SOUTH FLORIDA RESEARCH CENTER

Report T-670
Wintering Waterfowl in Everglades National Park

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

Florida contains large tracts of wetland habitat covering, by one ten-year old estimate, nearly 7 million hectares (Shaw and Fredine 1971). These wetlands provide wintering habitat for many types of water birds, including waterfowl. From 17 to 26% of the ducks censused in the Atlantic flyway have been reported to winter in Florida (Chamberlain 1960), but waterfowl populations wintering in Florida are believed to have undergone decreases and developed altered migration schedules because of loss of habitat within the state and concurrent improvement of habitat conditions further north (Crider 1968, Rodgers 1974, Goodwin 1979). The estuaries of Everglades National Park, at the southern tip of Florida, traditionally supported wintering waterfowl, which because of legislative policy have not been hunted since the establishment of the park in 1947. Rodgers (1974) suggested that about 15,000-25,000 ducks winter there annually, with the number using the area varying from year-to-year, primarily in response to weather and other conditions in the flyway further north. Little is known about waterfowl in the Everglades estuary. The only previous published study was Klukas and Locke's (1970) report of fowl cholera among coots (Fulica americana) in 1967-68. There has been no systematic assessment of waterfowl use of Everglades estuaries. In this paper, we analyze the status and the seasonal and geographic distribution of waterfowl wintering in the southern and southwestern coastal areas of Florida, based on available historical data and on the results of censuses conducted over three years.

METHODS

We analyzed four sets of data in this paper. The Coot Bay Christmas Count, held annually near New Years Day, provided a 31-year record (1951-1981) of a single day census of waterfowl over an area of 458 km^2 near Flamingo (Fig. 1). Because these data are from a small area, they were affected by the vagaries of waterfowl distribution and movement along the southern Florida coast, as ducks may shift short distances into or out of the count area in response to changing water and weather conditions. However, these data, resulting from a considerable effort, probably represent a fairly accurate census of waterfowl present in the count area on that day. They are especially useful in locating relatively rare species. On the count, waterfowl were censused by both ground parties and by fixed-wing aircraft. For the present application, we do not, as is usual, express the count data on a per party hour basis, because information on all but the very rare species was derived from complete aerial surveys that were conducted in the same way each year.

The second source of data was the mid-winter waterfowl survey sponsored by the U.S. Fish and Wildlife Service (Larned et al. 1980). This national survey attempts complete counts in major waterfowl habitats, rather than using a statistical sampling procedure and provides more information on distribution than absolute abundance (Fish and Wildlife Service 1981). In southern Florida, the survey was conducted by state or Federal personnel using fixed-wing aircraft. Specific routes

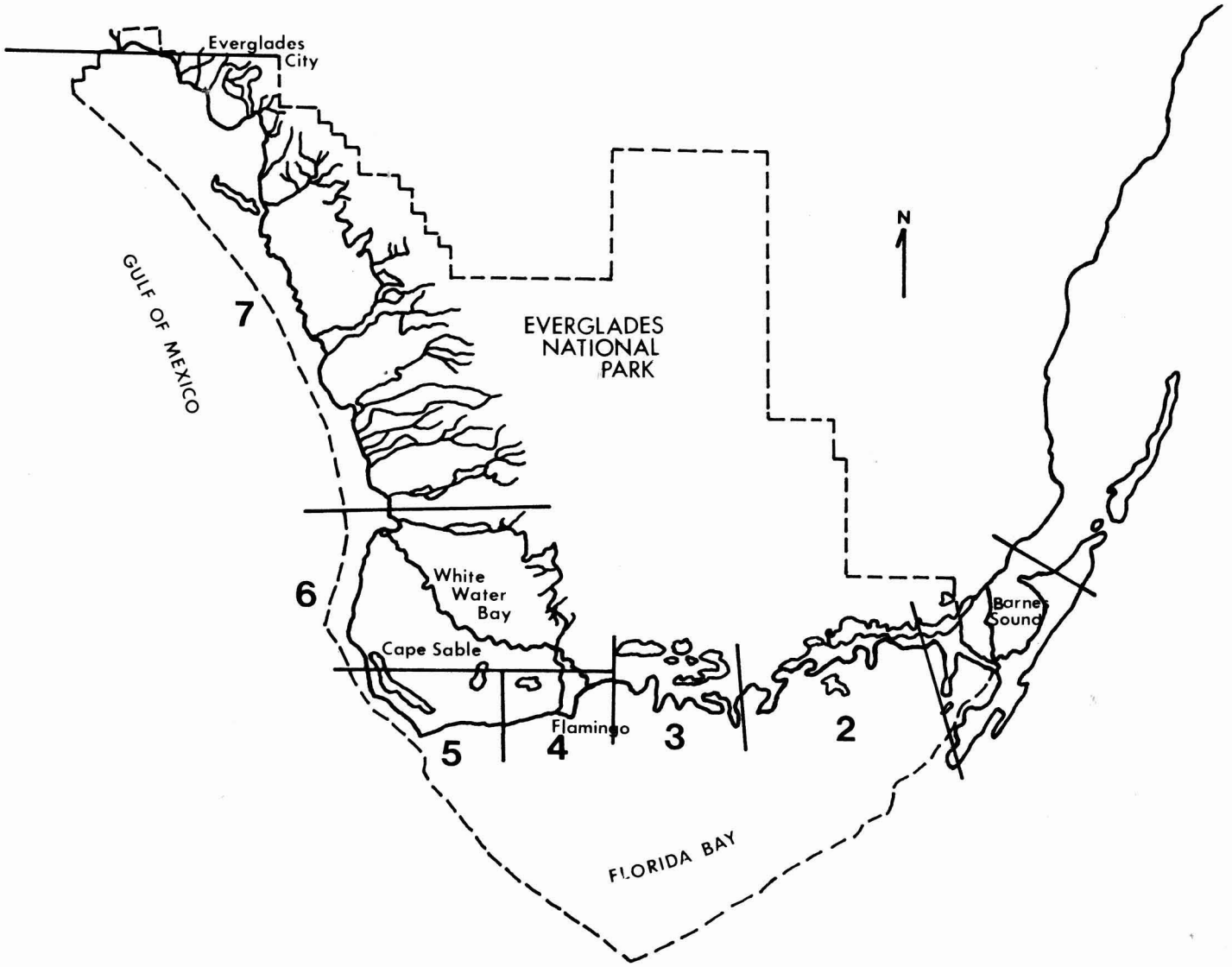

Figure 1. Map of southern Florida showing Everglades National Park and seven waterfowl census regions.

covered, altitude, observer skill, aircraft type, and areas covered varied in different years. Midwinter survey data were available to us from 1970 to 1981. The Christmas count provided a check on this aerial survey data.

A third source of data was banding records from the U.S. Fish and Wildlife Service bird-banding laboratory. From these data we obtained information on the origin of waterfowl reported from south Florida, at or south of latitude 27.0 N. Data were available from 1920 to 1981. For this analysis we divided North America into four sections. The northeast included Maine, Massachusetts, Vermont, Nova Scotia, Ontario, New York, New Jersey, New Brunswick, Prince Edward Island, Delaware and Maryland. The midwest included Michigan, Minnesota, Wisconsin, Manitoba, Ohio, North Dakota, Iowa, South Dakota, Saskatchewan, Missouri, Kansas, and Nebraska. The southeast included North Carolina and Florida. The west included California, Utah, Montana, Washington, Alberta, Colorado, Nevada, Oregon, Alaska and the Northwest Territory.

The most useful data were derived from our extensive aerial censuses flown in the winters of 1977-78, 1978-79, and 1979-80. In each month from November 1977 through March 1978, we censused coastal areas of southern and southwestern Florida from fixed-wing aircraft. The census covered Barnes Sound along the coast and inland lakes north of Florida Bay, Cape Sable, Whitewater Bay, and inland bays of the west coast north to Everglades City (Fig. 1). All shorelines, shallow lakes, bays, pools and coves were searched from an altitude of 50 to 100 m and all visible waterfowl were identified and counted. To analyze seasonal movements, we divided the census area into 7 regions, as shown in Fig. 1. The censuses in 1977-1978 provided information on seasonality of occurrence and spatial distribution. The entire area was resurveyed in January 1979 and January 1980 to provide a year-to-year comparison. The data represent an attempt to achieve a complete census, biased to an unknown degree by errors in counting, locating birds, identifying uncommon species and in the percentage of birds present that we missed. Lacking information on the extent of such bias, our best estimates of the wintering waterfowl population were the actual number of birds we counted, which represents a conservative population figure.

