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MARINE BIRDS OF THE SOUTHEASTERN UNITED STATES AND GULF OF MEXICO

Part I

GAVIIFORMES through PELECANIFORMES

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Bureau of Land Management
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PART I

GAVIIFORMES through PELECANIFORMES

by

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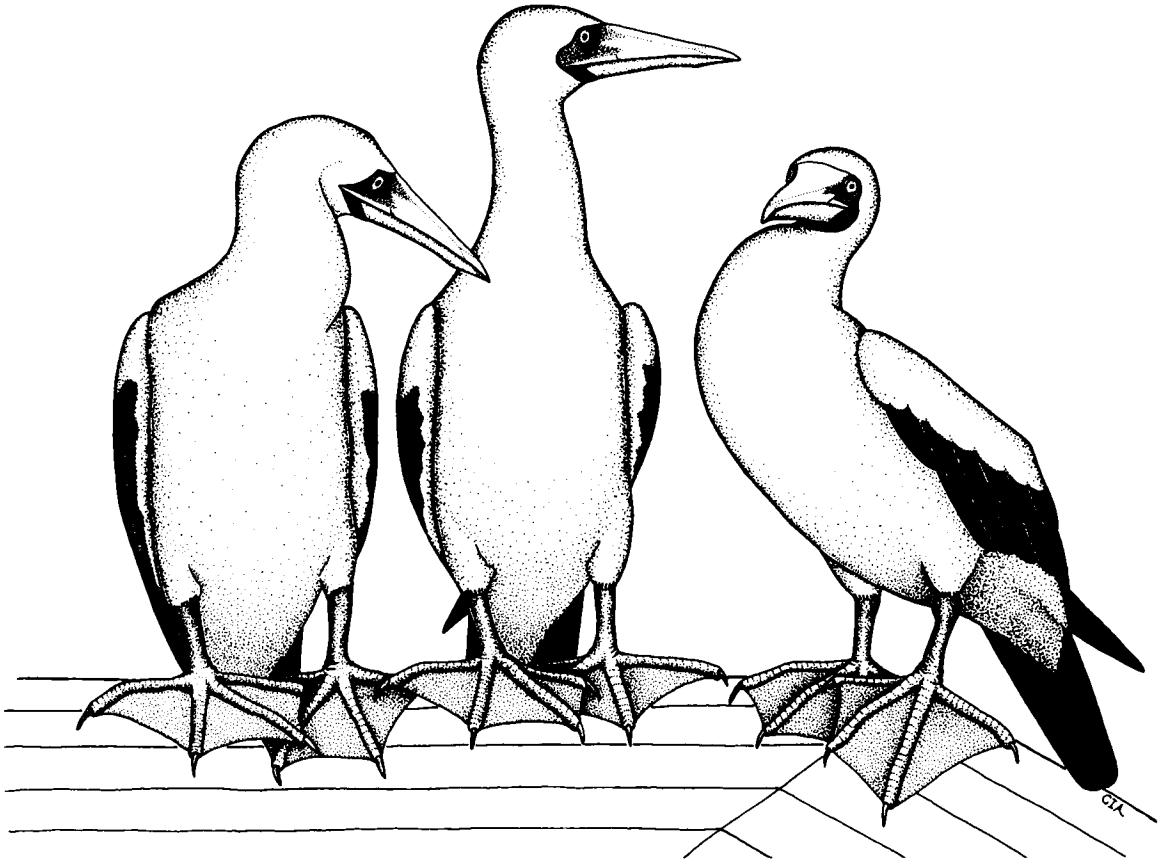

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PREFACE

Part I of the Marine Birds of the Coastal Southeastern United States is published by the National Coastal Ecosystems Team to provide a synthesis and analysis of information about marine birds in this area. Accounts for 39 species include information on distribution, abundance, food habits, breeding ecology, and susceptibility to oil pollution. Selected bibliographies follow each species account and list additional sources of information.

