. 58th Christmas bird count. Audubon Field Notes Vol. 12(2):131.
- _____. 1959. 59th Christmas bird count. Audubon Field Notes Vol. 13(2):142.
- _____. 1960. 60th Christmas bird count. Audubon Field Notes Vol. 14(2):154.

- National Audubon Society. 1961. 61st Christmas bird count. Audubon Field Notes Vol. 15(2):162-164.
-
- _____. 1962. 62nd Christmas bird count. Audubon Field Notes Vol. 16(2):155-157.
-
- _____. 1963. 63rd Christmas bird count. Audubon Field Notes Vol. 17(2):150-151.
-
- _____. 1964. 64th Christmas bird count. Audubon Field Notes Vol. 18(2):164-166.
-
- _____. 1965. 65th Christmas bird count. Audubon Field Notes Vol. 19(2):173-175.
-
- _____. 1966. 66th Christmas bird count. Audubon Field Notes Vol. 20(2):195-198.
-
- _____. 1967. 67th Christmas bird count. Audubon Field Notes Vol. 21(2):184-186.
-
- _____. 1968. 68th Christmas bird count. Audubon Field Notes Vol. 22(2):204-205.
-
- _____. 1969. Eastern brown pelican (Pelecanus occidentalis carolinensis) an annotated selected bibliography. Research Dept., National Audubon Society.
-
- _____. 1969. 69th Christmas bird count. Audubon Field Notes Vol. 23(2):230-231.
-
- _____. 1970. 70th Christmas bird count. Audubon Field Notes Vol. 24(2):229-231.
-
- _____. 1971. 71st Christmas bird count. Audubon Field Notes Vol. 25(2):269-271.
-
- _____. 1972. 72nd Christmas bird count. Audubon Field Notes Vol. 26(2):287-289.
-
- _____. 1973. 73rd Christmas bird count. Audubon Field Notes Vol. 27(2):287-280.
-
- _____. 1974. 74th Christmas bird count. Audubon Field Notes Vol. 28(2):298-300.
-
- _____. 1975. 75th Christmas bird count. Audubon Field Notes Vol. 29(2):324-326.
-
- _____. 1976. 76th Christmas bird count. Audubon Field Notes Vol. 30(2):335-337.

- National Audubon Society. 1977. 77th Christmas bird count. Audubon Field Notes Vol. 31(4):585-588.
- _____. 1978. 78th Christmas bird count. Audubon Field Notes Vol. 32(4):597-601.
- _____. 1979. 79th Christmas bird count. Audubon Field Notes Vol. 33(4):463-466.
- Nelson, G. 1911. Notes on Pelican Island. Auk 28:393-397.
- Nesbitt, Stephen A., Michael J. Fogarty, and Lovett E. Williams, Jr. 1977. Status of Fla. nesting brown pelicans, 1971-1976. Bird-Banding 48(2):138-144. WR 167.
- _____ and Lovett E. Williams, Jr. 1978. Brown pelican restocking efforts in Louisiana. Wilson Bull. 90(3)443-445.
- _____. Barbara A. Harris, Sheila A. Fenelon, and Dianna M. King. 1980. Reproduction of brown pelicans in captivity. Florida Game and Freshwater Fish Commission, Gainesville, Florida. p.5. (Unpublished).
- _____. Patricia E. Cowan, Neal P. Thompson, and Lovette E. Williams, Jr. 1980. Chlorinated hydrocarbon residues in brown pelicans. Florida Game and Freshwater Fish Commission, Wildlife Research Laboratory, Gainesville, FL. p.11. (Unpublished)
- Newman, Robert J. 1956. Central southern region. Audubon Field Notes 10(5):387-390.
- _____. 1958. Central southern region. Audubon Field Notes 12(5):418
- _____ and Stuart L. Warter. 1959. Central southern region. Audubon Field Notes 13(3):301.
- _____. 1959. Central southern region. Audubon Field Notes 13(4):378.
- Newman, Robert J. 1960. Central southern region. Audubon Field Notes 14(4):395
- _____. 1961. Central southern region. Audubon Field Notes 15(1):48.
- _____. 1961. Central southern region. Audubon Field Notes 15(3):335.
- Nicholson, Donald J. 1951. Brown pelican seen at Orlando. Fla. Nat. 24(2):59-60