RESULTS AND DISCUSSION

Faunal composition

Over the 31 years of the Coot Bay Christmas Count, the American Coot and 22 species of ducks (scientific names in Table 1) have been identified as occurring in the Everglades estuaries (Table 1). This represents nearly half of the species of ducks, geese, and swans in the United States.

Coots are historically the most abundant waterbirds in the Everglades estuaries (Rodgers 1974), and only a few species of ducks winter in large numbers in the area. For example, in the aerial surveys of January 1978, over 99% of the wintering duck population consisted of 6 species: Blue-winged Teal (41.4%), Lesser Scaup

Table 1. Waterfowl observed on the Coot Bay Christmas Count, 1951-1981. Summarized from Bolte and Bass (1981), Bass (1981), and Bass (in press).

Species	Minimum Number	Year	Maximum Number	Year	Percentage of Counts Observed
Brant (Branta bernicla)	0	-	2	1971	10
Snow Goose (Chen caerulescens)	0	-	1	1969	6
Fulvous Whistling Duck (Dendrocygna bicolor)	0	-	46	1977	35
Mallard (Anas platyrhynchos)	0	-	45	1958	61
Black Duck (Anas rubripes)	0	-	11	1977	3
Mottled Duck (Anas fulvigula)	2	1980	273	1960	100
Gadwall (Anas strepera)	0	-	52	1973	71
Pintail (Anas acuta)	7	1980	13,839	1977	100
Green-winged Teal (Anas crecca)	0	1957	7,400	1967	97
Blue-winged Teal (Anas discors)	50	1951	6,700	1967	97
American Wigeon (Anas americana)	0	1955	1,900	1967	97
Northern Shoveler (Anas clypeata)	15	1955	1,609	1977	100
Wood Duck (Aix sponsa)	0	-	4	1968	26
Redhead (Aythya americana)	0	-	15	1961	58
Ring-necked Duck (Aythya collaris)	0	-	5,626	1977	94
Canvasback (Aythya valisineria)	0	-	1,433	1974	68
Lesser Scaup (Aythya affinis)	20	1979	45,683	1952	97
Bufflehead (Bucephala albeola)	0	-	25	1972	26
Oldsquaw (Clangula hyemalis)	0	-	4	1977	3
Ruddy Duck (Oxyura jamaicensis)	0	1972	2,504	1952	94
Hooded Merganser (Lophodytes cucullatus)	0	-	50	1967	42
Red-breasted Merganser (Mergus serrator)	22	1975	1,683	1960	97

(23.6%), Pintail (18.5%), American Wigeon (9.2%), Ring-necked Duck (4.6%), and Northern Shoveler (2.5%). These species were also consistently present from one year to the next, being found on over 90% of the Christmas Counts (Table 1). Mottled Ducks, Green-winged Teal, Ruddy Ducks, and Red-breasted Mergansers also occurred on over 90% of the counts. Geese are rare in the Everglades estuaries; Brant and Snow Geese were observed in only three years and two years, respectively. Black Ducks and Old Squaws were seen only once. Mallards were not present regularly, although Mottled Ducks were, the latter being more common in the freshwater Everglades. Fulvous Whistling Ducks were first observed on the count in 1960 but have been seen regularly since 1977.

Origin of the wintering population

Data, spanning over 60 years exists for 419 individuals representing 15 species banded on or near their breeding grounds and recovered in south Florida (Table 2). Waterfowl recovered were originally banded in all parts of North America, except the southwest, including 35 states and provinces. Most of these species nest primarily in the northeast or midwest. Based on these banding returns, it was estimated that 66% of the wintering populations of these species were from the midwest, 22% from the northeast, 8% from the southeast, and 4% from the west. Such totals, of course, must vary from year-to-year but it would appear, over the long-term, that most ducks wintering in south Florida are from the midwest.

Waterfowl population levels

Table 3 lists the numbers of ducks and coots recorded on midwinter aerial surveys conducted in January from 1968 through 1980. The earliest complete survey of wintering waterfowl for which we have a record was conducted in the late 1960's by personnel of the Florida Game and Fresh Water Fish Commission. They censused the southwestern coast monthly from October 1967 to March 1968. In December, they found a peak population of over 7,000 ducks, 97% of which were in the Cape Sable area (Rodgers 1974). A complete survey of the southern and western coast was also flown in 1968 by personnel of the U.S. Fish and Wildlife Service (Rodgers 1974). They counted about 14,000 ducks and 14,500 coots in January (Table 3).

From 1970 through 1977, not all areas were covered by the midwinter survey each year. Cape Sable was covered most consistently, probably because the survey of 1967-68 showed it to be the area used most heavily by waterfowl (Table 3). Low numbers in these once per year midwinter surveys in the early 1970's may have been the result of selective coverage, which missed temporary regional accumulations of birds. This interpretation is supported by comparing midwinter survey data with those from the Coot Bay Christmas Count (Table 3). Even though both midwinter surveys and Christmas counts were conducted in the same month using

Table 2. Origin of banded waterfowl recovered in south Florida.

	northeast	southeast	midwest	west
Pintail	2	0	11	2
Green-winged Teal	18	0	0	0
Blue-winged Teal	32	0	184	1
American Wigeon	0	0	8	1
Northern Shoveler	0	0	2	0
Ring-necked Duck	30	0	56	3
Lesser Scaup	1	0	4	10
Hooded Merganser	6	0	0	0
Mallard	0	0	3	0
Black Duck	0	0	1	0
Mottled Duck	0	30	0	0
Gadwall	2	0	0	0
Wood Duck	3	2	3	0
Redhead	0	0	2	0
Canvasback	0	0	1	0
Unid. Teal	0	0	0	1
Section Total	94	32	275	18

similar aerial techniques and the count area was a subset of the survey area, in all but one year more ducks were found during the count than during the survey. In five of the seven years, more coots were found on the Christmas count than on the midwinter survey. It must be concluded that the data from the midwinter aerial surveys from 1970 through 1976 are of little use in evaluating wintering duck populations in the Everglades estuaries during this period.

Data from the Christmas count provide information on annual variability in the number of ducks in the count area (Table 3). From 1968 to 1981 duck counts varied over two orders of magnitude from about 400 to 40,000 birds. Coot numbers varied even more, from 30 to 20,000 birds. Differences between years probably reflect variability in habitat and weather conditions. The coastal marshes are usually dry in late winter, and the extent and timing of drying depend on local rainfall, which varies between years. Other local factors such as salinity patterns or food availability may also affect waterfowl numbers. The frequency of cold weather further north also probably influences waterfowl numbers in south Florida; after prolonged cold weather in the north the number of ducks found throughout the survey area seems to increase.

The best information on status of waterfowl in the Everglades estuary is from aerial censuses conducted during the three years of the present study, 1978-80 (Table 3). From these data, it would appear that the number of waterfowl wintering along the southern and southwestern Florida coast varies from 40,000 to 70,000, consisting of about equal numbers of ducks and coots (Table 3). Over the three years a minimum of about 25,500 $\pm$ 6,700 ($\bar{x} \pm$ SD) ducks and 27,800 $\pm$ 6,100 coots wintered along the southern and southwestern Florida coast. If the intensive surveys of 1968 provide a representative estimate of the waterfowl population in the late 1960's, comparison with the data available from the late 1970's suggests no decrease and possibly an increase in the numbers of waterfowl wintering in the Everglades estuary over the past decade. Montalbano's (pers. comm.) analysis of harvest data also suggests a slight, but not statistically significant, increase in waterfowl numbers statewide during this period.

Seasonality

Wintering waterfowl began to arrive in southern Florida in the fall and departed during the spring. By November 1977, over 7,000 ducks and 7,000 coots were present in the census area (Table 4). They increased to a peak of about 70,000 in January 1978. Numbers of ducks surveyed decreased by February, but coots did not decrease until March.