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ABSTRACT

Information on the seasonal distribution and abundance of 39 species of marine birds of the Orders Gaviiformes, Podicipediformes, Procellariiformes, and Pelecaniformes that occur off the southeastern shores of the United States and in the Gulf of Mexico has been compiled and mapped from thousands of literature citations; in many instances this provides the first synthesis of knowledge about a species for this area. Information on world-wide distribution, habitat, food, and various aspects of life history is also summarized. This information was gathered to assess the possible effects of offshore oil development on populations of marine birds.

Susceptibility of birds to oil depends not only on their juxtaposition in time and space, but also on currents, climatic factors, the stage in the life or annual cycle, and the behavior of the species. Contamination by oil may result in matted feathers; death may soon follow from chilling or starvation, or from the toxic effects of oil ingested when the birds attempt to preen themselves. Oil from feathers may be transferred to eggs by incubating birds and may greatly reduce reproductive success.

Among the birds covered by this volume, loons and grebes are considered the most susceptible to oil pollution. Cormorants, pelicans, and boobies are moderately susceptible and the truly pelagic birds, including most of the Procellariiformes, are the least susceptible.

Little is known about the occurrence of seabirds off our shores, but our knowledge is increasing. Recent ornithological studies offshore have revealed concentrations of species previously thought to occur rarely, if at all. More than 63% of the Manx Shearwaters ever seen off the southeastern coast were sighted in the last 5 years (1975-1979) and 37% were seen during the last 2 years (1978-1979) covered by this report. Comparable figures for Wilson's Storm-petrel are 40% and 26%. Nontheless, observations are limited. Future trips to locate or count birds should be scheduled when birds are expected to be present at periods when little previous information was obtained.

Additional research should be conducted on the distribution and status of birds that use the marine environment. More attention should be directed toward investigating the status and distribution of pelagic birds, toward learning the abundance and distribution of marine birds that nest in the southeastern states, and toward discovering the distribution and status of birds that are transients or winter visitors in the southeast. Research is also needed to determine the numbers and proportion of each species that are being oiled in the southeast so that the effects of oil pollution can be assessed more adequately.

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PURPOSE OF REPORT

The purpose of this report is to summarize the status of marine birds in the southeastern United States and explore the potential effects on these species of the development of petroleum resources on the outer continental shelf (OCS). This entailed a review of available information to:

1) determine where and when marine birds would most likely occur in areas to be developed for oil and gas production;

2) ascertain which species would be most at risk from oil and ancillary activities related to the development of oil resources;

3) evaluate the importance of populations in the southeastern United States in relation to the entire distribution and abundance of the species; and

4) summarize information on the life history of each species, emphasizing data obtained in the southeast.

This material is presented in a form that enables the Bureau of Land Management (BLM) to identify aspects of OCS development that might threaten populations of marine birds and provides information that will allow managers to make decisions that minimize damage to these populations during the development of energy resources.

A corollary objective is to recommend topics for future research in areas for which information is particularly weak.

STUDY AREA

The study area includes the coastal and offshore waters of the southeastern United States, from the northern border of North Carolina to the border of Mexico. A wide variety of coastal habitats occurs within this area. Among them are sandy barrier islands, fresh, salt, and brackish marshes, open beach, coastal bays, dredge spoil islands, mud-flats, and mangrove islands. The dominant habitats of sections of the coastline will be discussed below.

HABITATS

North Carolina is dominated by a series of fringing barrier beaches behind which lie large estuaries with extensive areas of shallow water and salt marsh. These fringing islands, called the Outer Banks, are some 20-30 mi (30-50 km) farther from the mainland than are such islands along other areas of the Atlantic coast (Warinner et al. 1976). Extensive stands of salt marsh with deep tidal channels are found south of Cape Lookout, North Carolina, through South Carolina and Georgia. Almost three-quarters of the salt marsh acreage along the Atlantic seaboard is found in these three states. The largest areas of salt marsh on the Atlantic coast are in Georgia which has

193,000 ha (about 477,000 ac), North Carolina with 64,000 ha (158,000 ac), and South Carolina with 176,000 ha (435,000 ac)(West 1977).