- Oberholser, H. C. 1918. Notes on North American birds. Auk 35:62-65.
- _____. 1938. The birdlife of Louisiana. Dept. Cons., New Orleans, xii + 834 pp., Figs. 1-45.
- Ogden, John C. and Henry M. Stevenson. 1965. Florida region. Audubon Field Notes 19(5):535.
- Orians, Gordon H. 1969. Age and hunting success in the brown pelican. (Pelecanus occidentalis). Anim. Behav. 17(2):316-319. (May)
- Owre, O.T. 1962. Nematodes in birds of the order Pelicaniformes. Auk 79(1):114
- Palmer, R.S. (ed) 1962. Handbook of North American birds: Vol. I Yale Univ. Press, New Haven.
- Parnell, James F. 1965. Southern Atlantic coast region. Audubon Field Notes 19(1):25.
- _____. 1965. Southern Atlantic coast region. Audubon Field Notes 19(3):369.
- _____. 1966. Southern Atlantic coast region. Audubon Field Notes 20(1):27.
- _____. 1966. Southern Atlantic coast region. Audubon Field Notes 20(3):410.
- _____. 1967. Southern Atlantic coast region. Audubon Field Notes 21(3):404-405.
- _____. 1967. Southern Atlantic coast region. Audubon Field Notes 21(5):556.
- _____. 1968. Southern Atlantic coast region. Audubon Field Notes 22(3):429.
- _____. 1968. Southern Atlantic coast region. Audubon Field Notes 22(5):597.
- Parnell, James F. and Robert F. Soots. 1975. Proceedings of a conference on management of dredge islands in North Carolina estuaries 1974. 142 p. illus. (Sea Grant pub. No. UNC-SG-75-01)
- Pearson, T. G. 1912. Report of secretary. Bird-Lore 14(3):191.
- _____. 1915. Motion-pictures for the national association. Bird-Lore 17(5):410-412.
- _____. 1918. Death to a pelican. Bird-Lore 20(2):194-198.
- _____. 1918. Report of R. Gilbert Person, secretary. Bird-Lore 20(6):455.

- Pearson, T. G., C. S. Brimley and H. M. Brimley. 1919. North Carolina geological and economic survey. Vol. 4(4)49-51.
- _____. 1920. Exploring for new bird colonies. Bird-Lore 20(6):455.
- _____. 1920. Exploring for new bird colonies. Bird-Lore 22(4):255-262.
- _____. 1920. Exploring for new bird colonies. Bird-Lore 22(5):321-327.
- _____. 1921. Notes on the bird-life of Southwestern Texas, Auk 38 (4):513-523.
- _____. 1924. Slaughter of brown pelicans. Bird-Lore 26(3):221-222.
- _____. 1926. A new bird reservation. Bird-Lore 28(2):168.
- _____. 1927. The brown pelican on trail again. Bird-Lore 29(1):8587.
- _____. 1928. Sanctuaries and reservations. Bird-Lore 30(6):437.
- _____. 1930. Bird-sanctuaries. Bird-Lore 32(6):475-479.
- _____. 1932. Mr. Holt investigates some southern bird colonies. Bird-Lore 34(5):367.
- _____. 1937. Adventures in bird protection. O Appleton-Century Co, N. Y. pp. 236-257.
- Peters, Harold S. 1936. A list of external parasites from birds of the Eastern part of the U.S. Bird-Banding 7(1):9-27.
- Reimann, Edward J. 1940. The Southwestern Florida patrol. Fla. Nat. 13(2):29-33, 39-40. 13(4):73-79.
- Risebrough, R. W., F. C. Sibley, and M. N. Kirren. 1971. Reproductive failure of the Brown Pelican on Anacapa Island in 1969. Amer. Birds 25:8-9.
- Robbins, Chandler S. 1951. The changing seasons. Audubon Field Notes 6(3):183-185.
- Robertson, William B., Jr. and Dennis R. Paulson. 1961. Florida region. Audubon Field Notes 15(1)27.
- _____. and John C. Ogden. 1968. Florida region. Audubon Field Notes. 22(1)26.