Numbers of ducks reached their maximum at different times in different areas (Fig. 1). The upper west coast (Region 7) supported the highest numbers before January while the northern Cape Sable area (Region 6) supported highest numbers after January. A similar seasonal shift in distribution has been noted along the west coast in other waterbirds such as Wood Storks (Mycteria americana) (Ogden et al. 1978) and herons (Kushlan and Frohring in prep.).

Table 3. Numbers of ducks and coots censused in the Everglades estuaries during midwinter aerial surveys in January from 1968 through 1981 and comparable numbers from the Coot Bay Christmas Count.

		Midwinter Aerial Survey		Coot Bay Count	
Year	Area[1]	Ducks	American Coot	Ducks	American Coot
1968	CS, SC, WC	13,900	14,500	17,134	3,600
1969	N	N	N	21,566	9,900
1970	CS	1,000	-[2]	10,268	1,160
1971	CS	1,000	100	12,489	20,000
1972	CS	4,300	1,2000	4,040	2,030
1973	CS	1,000	-	4,521	7,208
1974	CS, SC	1,000	15,200	11,699	3,886
1975	CS	3,700	-	3,968	3,456
1976	CS, WC	9,800	12,000	38,617	930
1977	CS, SC	36,700	18,900	4,490	33
1978	CS, SC, WC	34,200	35,500	13,995	5,099
1979	CS, SC, WC	20,100	20,600	7,614	14,364
1980	CS, SC, WC	22,300	27,200	356	80
1981	CS, SC, WC	7,900	11,400	2,960	2,119

[1]Areas covered were CS = Cape Sable, SC = southern coast, WC = west coast (Fig. 1 for locations). N = indicates no survey data available.

[2]Dash indicates no birds recorded.

Table 4. Monthly aerial censuses of ducks and coots in the Everglades estuaries, November 1977 to March 1978.

	American Coot	All Species of Ducks	Blue-winged Teal	Lesser Scaup	Pintail	American Widgeon	Ring-necked Duck	Northern Shoveler
November	7,230	7,210	4,730	1,180	450	430	300	10
December	22,560	16,090	1,930	6,820	1,190	4,010	2,000	130
January	35,500	34,200	14,170	6,870	6,340	3,160	1,560	840
February	36,100	12,530	620	6,820	2,680	1,800	180	300
March	10,850	4,840	2,360	1,960	50	310	0	6

The Blue-winged Teal, the most abundant duck in the survey, winters in areas south of the United States in greater numbers than any other North American duck, many passing through southern Florida enroute (Bellrose 1976). They were the first migrant ducks to arrive in southern Florida, as was reflected by the relatively high number found in November (Table 3). Montalbano (1980) found that further north in the state teal arrive earlier, peaking in September. The second increase of teal in March (Table 3) may reflect their return migration (Bellrose 1976).

The Lesser Scaup was the most abundant diving duck in the Everglades estuaries and, along with the Ring-necked, is the most abundant duck wintering in Florida (Chamberlain 1960, Goodwin pers. comm.). Scaup numbers remained fairly constant through the winter, from November to March (Rodgers 1974).

The Pintail winters in numbers south of Florida (Bellrose 1976). Over 8,000 have been reported from the Cape Sable area in the past (Rodgers 1978). Chamberlain (1960) stated that Pintail are "quite punctual" in their departure from southern Florida during mid-February. The drop in numbers in this survey from February to March supports that statement.

The American Wigeon begins arriving in southern Florida in numbers in November and maintains a fairly high and stable population from December through February (Chamberlain 1960, Bellrose 1976). The numbers in the Everglades estuaries were stable in December and January.

The Ring-necked Duck has been referred to as the diving duck of freshwater habitats in Florida (Chamberlain 1960). Two important wintering areas are Lake Okeechobee (Bellrose 1976) and Loxahatchee National Wildlife Refuge. In Loxahatchee, J. E. Takekowa (pers. comm.) has found that Ring-necked Ducks make up 75 to over 90% of the wintering waterfowl population. A similar situation prevails in other water conservation areas of the northern Everglades. Depending on water levels, Ring-necked Ducks may shift wintering sites among northern Everglades and Lake Okeechobee habitats in different years (Takekawa pers. comm.). They also have been reported to be common in the interior Everglades marsh of Everglades National Park (Rodgers 1974). However, we have not observed this to be the case in our studies there since 1975. Their occurrence in impounded estuarine areas such as Merritt Island National Wildlife Refuge depends on salinity conditions each year (J. L. Baker pers. comm.) The Ring-necked Duck arrives in Florida in November, maintains stable populations into February and declines sharply in late February and early March (Chamberlain 1960). Numbers of Ring-neck Ducks wintering in the Everglades estuaries reflected this larger pattern.

The Northern Shoveler normally winters west of Florida (Bellrose 1976) and are the least abundant of the common dabbling ducks in Florida (Chamberlain 1960). Numbers in the current survey peaked in January.

Regional distribution

Waterfowl distribution varied within the census area. The regional pattern of distribution is shown in Figure 2. Waterfowl numbers were consistently low along Barnes Sound and northeastern Florida Bay (Regions 1 and 2). Blue-winged Teal were the most common duck, but in northeast Florida Bay their numbers varied from 200 to 1,100 birds in different years.

The inland lakes and shallow bights north of central Florida Bay (Region 3) consistently attracted more waterfowl than other areas. In January 1978, those habitats supported nearly 45,000 birds, including 31,000 coots. Lesser Scaup were consistently the most abundant duck in this area, followed in numbers by Blue-winged Teal. In some years, it was an important habitat for American Wigeon.

The lakes and mudflats of Cape Sable (Regions 4 and 5) also had relatively high numbers of waterfowl, particularly near Flamingo (Region 4), with numbers fluctuating from year-to-year. For example, the number of ducks censused there varied from 11,000 in 1978 to 40 in 1979, and coots varied from 3,000 in 1978 to none in 1979. The potholes, streams, rivers, and mangrove swamps of northern Cape Sable and Whitewater Bay (Region 6) usually supported few waterfowl. Lesser Scaup was the primary species using this area.

Waterfowl use of the west coast (Region 7) was variable and peaked before the January census. Depending on the year, either Blue-winged Teal or Lesser Scaup was the most abundant duck there. This region was the most difficult to census adequately, and counts underestimated the total number of waterfowl present.

Role of Everglades estuaries

Although in some recent years at least 70,000 ducks and coots wintered in the estuaries of the Everglades, it is difficult to determine accurately how these numbers relate to the total waterfowl population of the state. Two methods usually used to compare waterfowl abundance are analysis of harvest data and analysis of survey data. Use of harvest data is probably one of the best methods of estimating populations and generating comparable indices. Rodgers (1974), for example, analyzed harvest data and found that the Everglades region, north of the park, accounted for one-fourth of the waterfowl taken by hunters in the state. Although this method has also been used on a statewide basis (Rodgers 1974, Montalbano 1980), it is inapplicable to an area protected from hunting, such as the Everglades estuaries. Comparing populations using survey data as indices of abundance must be done cautiously because it has not yet been practical to survey all waterfowl habitat in Florida. Rodgers (1974), analyzing midwinter survey data, estimated that statewide waterfowl populations were 680,000 in 1969 and 220,000 in 1970, for a 2-year mean of 450,000 birds. Survey of the Everglades estuaries in 1968 accounted for only 6% of the number found in 1969-1970. Goodwin (1979) used available survey data for 1976-1977 to tally duck use on 15 wildlife refuges, parks, and management areas throughout the state. Substituting our better data from Everglades National Park available in the present study (36,700, Table 2), the