Barrier islands are also very important coastal habitat in these three states. The land areas of the barrier islands for each state are 120,000 ac (48,000 ha) in North Carolina, 124,000 ac (49,600 ha) in South Carolina, and 153,000 ac (61,200 ha) in Georgia (Warner 1976) for a total of about 380,000 ac (152,000 ha). The area of water behind these islands becomes smaller to the south (Warinner et al. 1976). These three states (North Carolina, South Carolina, and Georgia) respectively have about 266 mi (428 km), 199 mi (192 km), and 98 mi (158 km) of open beach along their barrier islands. In other parts of the study area (e.g., parts of the Florida Gulf coast) beaches are few or nonexistent (Woolfenden and Schreiber 1973).

The east coast of Florida is also dominated by a chain of barrier islands occasionally broken by tidal passes. Typically, these islands are sandy along their outer perimeters. Large areas of marsh and estuarine swamp lie landward of these islands (Warinner et al. 1976) and salt marshes gradually give way to mangrove swamp (Reimold 1977). Much of the Gulf coast of Florida is dominated by salt marshes and mangrove swamps (Warinner et al. 1976). Open beach is often extensive from Naples on the Florida peninsula north along the panhandle to Alabama (Woolfenden and Schreiber 1973). In Alabama, tidal salt marsh, sandy beaches, and offshore islands are common coastal landforms. Mississippi's gulfward border consists almost entirely of barrier islands that have salt marshes in their centers. The shoreline of Mississippi has had much development of real estate but still contains fresh, salt, and brackish marshes (Warinner et al. 1976). Only a limited extent of salt marsh is found from northern Florida to Mississippi. Most marshes are small, disjunct, and in alluvial pockets protected by bay shores (West 1977).

Louisiana has more marsh and estuarine area than any of the other United States except Alaska (Warinner et al. 1976) (more than 40% of the coastal wetlands in the contiguous United States; Turner and Gosselink 1975). In some places the marshes extend inland as much as 40–50 km (25–30 mi) (West 1977). The coastline along the western third of the state is sandy, but the rest of the area is dominated by barrier islands and marsh that are strongly influenced by the enormous amounts of mud and silt deposited by the Mississippi River (Warinner et al. 1976). The Louisiana coast is one of the most productive areas for marine birds in the continental United States and supports enormous wintering populations of waterfowl.

The coast of Texas makes up a large share of the western shore of the Gulf of Mexico. Sandy beaches and offshore barrier islands are abundant. Two semi-landlocked lagoons, the Upper and Lower Laguna Madre, and a large low-salinity estuary, Sabine Lake, are areas of great importance to wintering waterfowl. An estimated 78% of the world's population of Redhead ducks winters in the Laguna Madre and 13% of the world's shrimp harvest comes from Texas waters (Warinner et al. 1976). A limited amount of salt marsh is present along bay shores enclosed by offshore bars (West 1977).

CLIMATES

The climatic regime, like the landforms, differs widely from one part of the study area to another. The northeastern portion is the coldest. The lowest midwinter temperatures along the coast of North Carolina are on the order of 20°F (-7°C) and the average daily maximum during midsummer along the extreme southern coast is only 86°F (30°C), some 6 degrees less than is usually recorded in the interior. July is the wettest month and October the driest. Along the coast, snow and sleet usually fall only once or twice a year, and are usually associated with northeasterly winds. Prevailing winds in North Carolina blow from the southwest most of the year and from the northeast in September and October (Hardy 1974). The weather along South Carolina is similar to that in North Carolina but varies somewhat. Average annual temperatures along the coast of South Carolina are about 68°F (20°C), with an average daily maximum in July of 88°F (31°C). Average daily minimums in January range from 35°F (1.7°C) in the northeast to 42°F (6°C) in the southeast. March is particularly rainy along the coast, and October and November are the driest months. Prevailing winds in South Carolina are from the southwest and south in spring and summer, predominantly from the northeast in autumn, and about evenly split between northeast and southwest in winter (Landers 1974).

The climate in Georgia is characterized by short mild winters and warm humid summers. The coastal area becomes progressively drier and warmer from north to south. Peak periods of precipitation occur in winter and early spring. The average annual rainfall ranges from more than 75 inches (190 cm) in the extreme northeastern part of the state to about 53 in (135 cm) along the lower east coast. Average summer temperatures range from about 73°F (36°C) in the extreme north to nearly 82°F (28°C) in parts of south Georgia. Average temperature for the three winter months ranges from 41°F (5°C) in the north to 56°F (13°C) on the lower east coast. Areas in northern Georgia have freezing temperatures during the day for almost a third of the year but those along the lower coast only have about 10 days that reach 32°F (0°C) or less (Carter 1974).