- Robertson, William B., Jr. 1968. Florida region. Audubon Field Notes 22(4):517.
- _____ and John C. Ogden. 1969. Florida region. Audubon Field Notes 23(1):34-41.
- Safterbury, Archie D. 1949. Brown pelicans in Pamlico Sound. The Chat 13(2):32. (Mar. 1949)
- Schreiber, R. W. and R. L. DeLong. 1969. Brown pelican status in California. Audubon Field Notes 23:57-59.
- _____ and Robert W. Risebrough. 1972. Studies of the brown pelican. 1. Status of brown pelican populations in the United States. Wilson Bul. 84(2):119-135. (June 1972)
- _____ and E.A. Schreiber. 1973. Florida's brown pelican population: Christmas bird count analysis. American Birds 27:711-715.
- _____. 1974. The maintenance activities and communicatory behavior of the brown pelican. Pelecanus occidentalis. Ph.D. dissertation, Univ. South Fla. 154 p.
- _____. 1975. Bad days for the brown pelican. Natl. Geogr. 147:117-123.
- _____, Glen E. Woolfenden, and William E. Curtsinger. 1975. Prey capture by the brown pelican. Auk 92(4):649-654. (Oct. 1975)
- _____. 1976. Growth and development of nestling brown pelicans. Bird-Banding 47(1):19-39.
- _____. 1976. Movements of color marked brown pelicans. In Florida and South Carolina. Bird-Banding 47(2):101-111.
- _____. 1977. Maintenance behavior and communication in the brown pelican. Orthol. Monogr. No. 22.
- _____. 1979. Reproductive performance of the eastern brown pelican. Pelecanus occidentalis. Contributions in Science. Nat. His. Mus. Los Angles, Cal. No. 317.
- Schmidt-Nielson, Knut, and Ragnat Fange. 1958. The functions of the salt gland in the brown pelican. Auk 75:282-289.
- Selander, Robert K. 1966. Sexual dimorphism and differential niche utilization in birds. Condor 68(2):113-151.
- Shannon, Wayland E. 1933. The eastern brown pelican at Brevard Reserve. Fla. Nat. 6(3):41-44.
- Shannon, Wayland E. 1934. Notes on the bird life of Merrit's Island during the 1932 and 1933 seasons. Fla. 7(3):29-37.

- Simmons, Georganna. 1974. Brown pelican on the brink. Natl. Park Conserv. Mag. 48(12):21-23. (Dec. 1974)
- Smith, Gene. 1969. The brown pelican. Fla. Wildlife 22(11):34.
- Soots, Robert F. and James F. Darnell. 1975. Ecological succession of breeding birds in relation to plant succession. 1975. 91p. illus. (Sea Grant Pub. No. UNC-SG-75-27)
- South Carolina Wildlife. 1979. Eastern brown pelican wildlife notes, 1(5) South Carolina Wildlife & Marine Res. Dept., PO Box 167, Columbia, S.C. 29202
- Sprunt, Alexander Jr. 1925. An avian city off the S.C. coast. Auk 42(3): 311-318.
- _____. 1935. Coastal Carolina bird-trips. Bird-Lore 37(2):99-104.
- _____. 1938. Pelicans increase. Bird-Lore 40(4):276-277.
- _____ and E. B. Chamberlain. 1949. South Carolina birdlife. Univ. So. Car. Press, Columbia, xx + 583 pp. 34 pls.
- Stedman, Stephen J. 1974. Singular brown pelican feeding behavior. Fla. Field Nat. 2(2):44-45 (Fall 1974). 1407 East Sixth Court, Panama City, Fla. 32401
- Stevens, O. S. 1936. The first descriptions of North American birds. Wilson Bull. 48(3).
- Stevenson, Henry M. 1955. Florida region. Audubon Field Notes 9(5):373-375.
- _____. 1957. Florida region. Audubon Field Notes 11(3):257-263.
- _____. 1961. Florida region. Audubon Field Notes 15(3):322.
- _____. 1964. Florida region. Audubon Field Notes 18(5):503.
- _____. 1968. Florida region. Audubon Field Notes 22(3):431.
- Stewart, James, Jr. 1962. Central southern region. Audubon Field Notes. 16(5):481.
- _____. 1963. Central southern region. Audubon Field Notes. 17(5):465.
- _____. 1964. Central southern region. Audubon Field Notes. 18(5):513.