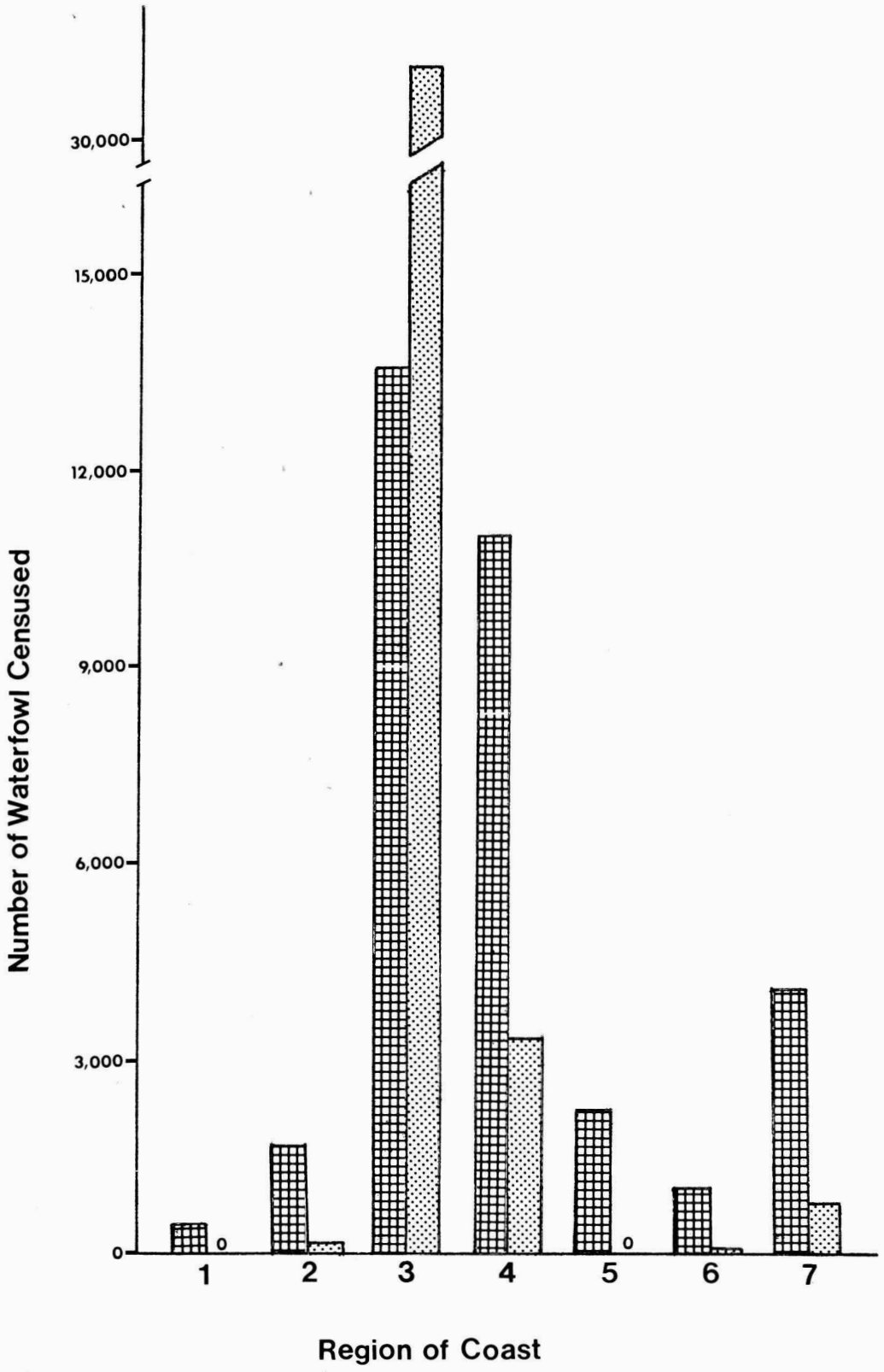

Figure 2. Number of ducks (cross-hatched) and coots (stippled) censused in January 1978 in seven regions along the southern Florida coast. See Figure 1 for locations of census areas.

total duck population on these refuges was 323,700. According to these data, the Everglades estuaries supported about 11% of the ducks on the 15 Florida refuges analyzed by Goodwin (1979). These refuges, of course, comprise only a portion of Florida's waterfowl habitat.

Such estimates suggest that the Everglades estuaries do not represent the dominant wintering area for waterfowl within the state. Fewer ducks occur in the Everglades than on areas such as St. Marks and Merritt Island National Wildlife Refuges (Goodwin 1979). In Everglades National Park, management is aimed at protection and preservation of natural ecosystems, and waterfowl wintering in the Everglades are supported without species-oriented manipulation. The ability of the Everglades estuary to provide stable habitat for wintering waterfowl is not known in any quantitative sense. Variations in water levels and salinity probably have marked effects on habitat quality. Locally, the role of hydrological and salinity regimes in maintaining waterfowl habitat merits particular attention. Although these estuaries may not have a significant effect on the continental waterfowl populations, it is probable that 70,000 ducks and coots have a substantial impact on the Everglades estuary itself. To the extent that the numbers and seasonal distribution of waterfowl in the Everglades are affected by habitat management and species oriented hunting regulations along the flyways further north, such activities could influence the ecological impact of waterfowl in the Everglades estuaries.