Florida has a wider range of climates than any other state in the southeast. The climates range from temperate to subtropical in the north to tropical in the Florida Keys. Summers are warm, relatively humid, and long, and winters are mild and brief. Rainfall is abundant, with peak rainfall on the peninsula from June to September. Mean annual temperatures range from the upper 60's (F) in northern Florida to the mid 70's in the south and reach nearly 78°F (26°C) at Key West. Rainfall varies widely from area to area and from year to year, with most areas usually receiving between 50-65 in (127-165 cm). The drier Keys have an average annual rainfall of only about 40 in (100 cm). On the southern part of the peninsula prevailing winds are from the southeast and east; elsewhere they are more erratic but tend to be from the north in winter and from the south in summer. Tropical storms frequently cause great damage; few years pass without a hurricane affecting one part of the state or another (Bradley 1974).

The Gulf has a maritime tropical climate with mean winter temperatures of about 70°F (21°C) and mean summer temperatures of 84°F (29°C). Relative to other parts of the study area, both summer and winter are hot and humid;

humidity is greatest during spring and summer and lowest during late fall and winter (BLM 1978a). Rain occurs fairly evenly throughout the year along the eastern and northern Gulf, with a peak from June through August (BLM 1978a). The peak tends to be later farther east and occurs in August and September (BLM 1978b). The area becomes progressively wetter from the southwest to the north and central portions of the northern Gulf. The driest area of the Texas coast extends from Brownsville north to about Corpus Christi, the most humid from Galveston to the Sabine River (Chaney et al. 1978). Average annual precipitation ranges from about 69 cm (27 in) at Brownsville to 137 cm (54 in) at New Orleans (BLM 1978a) and 170 cm (67 in) in Mobile (BLM 1978b).

Tropical storms and hurricanes that often ravage coastal habitats are regular during late summer and fall and enter the Gulf largely through the Yucatan Channel and Straits of Florida. Southeasterly winds predominate over the northern Gulf during the summer. Easterlies are more common during the winter and prevailing winds from the west and southwest are rare at any time of year (BLM 1978a).

METHODS

Most of the information was obtained by a standard academic search of the literature. Additional information on oiling of individual species of birds and their distribution was obtained through examination of museum specimens, and from interviews with other individuals but the latter was not a major source. A preliminary exploration of the resources of several information retrieval systems on computers was made but the data did not meet our needs. These sources were particularly weak on information on local distribution of birds, much of which is to be found in regional journals not covered by computer services; the depth of temporal coverage was also not adequate for the purposes of this study. We agree that visual searches of ornithological and other periodicals "proved far more productive from the standpoint of both numbers of citations and thoroughness of the search," as Bartonek and Lensink (1978) pointed out in a review and bibliography of the literature of marine birds of Alaska.

We obtained literature citations primarily by scanning the literature and by consulting bibliographies in relevant papers. The primary sources for the journals, books, and papers consulted were the libraries and reprint files of the Bird Divisions of the Smithsonian Institution, Washington D.C., and the American Museum of Natural History, New York. Other major sources of information were the library of the Department of the Interior, the Library of Congress, and the Bird Library and reprint files of the Patuxent Wildlife Research Center at Laurel, Maryland. The Welder Wildlife Foundation, Sinton, Texas, and the library of government publications and reports maintained by the National Coastal Ecosystems Team, Slidell, Louisiana, were particularly rich sources of information otherwise difficult to obtain. Unpublished reports and papers were obtained from personnel of the Florida Audubon Society at Vero Beach, the Florida Game and Freshwater Fish Commission at Gainesville, and Everglades National Park at Homestead as well as from other individuals listed in the acknowledgments. Several dozen valuble but unpublished theses

were obtained from several educational institutions.