- Stewart, James, Jr. 1965. Central southern region. Audubon Field Notes. 19(5):552.
- _____. 1967. Central southern region. Audubon Field Notes. 21(5):579.
- _____. 1968. Central southern region. Audubon Field Notes. 22(5):614.
- Stillman, William M. 1912. Florida notes. Bird-Lore 14(3):164-165.
- Stokes, Ted. 1968. Birds of the Atlantic Ocean, New York: The Macmillian Co.
- Storer, John H. 1945. Aerobatics. Audubon Magazine 47(2):101-106.
- Stullken, Donald E. 1949. Death of a brown pelican. Auk 66(1):76-77.
- Thomas, L. J. 1937. On the life cycle of Contracaecum spiculigerum. J. Parasitol 23:429-431.
- Tomkins, Ivan R. 1963. Southern Atlantic coastal region. Audubon Field Notes 17(1):22.
- Thomas, L.J. 1940. Life cycles of Contracaecum spiculigerum, A newtode from the cormorant, Phalacrocorax auritus and other fish-eating birds. Congr. Int. Microbiol 3:460-462.
- U.S. Department of Interior, Fish and Wildlife Service. 1941. Quarterly narrative report for May, June, and July, 1940. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
- _____. 1943. Quarterly narrative report for May, June, and July, 1942. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
- _____. 1944. Quarterly narrative report for May, June, and July, 1943. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
- _____. 1945. Quarterly narrative report for May, June, and July, 1944. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
- _____. 1946. Quarterly narrative report for May, June, and July, 1945. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
- _____. 1947. Quarterly narrative report for Jan., Feb., Mar., and Apr., 1946. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

U. S. Department of Interior, Fish and Wildlife Service. 1948. Quarterly narrative report for Jan., Feb., Mar., and Apr., 1947. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1948. Quarterly narrative report for May, June, July, and Aug., 1947. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1949. Quarterly narrative report for May, June, July, and Aug., 1948. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1950. Quarterly narrative report for Jan., Feb., Mar., and Apr., 1949. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1951. Quarterly narrative report for May, June, July, and Aug., 1950. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1952. Quarterly narrative report for May, June, July, and Aug., 1951. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1953. Quarterly narrative report for May, June, July, and Aug., 1952. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1954. Quarterly narrative report for May, June, July, and Aug., 1953. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1956. Quarterly narrative report for May, June, July, and Aug., 1955. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1957. Quarterly narrative report for May, June, July, and Aug., 1956. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1958. Quarterly narrative report for May, June, July, and Aug., 1957. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1959. Quarterly narrative report for May, June, July, and Aug., 1958. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

1960. Quarterly narrative report for May, June, July, and Aug., 1959. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)

- U. S. Department of Interior, Fish and Wildlife Service. 1961. Quarterly narrative report for May, June, July, and Aug., 1960. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
-
1962. Quarterly narrative report for May, June, July, and Aug., 1961. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
-
1963. Quarterly narrative report for May, June, July, and Aug., 1962. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
-
1963. Quarterly narrative report for May, June, July, and Aug., 1962. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
-
1964. Quarterly narrative report for May, June, July, and Aug., 1963. Cape Romain Wildlife Refuge. McClellanville, S.C. (Unpub.)
-
1965. Annual narrative report for 1964. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1966. Annual narrative report for 1965. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1967. Annual narrativerreport for 1966. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1968. Annual narrative report for 1967. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1969. Annual narrative report for 1968. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1970. Annual narrative report for 1969. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)
-
1971. Annual narrative report for 1970. Cape Romain Wildlife Refuge, Awendaw, S.C. (Unpub.)
-
1972. Annual narrative report for 1971. Cape Romain Wildlife Refuge, Awendaw, S.C. (Unpub.)

U. S. Department of Interior, Fish and Wildlife Service. 1973. Annual narrative report for 1972. Cape Romain Wildlife Refuge, Awendaw, S.C. (Unpub.)