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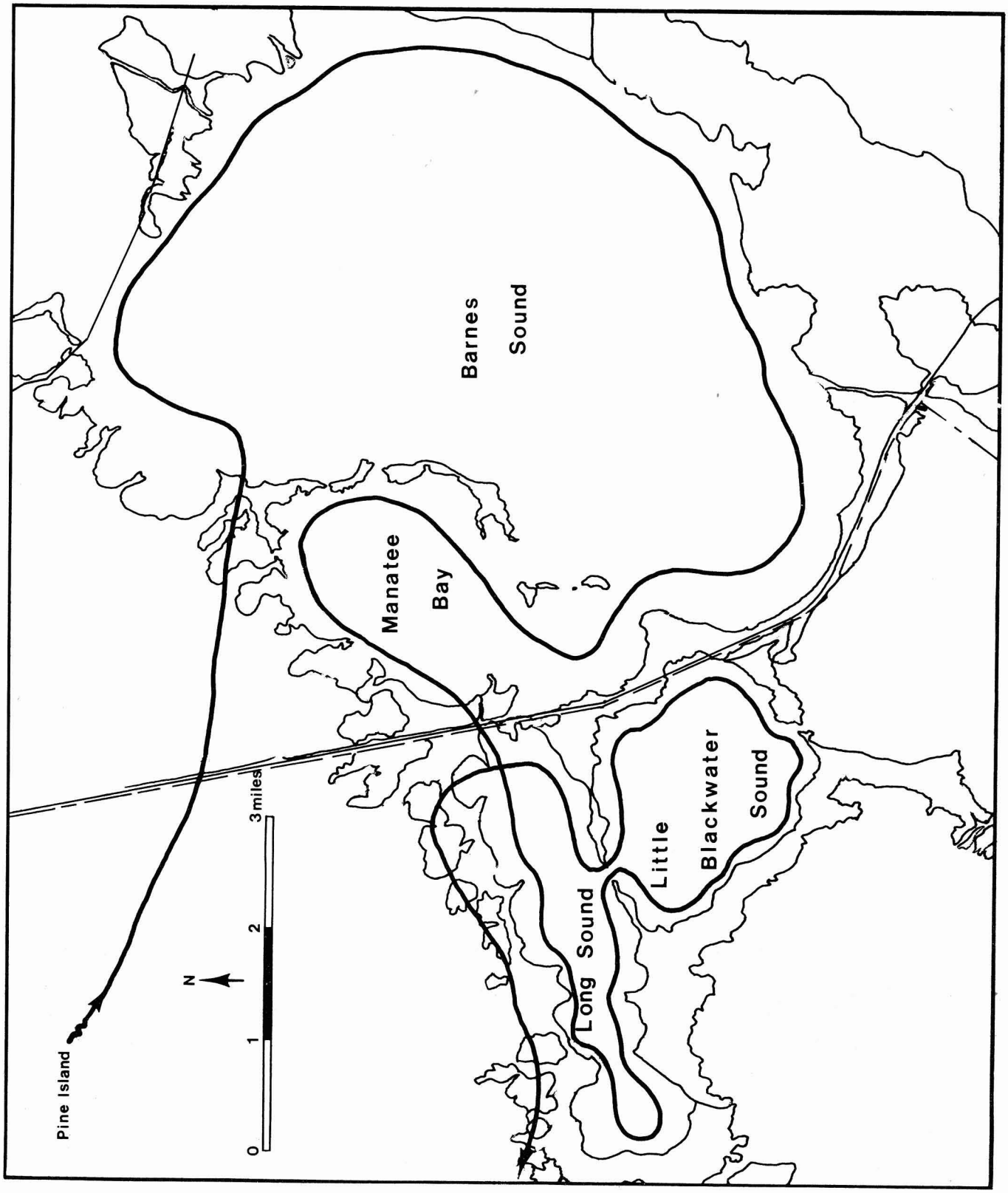
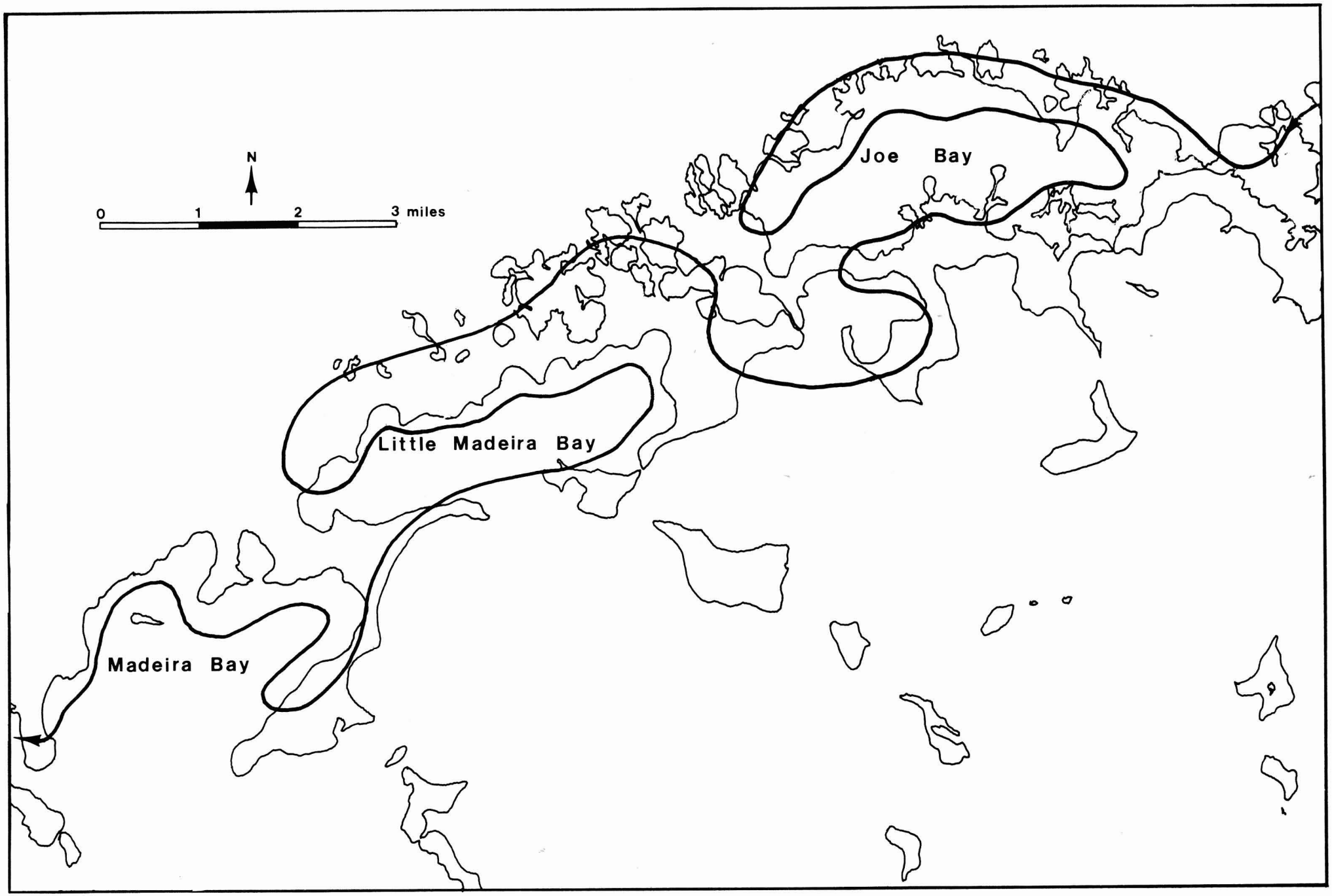
Appendix 1. Historic data from midwinter waterfowl surveys in Everglades National Park.

	Fulvous Tree Duck	Mallard	Mottled Duck	Pintail	Gadwall	Green-winged Teal	Blue-Winged Teal	American Widgeon	Shoveler	Ring-necked Duck	Lesser Scaup	Canvasback	Redhead	Bufflehead	Hooded Merganser	Redbreasted Merganser	Ruddy Duck	American Coot
1970																		
507	>1000 ducks																	
801	no data																	
1971																		
507			tr	tr			100				tr					tr		100
801	no data																	
1972																		
507				300		tr	100	100	tr	2700	1000					100		1200
801	trace for all waterfowl																	
1973																		