Searches were made of several secondary sources of literature citations. Literature review sections of major ornithological journals, particularly The Auk, The Ibis, and Bird-Banding, were especially useful as was Wildlife Review. Other sources of citations consulted extensively were Current Contents, Oil Pollution Abstracts, and Dissertation Abstracts. Biological Abstracts, Ecological Abstracts, and The Zoological Record were also consulted but were less efficient sources of information. All state bird journals dealing with the southeastern United States (see list below) were scanned in their entirety or nearly so; these journals, along with American Birds (Audubon Field Notes in earlier volumes) provided much of the information on local distribution in each state.

We placed considerable emphasis on recentness of information in the literature search. A few journals (e.g., Wilson Bulletin, The Auk, Bird-Banding) were examined for at least 30 years into the past, The Auk from 1930 to the present. Many other journals, depending on the degree to which they yielded useful information, were scanned for only a relatively few recent years. We made a concerted effort to cover the foreign literature as thoroughly as possible. Most of the species treated in this report have a wide geographic distribution, and much of what is known of salient aspects of their breeding biology is found only in foreign periodicals. The linguistic limitations of the senior author, as well as the temporal and fiscal limitations involved in the production of this report, precluded full use of this material.

Listed below are the serial publications covered most extensively by direct examination. Where appropriate, listed in parentheses are those areas of the world that these journals cover most thoroughly.

Acta Ornithologica (Poland, U.S.S.R.)
Alauda (France, French Africa)
Animal Behavior
Ardea (western Europe)
Auk (North America, world)
Behaviour

Biologia (Bratislava)(Seria B) (Czechoslavakia)
Biotropica
Blue Jay (central Canada)
Bulletin of the British Ornithologists' Club (world)
California Fish and Game

Canadian Journal of Zoology
Chesapeake Science (Estuaries) (U.S. Atlantic coast)
Dansk Fugle (Denmark)
Ecology
Ekologia Polska (Poland)

Alabama Birds
American Birds (Audubon Field Notes) (United States, Canada)
Atoll Research Bulletin
Australian Bird Watcher

Bird-Banding (Journal of Field Ornithology) (United States)
Bird Study (Great Britain)
British Birds
Bulletin of the Texas Ornithological Society
Canadian Field-Naturalist

Chat (North and South Carolina)
Condor (North America, neotropics)
Corella (Austalian Bird-Bander)
Dansk Ornithologisk Forenings Tidsskrift (Denmark)
Elepaio (Hawaii)

El Hornero (Argentina)
Fauna (Oslo) (Norway)
Florida Naturalist
Gerfaut (western Europe, Africa)

Jack-Pine Warbler (Michigan)
Journal of Animal Ecology
Journal of Ecology
Kingbird (New York)
Larus (Yugoslavia, eastern Europe)
L' Oiseau et la Revue Francaise d'Ornithologie (France, world)

Marine Pollution Bulletin
Maryland Birdlife
Mississippi Ornithological Society Newsletter
Notornis (New Zealand, Pacific islands)
Ostrich (South Africa)

Oriole (Georgia)
Ornithologische Mitteilungen (world)
Ornis Fennica (Finland, Baltic area)
Proceedings of the Louisiana Academy of Science
Revue Suisse de Zoologie (Switzerland, central Europe)

Rivista Italiana di Ornithologia (Italy)
Ring (Europe, world)
Sterna (Norway)
South Australian Ornithologist
Southwestern Naturalist (southwestern U.S.)

Tori (Japan)
Transactions of the North American Wildlife and Natural Resources Conference
Die Vogelwarte (western and central Europe)
Wilson Bulletin (North America, world)
Zoologichesky Zhurnal (U.S.S.R.)

Emu (Australia, New Guinea)
Florida Field Naturalist
Florida Scientist
Ibis (Old World, Africa)

Journal fur Ornithologie (Germany, world)
Journal of Applied Ecology
Journal of Wildlife Management (N. America)
Limosa (Netherlands)
Loon (Minnesota)

Louisiana Ornithological Society News
Mississippi Kite
Murrelet (Pacific northwest, Alaska, western Canada)
Nos Oiseaux (France, western Europe)
Der Ornithologische Beobachter (Switzerland, middle Europe)

Oikos (Denmark, Scandinavia)
Ornis Scandinavica (Scandinavia, Finland)
Proceedings of the Annual Conference Southeastern Association of Game and Fish Commissioners (southeastern U.S.)