_____. 1974. Annual narrative report for 1973. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1975. Annual narrative report for 1974. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1976. Annual narrative report for 1975. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1977. Annual narrative report for 1976. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1978. Annual narrative report for 1977. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1979. Annual narrative report for 1978. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

_____. 1980. Annual narrative report for 1979. Cape Romain Wildlife Refuge, McClellanville, S.C. (Unpub.)

Van Tets, G. F. 1965. A comparative study of some communication patterns in the pelecaniformes. Ornithol. Monogr. No. 2. Amer. Ornithol. Union.

Wallace, George J. 1972. Report of the committee on conservation 1971-72. Auk 89:872-878.

Webster, Fred S. 1956. South Texas region. Audubon Field Notes 10(3):264-268.

_____. 1959. South Texas region. Audubon Field Notes 13(1):46.

_____. 1960. South Texas region. Audubon Field Notes 14(5):461-462.

_____. 1963. South Texas region. Audubon Field Notes 17(5):469.

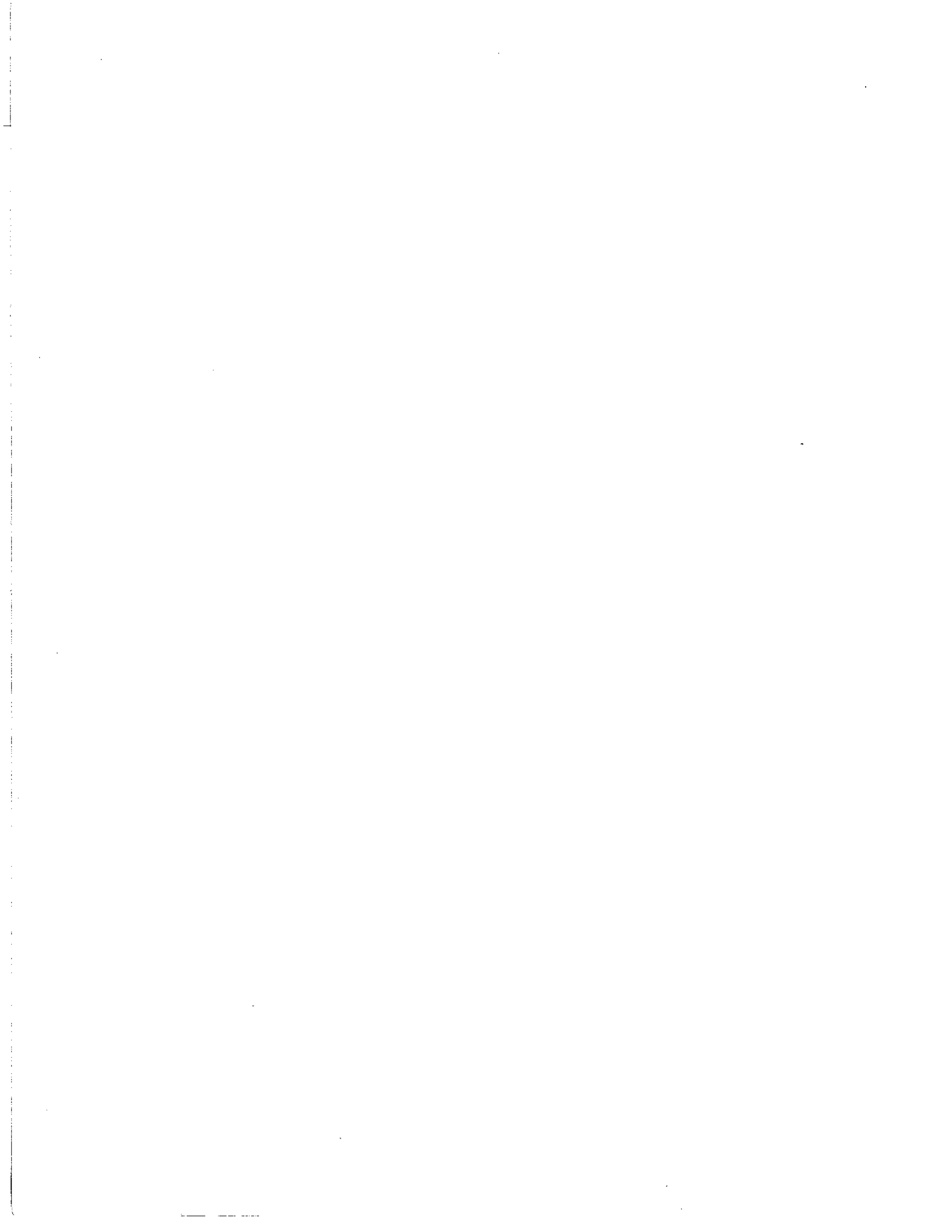
_____. 1964. South Texas region. Audubon Field Notes 18(5):520.