507			tr	200		tr	400	tr		300						tr		
801	no data																	
1974																		
507			tr	1200			600	1700	200		800	100	100			tr	100	10200
801																		5000
1975																		
507				3200				300	100	tr	100					tr		
801	no data																	
1976																		
506&																		
507			16	2380			1454	567	57	38	4275	112	2			858		11961
801	no data																	
1977																		
507	20	10	150	10800	10	250	11800	1800	2900	200	5300	60	10	10		125	300	18400
801			100	100			2100	50								650		450
1978																		
507			4	1118			1705	632	30	10	3890				6	3		865
801				5224			12468	2528	808	1551	4175				42	5		34637

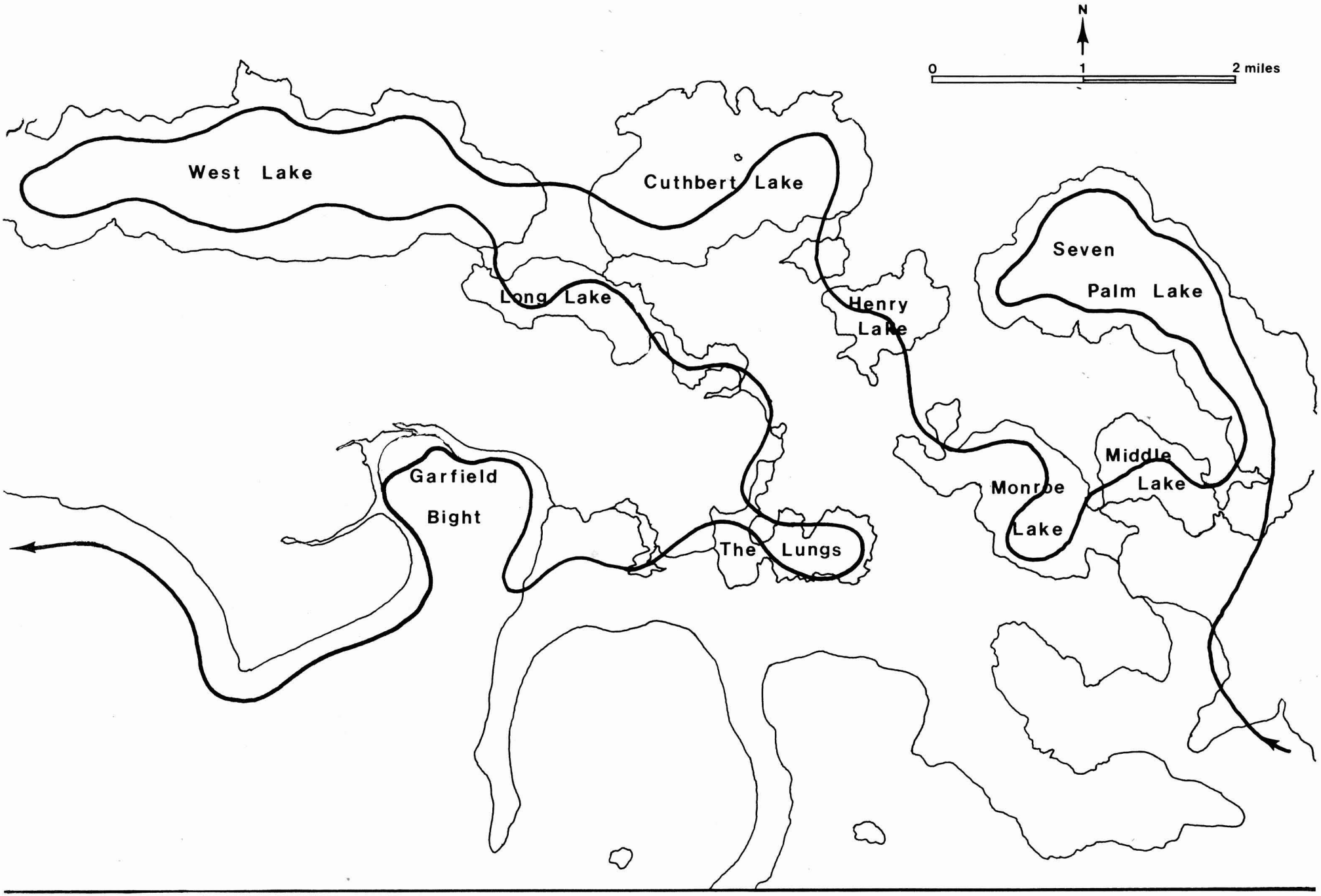
Appendix 2. Survey routes used for aerial surveys, 1977-1980.