Ringing & Migration (Great Britain, world)
Suomen Riista (Finland, Baltic area)
Scottish Birds
Soviet Journal of Ecology

Texas Journal of Science
Var Vagelvarld (Sweden)
Vestnik Zoologi (U.S.S.R.)
Western Birds (western U.S.)
Wildfowl
Zeitschrift fur Tierpsychologie

The reprint files of a number of institutions were a particularly fertile source for some less easily obtainable material. The most useful of these were the files of the National Fish and Wildlife Laboratory, the Bird Division of the National Museum of Natural History, the American Museum of Natural History, and the Bird Library of the Gabrielson Laboratory of Patuxent National Wildlife Research Center.

In all, about 10,000 citations dealing directly with the species treated are included in the three parts of this report. The more general articles found in the Literature Cited sections at the end of each report will probably contribute at least an additional 1,000 citatons.

ARRANGEMENT AND CONTENT OF SPECIES ACCOUNTS

The species accounts vary in length and in detail depending upon the quality and quantity of material examined and depending upon the importance of the species. Species regularly or seasonally abundant in the southeastern United States are treated in more detail than those that are less abundant or that occur there only occasionally. Further, those more susceptible to the effects of oil pollution and oil development are given a more detailed treatment than other birds of equivalent abundance but lesser vulnerability. The detail and length of the species accounts are also related to the availability and recentness of monographic works on the species in question, and to the degree to which information has accrued since the publication of these works. All but a very few species covered in this volume were monographed by Palmer (1962), and summaries that primarily emphasized Old World information for several species have recently been provided by Cramp et al. (1974, 1977). Nonetheless, much of the important information on the distribution and abundance in southeastern waters and adjacent areas for pelagic species of birds is only now being obtained. Much new information was published while this report was being compiled (e.g., Lee and Booth 1979, Lee and Rowlett 1979, Duncan and Havard 1980, Rowlett 1980). Although we have attempted to make this report as timely and thorough as possible, we believe it most likely that marked differences in status for several species of marine birds in the southeast will be revealed in the next few years.

ABBREVIATIONS

Most of the abbreviations used in the text are in standard use and will be known to the reader; a few that we use may be less familiar. These are listed below with a brief indication of their interpretation.

N, S, E, W, (capitalized without period)	compass directions
N., S., E., W. (capitalized with period)	geographic site designation (e.g., S. Padre Island)

photogr.	photographed	Co.	County
coll.	collected	Par.	Parish
spec.	specimen	NWR	National Wildlife Refuge
sp./spp.	species (singular/plural)	WMA	Wildlife Management Area
ad.	adult	St. Park	State Park
imm.	immature	Natl. Park	National Park
subad.	subadult	Natl. Seashore	National Seashore
nonad.	nonadult		

n	sample size	unpubl.	unpublished
SD	Standard Deviation	pers. observ.	personal observation
ca.	circa (about)	pers. comm.	personal communication
CBC	Christmas Bird Count	op. cit.	(opere citato) in the work cited
ms	manuscript		
in prep.	in preparation	subseq.	subsequent
prep.	preparer	et. seq.	and the following
comp.	compiler	cf	(confer) compare/see
ed./eds.	editor/editors	in litt.	in the letters (of)

SPECIES INCLUDED

This report includes all but 2 of the 40 species of loons, grebes, albatross, shearwaters, petrels, storm-petrels, tropicbirds, frigatebirds, cormorants, boobies, gannets, and pelicans recorded at least once from the waters of the coastal southeastern United States. We also include one species, the Cahow or Bermuda Petrel, that is as yet unrecorded from the area. This species was included because it is a rare and severely endangered species whose nonbreeding range may include the offshore waters of the Atlantic seaboard.