_____. 1965. South Texas region. Audubon Field Notes 19(1):57.

- Webster, Fred S. 1965. South Texas region. Audubon Field Notes
19(5):560.
- _____. 1966. South Texas region. Audubon Field Notes
20(5):582.
- _____. 1967. South Texas region. Audubon Field Notes
21(5):585.
- _____. 1968. South Texas region. Audubon Field Notes
22(4):553.
- _____. 1968. South Texas region. Audubon Field Notes
22(5):624.
- Westfall, M. J., Jr. 1937. Pelicans continue to thrive. Fla. Nat.
10(2):25-27.
- Weston, Francis M. 1928. Pensacola (Florida) Region. Bird-Lore
30(2):129-130.
- _____. 1929. Pensacola (Florida) Region. Bird-Lore
31(5):343-344.
- Wetmore, A. 1945. A review of the forms of the brown pelican. Auk
62:577-586.
- Williams, George G. 1938. Notes on waterbirds of the upper Texas coast.
Auk 55(1):62-70.
- _____. 1949. South Texas region. Audubon Field Notes
3(5):245.
- Williams, George G. 1950. South Texas region. Audubon Field Notes
4(5):284.
- Williams, L. 1927. Brown pelicans nesting at Point Lobos, Monterey
County, California. Condor 29:246-249.
- _____. 1931. Further notes on brown pelicans at Point Lobos,
California. Condor 33:66-69.
- Williams, Lovett E., Jr. 1962. Central southern region. Audubon Field
Notes 16(4):421.
- _____ and Lucille F. Stickel. 1967. A survey of
pesticide residues in brown pelicans and their foods. Patuxent
Wildlife Research Center, Annual Progress Report, 1967.
- _____ and Larry Martin. 1968. Nesting status of the
brown pelican in 1968. Quar. J. Fla. Acad. Sci. 31(2):130-140.
- _____ and L.L. Martin. 1969. Can we solve the brown
pelican's problem? Fla. Nat. 43:107-110.




- Williams, Lovett E., Jr. and L. L. Martin. 1970. Nesting populations of brown pelicans in Florida. Proc. 24th Ann. Conf. Se. Assoc. Game & Fish. p. 154-169.
- _____. 1972. Pelican's progress. Fla. Wildl. 26(4):4-6. illus. Sept. 1972.
- _____ and Ted Joanen. 1974. Age at first nesting in the brown pelican. Wilson Bull. 86(3):279-280. Sept. 1974.
- _____. Ed. 1978. Recovery plan, eastern brown pelican. Florida Game and Freshwater Fish Commission, 4005 S. Main St., Gainesville, FL. 32601.
- Wolff, Robert L. 1957. Brown pelicans nesting again in Pamlico Sound, N.C. The Chat 22:25.
- Woodhead, E. S. 1938. 1937 Brevard rookery report. Fla. Nat. 11(3):61.
- Zink, Robert M. 1977. Winter observations of brown pelicans in Veracruz, Mexico. Auk 94(3):588. July, 1977, WR 167. Univ. Minn., Minneapolis 554551.



Submitted by:

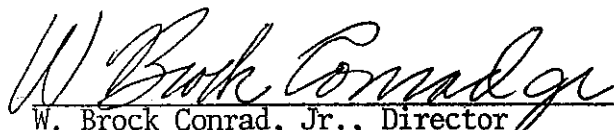

Philip M. Wilkinson, Project Leader

Reviewed by:


Thomas S. Kohlsaat, Supervisor
Nongame and Heritage Trust Section

Approved by:

SOUTH CAROLINA WILDLIFE AND MARINE RESOURCES DEPARTMENT


W. Brock Conrad, Jr., Director
Division of Wildlife and Freshwater Fisheries