Barnes Sound
Manatee Bay
Long Sound
Little Blackwater Sound
Pine Island
N
0
1
2
3 miles

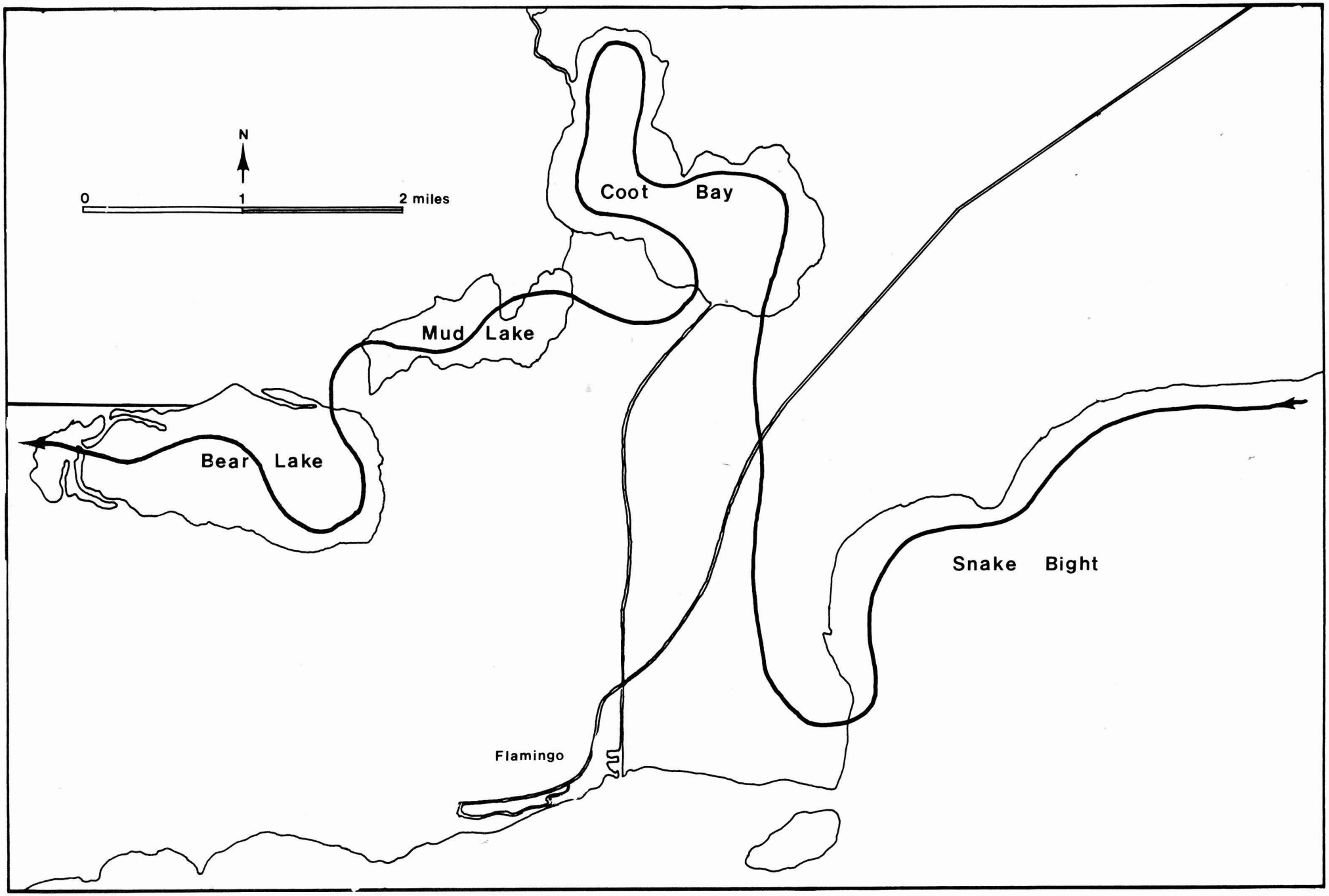
REGION 1



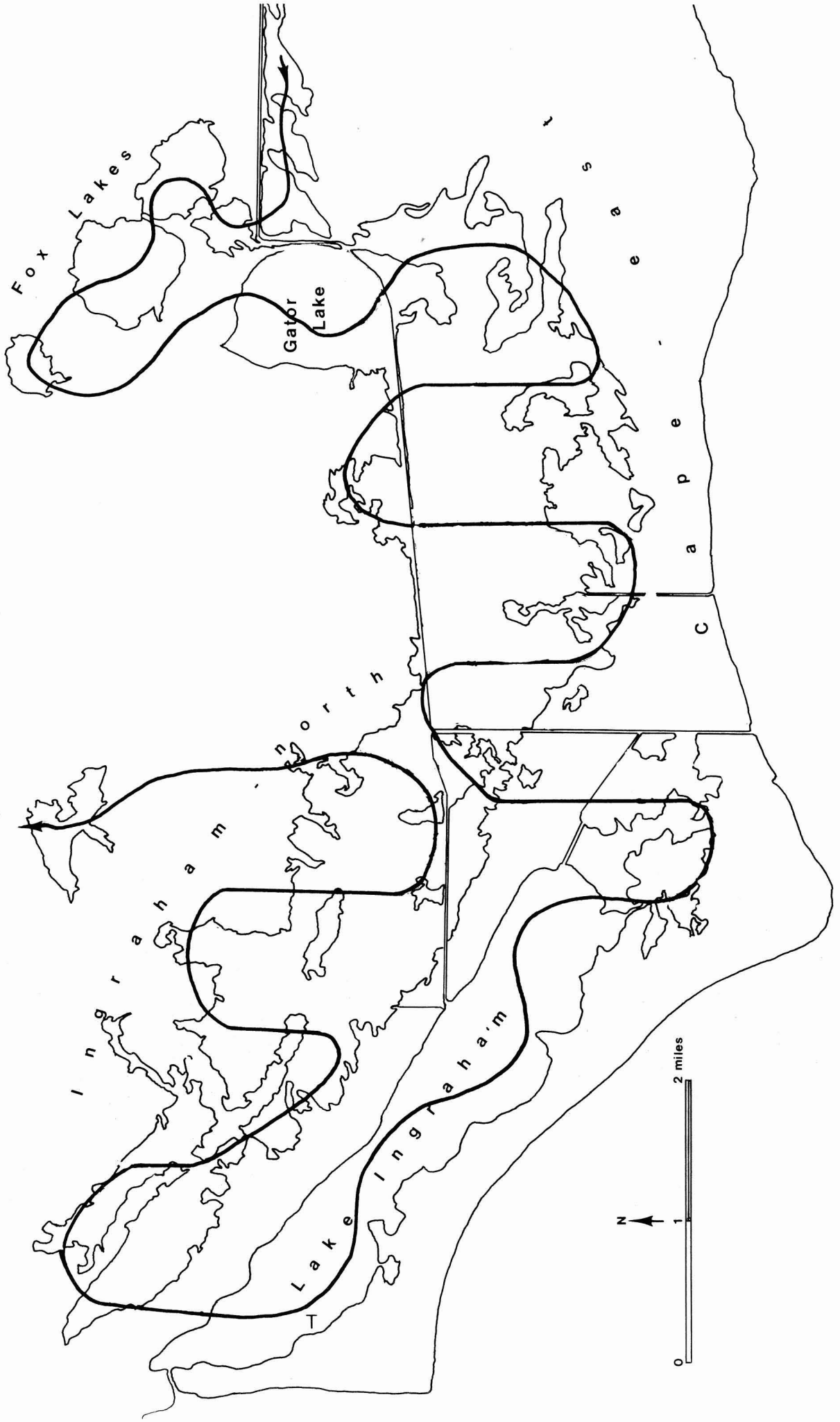
REGION 2

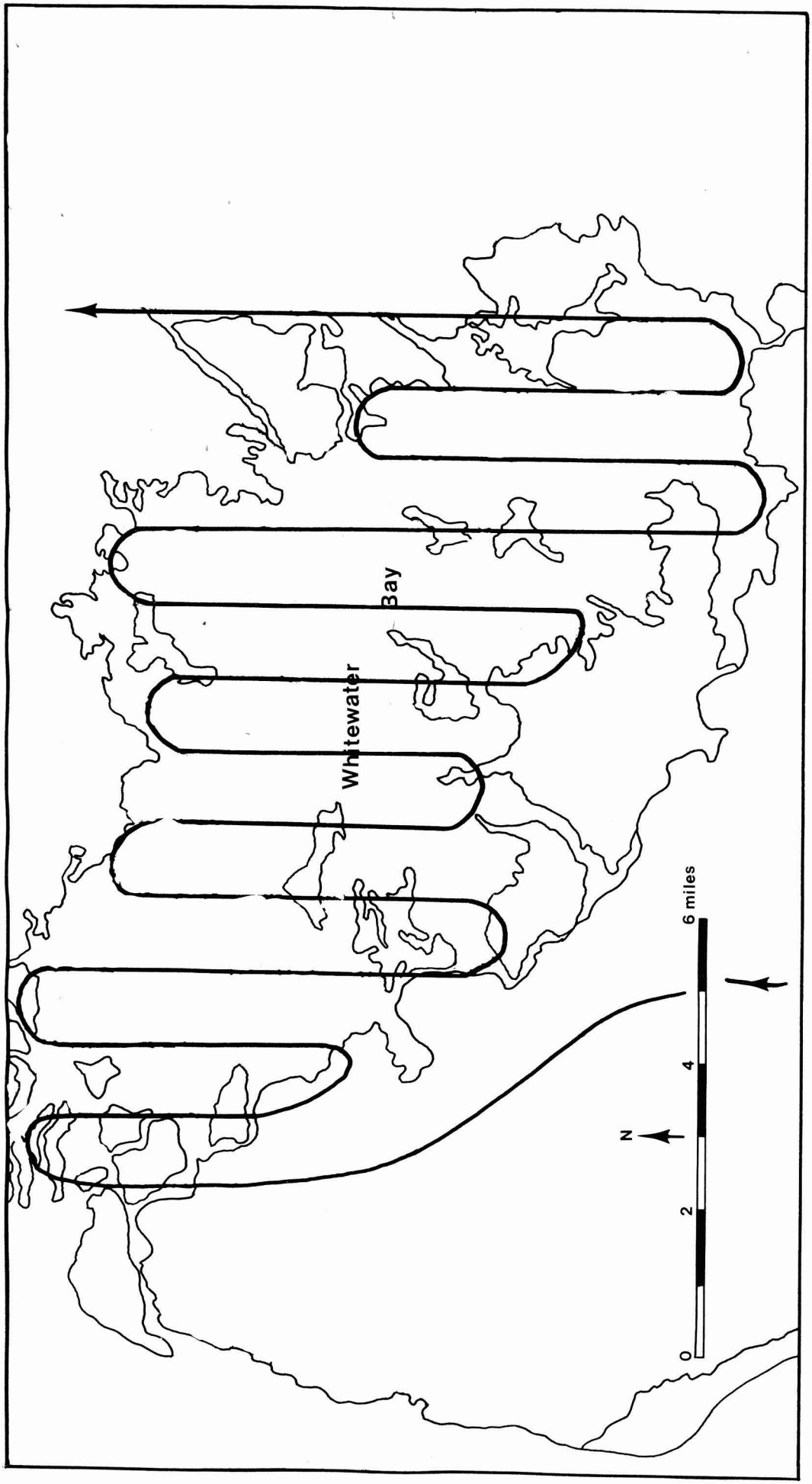

N
0
1
2 miles
West Lake
Cuthbert Lake
Long Lake
Henry Lake
Seven Palm Lake
Middle Lake
Monroe Lake
Garfield Bight
The Lungs