One of the two species excluded from this report is the Black-bellied Storm-Petrel (Fregetta tropica), known only from an 18th century record from St. Marks, Florida (Howell 1932, AOU 1957); this record has also been attributed to the White-bellied Storm-Petrel (Fregetta grallaria) (Palmer 1962) and we suspect the validity of the record. The other species excluded is the Red-footed or Red-legged Cormorant or Shag (Phalacrocorax gaimardi) reportedly seen at Galveston, Texas, in December 1946 (Oberholser 1974). Although marine birds often wander extraordinary distances, this species is otherwise known only from the coasts of Peru, Chile, and Argentina (Blake 1977); in the unlikely event that the identification was correct, we suspect that the bird may have escaped from captivity.

About half the species treated here are strongly pelagic and are rarely seen from shore. As a result, pelagic species that may be common offshore are regarded as accidental in state check-lists and regional works. Two species that fit this category are the Blue-faced Booby and the Bridled Tern. Recent studies (Duncan and Havard 1979 ms, 1980; Lee and Booth 1979) have found these species to be far more abundant in some areas than was previously thought. Consequently, we have included accounts for some species that have been infrequently recorded, but which are probably more common than the record indicates.

The remaining species treated here are coastal birds (e.g., loons, grebes, cormorants, pelicans) and include one endangered species, the Brown Pelican, as well as seven species on the current "Blue List", an "early warning" list that tries to indicate species that may be declining in all or parts of their range in North America (Arbib 1979). Three species considered herein, the Common Loon, Red-necked Grebe, and Double-crested Cormorant, are thought to be decreasing throughout a wide area; all are moderately to highly susceptible to oil pollution. Two other species with more restricted ranges, the Western

Grebe and the White Pelican, are also believed to be declining; the former is strongly susceptible to oiling. The Eared Grebe and Northern Gannet are marginally blue-listed because of insufficient evidence and are regarded by Arbib (1979) as species whose status requires clarification. Both are susceptible to oil pollution.

SCIENTIFIC AND VERNACULAR NAMES

The species accounts are headed by the English and scientific names of the species, followed by vernacular names in other languages and alternative English names used in the United States and other English-speaking countries.

Scientific names used for birds follow the revised edition of Peters' Check-list of Birds of the World (Dorst and Mougin 1979, Jouanin and Mougin 1979, Storer 1979a, 1979b). Widely used alternative scientific names are also noted. Explanation is made in footnotes where changes in scientific names have been adopted recently. Ordinal sequence follows that of the AOU Check-list (1957) as does the sequence of families, with the exception of the Pelecaniformes for which we follow Dorst and Mougin (1979). Within families, species are listed in the order given in the revised edition of Volume I of Peters' Check-list.

Scientific names of other organisms (e.g., plants, fish, crabs, molluscs) given in the text are either those used in the works cited or are from standard recent references or regional guides. Scientific names have been supplied only when we could be certain what species was meant by the vernacular name used in the original text.

English names follow the ABA Checklist (ABA 1975) except for two species (Black-browed Albatross and Cahow) included in this volume but not listed in the checklist. We also use names different from those in the ABA Checklist for three other species (Trindade Petrel, Harcourt's Storm Petrel, Blue-faced Booby). These names are all in widespread use and those used by the ABA are listed here in the section giving alternative vernacular names.

The primary source for most of the non-English vernacular names is the Nomina Avium Europaearum (Jorgensen 1958); other sources consulted include Dement'ev and Gladkov (1951a, 1951b), Austin and Kuroda (1953), Edwards (1972), and Cramp et al. (1977). The abbreviations for the languages and other geographical English usages appearing in this section are as follows:

DA:	Danish	IC:	Icelandic	PR:	Portuguese
DU:	Dutch	IT:	Italian	RU:	Russian
EN:	English (Old World)	JA:	Japanese	SAf:	South African
FI:	Finnish	NW:	Norwegian	SP:	Spanish
FR:	French	NZ:	New Zealand	SW:	Swedish
GE:	German	PO:	Polish	US:	United States

With few exceptions the foreign language common names are those in the widest use in the ornithological literature of the countries indicated. In several instances we have included transliterated names from languages in

which Roman characters are not used (Japanese, Russian). For Japanese names we have relied on Austin and Kuroda (1953) and for Russian names we have supplied the names used in translations of Dement'ev and Gladkov (1951a, 1951b).