REGION 3

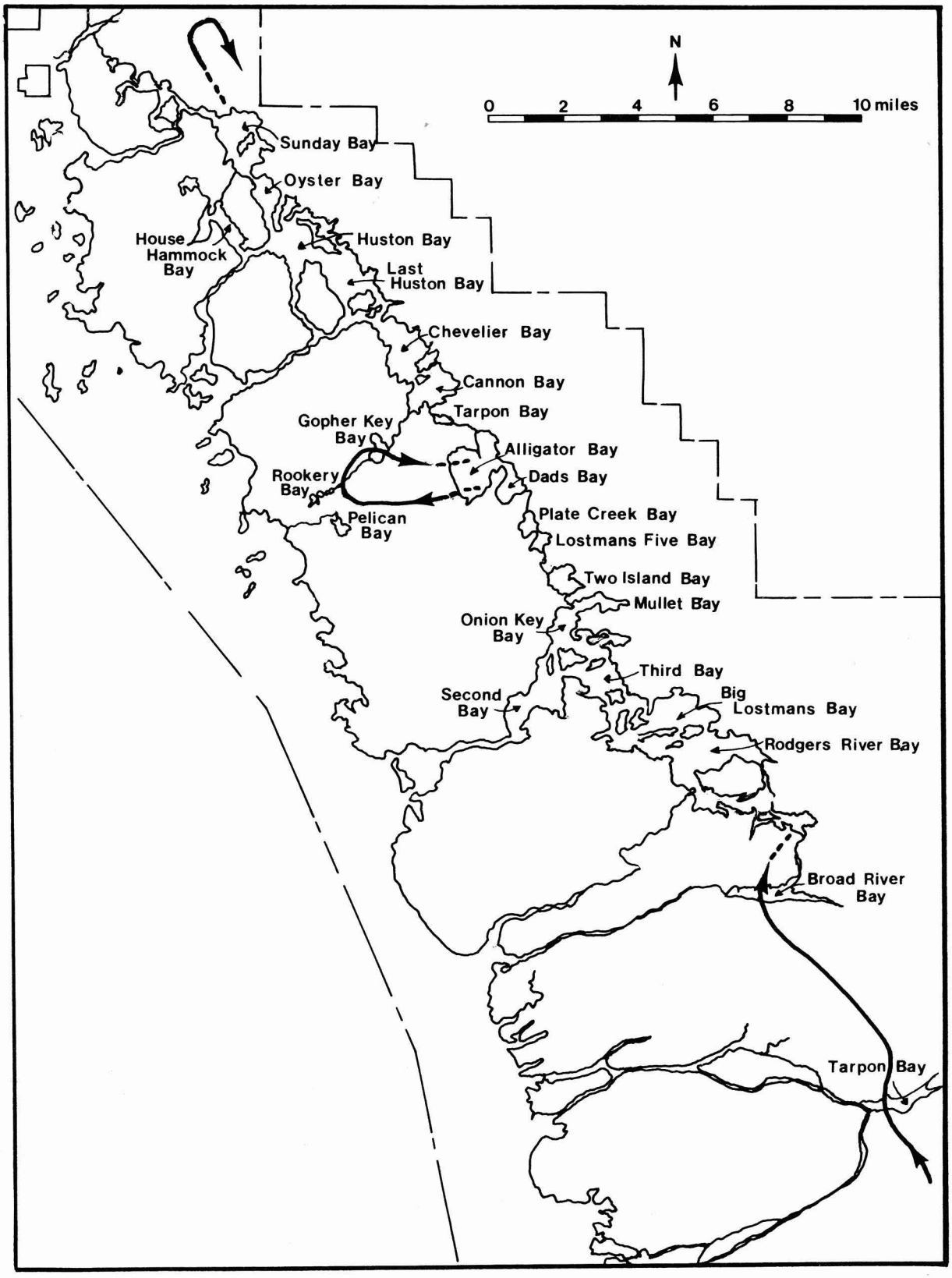


REGION 4


Fox Lakes
Gator Lake
Lake Ingraham
North Ingraham
Capeseas
T
N
1
2 miles
0



REGION 6


N
0 2 4 6 8 10 miles
Sunday Bay
Oyster Bay
House Hammock Bay
Huston Bay
Last Huston Bay
Chevelier Bay
Cannon Bay
Tarpon Bay
Gopher Key Bay
Alligator Bay
Rookery Bay
Dads Bay
Pelican Bay
Plate Creek Bay
Lostmans Five Bay
Two Island Bay
Mullet Bay
Onion Key Bay
Third Bay
Second Bay
Big Lostmans Bay
Rodgers River Bay
Broad River Bay
Tarpon Bay

REGION 7

Appendix 3. Number of waterfowl found in Everglades National Park, November 1977-March 1978.

	Fulvous Tree Duck	Mallard	Mottled duck	Pintail	Blue winged Teal	American Widgeon	Shoveler	Ring-necked Duck	Lesser Scaup	Canvas-back	Hooded Merganser	Red-breasted Merganser	American Coot
Region 1													
November	0	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0	7
January	0	0	0	0	400	35	0	55	0	0	0	3	0
February	0	0	0	0	0	0	0	0	78	0	0	0	35
March	0	0	0	0	0	0	0	0	0	0	0	0	0
Region 2													
November	0	0	10	0	240	15	0	0	0	2	0	25	36
December	0	0	0	0	150	111	0	0	8	0	0	6	16
January	0	0	0	119	1,143	300	0	8	23	0	42	0	203
February	0	0	13	90	410	265	195	0	275	0	89	0	30
March	0	0	2	2	415	75	0	0	0	0	5	3	15
Region 3													
November	0	2	10	4	4,175	380	10	300	1,135	0	0	20	7,180
December	0	0	0	0	595	2,654	50	1,855	2,625	0	0	0	19,840
January	0	0	0	2,175	3,665	2,193	0	1,444	4,152	0	0	2	31,134
February	0	0	0	2,530	0	1,260	28	180	4,271	0	0	0	36,020
March	0	0	5	0	1,687	230	0	0	1,766	42	0	0	10,761
Region 4													
November	40	0	0	0	45	0	0	0	20	0	0	0	0
December	0	0	0	500	632	25	75	100	55	4	0	0	1,200
January	0	0	0	2,930	7,260	0	808	44	0	0	0	0	3,300
February	0	0	0	50	30	81	4	0	392	0	0	15	0
March	0	0	0	10	25	0	0	0	50	0	0	82	0
Region 5													
November[1]	0	0	0	450	270	30	0	0	25	0	0	0	10
December[1]	0	0	0	285	15	75	0	0	0	0	0	0	0
January	0	0	0	878	1,300	30	30	10	0	0	0	0	0
February[1]	0	0	15	0	180	179	75	0	80	0	0	15	12
March	0	0	0	30	122	10	2	0	25	0	0	0	62
Region 6													
November[2]	-	-	-	-	-	-	-	-	-	-	-	-	-
December	0	0	2	0	0	0	0	40	636	0	0	0	0
January	0	0	4	0	0	82	0	0	968	0	0	0	40
February	0	0	2	7	-	13	2	0	1,722	1	0	2	0
March[2]	-	-	-	-	-	-	-	-	-	-	-	-	-
Region 7													
November[2]	-	-	-	-	-	-	-	-	-	-	-	-	-
December	0	0	0	400	540	1,155	0	0	3,495	0	0	0	1,500
January	0	0	0	240	405	520	0	0	2,922	0	6	3	825
February[2]	-	-	-	-	-	-	-	-	-	-	-	-	-
March	0	0	0	10	110	0	4	0	119	0	0	0	12

[1] incomplete census

[2] not censused

Appendix 4. Numbers of waterfowl counted on aerial censuses found in the Everglades estuary during January 1978-80. Regions shown in Figure 1.

Region	Year	Mottled Duck	Pintail	Blue-winged Teal	American Wigeon	Shoveler	Ring-necked Duck	Lesser Scaup	Hooded Merganser	Red-breasted Merganser	Green-winged Teal	All Species of Ducks	American Coot
1	78	-	-	400	35	-	35	-	-	3	-	493	-
	79	-	-	400	-	-	-	-	-	1	-	401	700
	80	-	-	-	-	-	-	-	-	-	-	-	-
2	78	-	119	1,143	300	-	8	23	42	-	-	1,635	203
	79	-	190	920	-	-	-	-	-	100	-	1,260	45
	80	45	-	230	225	-	-	57	-	12	10	579	160
3	78	-	2,175	3,665	2,193	-	1,444	4,152	-	2	-	13,631	31,134
	79	-	350	2,310	131	1,000	-	2,410	-	-	-	6,201	11,150
	80	-	-	1,000	610	130	-	6,940	-	5	-	8,685	18,515
4	78	-	2,930	7,260	-	808	44	-	-	-	-	11,042	3,300
	79	-	-	30	-	-	-	10	-	-	-	40	-
	80	25	15	214	50	-	-	350	-	-	-	654	950
5	78	-	878	1,300	30	30	10	-	-	-	-	2,248	-
	79	107	3,690	4,535	1,005	-	-	1,275	-	120	-	10,732	8,400
	80	25	2,470	1,335	275	35	-	5,000	-	-	-	9,140	6,310
6	78	4	-	-	82	-	-	968	-	-	-	1,054	40
	79	-	-	25	-	-	-	215	-	5	-	245	-
	80	-	-	-	-	-	-	475	2	-	-	477	-
7	78	-	240	405	520	-	-	2,922	6	3	-	4,096	825
	79	-	-	555	250	-	-	430	-	6	50	1,241	315
	80	-	-	1,300	840	-	-	575	-	-	-	2,715	1,235

Appendix 5. Banding location of ducks recovered in south Florida, 1910-1981

	Hooded Mer.	Mallard	Black Duck	Mottled Duck	Gadwall	Am. Wigeon	G-w Teal	B-w Teal	Unid. Teal	N. Shoveler	Pin-tail	Wood Duck	Red-head	Canvas-back	Ringed-Neck Duck	Lesser Scaup
Northeast																
Maine	1							1				1			5	
Mass.							3	2								
Vermont	3							1								
Nova Scotia	1						1	5							10	
Ontario	1						6	14			1	1			2	1
New York							4	3				1			6	
Maryland																
New Jersey					1			1								
Quebec					1		3	1			1					
New Brunswick							1	2							6	
Prince Edward Island								1							1	
Delaware								1								
Midwest																
Michigan						1		6			1				15	
Minnesota								25							35	
Wisconsin		1						12			1	1			4	
Indiana												1				
Iowa								13								
Nebraska								3								
S. Dakota								8			1					
Missouri								1								
Kansas								1								
Manitoba		2				2		71			5		1	1	1	3
Ohio			1					2				1				
Saskatchewen						4		25		1	2				1	1
N. Dakota						1		17		1	1		1			
Southeast																
Florida				30												
N. Carolina												2				
West																
Nevada											1					
Alaska																3
Alberta																5
Colorado									1							
N.W. Territory											1				3	2
California																
Utah						1										
Montana								1								
Total																
NE	6				2		18	32			2	3			30	1
MW		3	1			8		184		2	11	3	2	1	56	4
SE				30								2				
W						1		1	1		2				3	10