The primary reason for supplying these alternative names is to assist future literature searches based on retrieval of citations by computer. Some of the English translations of foreign language names (which are those entered on computers) imply a different species than the name would normally suggest to a reader of English or cannot be readily associated with an English name (e.g., the translation of the Russian common name for Larus ridibundus is Laughing Gull, a name that in English indicates the North American Larus atricilla). As a result, searches of computer literature systems by scientific name alone may fail to indicate important notes or papers documenting recent changes in distribution.

We supply alternative scientific names widely or recently in use as another aid to searches of literature compiled on computers. The Caspian Tern appears in recent literature as Sterna caspia, Sterna tschegrava, Hydroprogne tschegrava, and Hydroprogne caspia as well as with caspius as a variant of the specific epithet. One computer search we made revealed no less than four different lists of titles when each scientific name was used as a keyword. In addition, many of the more regionally oriented foreign language journals, like those in the United States, fail to list scientific names in the titles and in usage might cause confusion when computer-based retrieval of ornithological information is attempted for a wide geographic area. On the other hand, when the translated foreign name is one of widespread use in English-speaking countries we have not bothered to list it.

In some instances we have listed more than one vernacular name for a foreign language; this is particularly true for Spanish, in which vernacular names may vary considerably from area to area. Our production process did not allow a highly accurate rendering of foreign words which incorporates characters or accents. As a result, there are lapses in our orthography, particularly for the Scandinavian languages.

GENERAL DISTRIBUTION

This section is divided into two parts, one giving occurrence in North America, the other, occurrence elsewhere in the world. Most of this information has been taken from standard distributional works, but we have supplemented this material where possible with more recent literature. Breeding and wintering ranges are emphasized in this section, with less information given on areas of occurrence during migration. Material relating to North America is more detailed and more complete than for other areas of the world.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

In this section we present more detailed remarks on distribution in the southeast. We have incorporated as much recent information through 1979 as

we have been able to obtain. The basis for this section is the most recent state ornithological handbooks and checklists; it also includes information from a search through seasonal observations published in American Birds and state journals, a retrieval of breeding data from the Cornell Nest Records Scheme, and a number of unpublished manuscripts dealing with distribution in various sections of the southeast. This section also incorporates information on seasonal occurrence, breeding status and numbers, and brief remarks on habitats used. The emphasis is on coastal areas but in some cases remarks are also made about status elsewhere in the state. Available data for many species are often unsatisfactory, incomplete, or extremely scanty. This is particularly true for transients, either pelagic migrants or common onshore migrants whose numbers are seldom recorded.

Information is given in order by state from North Carolina to Texas; we have not listed states in which a species has not been recorded. A varied treatment was used for Florida; information is usually presented in two subsections, one dealing with the Atlantic coast, the other with the Gulf. We adopted this style because status of a species may vary considerably from coast to coast. In some instances we also included a section dealing with the Keys when status there is different from that on either coast. On occasion, we have subsumed all information under a single entry for the state; this is the case when a species is known from Florida from only a very few records.

Some questions about the biology or racial affinities (the latter indicating the general geographic origin of species not breeding in the southeast) can best or only be determined by an examination of specimens. Answering these questions would require the assembly of most available specimens in one place; alternatively, it would require extensive travel to various museums. Since relatively few specimens of some seabirds have been collected, we have in many instances listed an abbreviation indicating the museum in which a specimen from the southeast is, or is said to have been, deposited. Most of our information comes from scattered reports in both published and unpublished literature, some from direct examination of specimens. We list below the abbreviations used and the names and addresses of the museums indicated.

AMNH	American Museum of Natural History, 79th Street & Central Park West, New York, NY 10024
Auburn U Mus.	Auburn University, Auburn, AL 36830
Brev Mus.	Brevard Museum Inc., 2201 Michigan Ave., Cocoa, FL 32922
CC Mus.	Corpus Christi Museum, 1919 N. Water St., Corpus Christi, TX 78401
CM	Charleston Museum, 121 Rutledge Ave., Charleston, SC 29401
FSM	Florida State Museum, University of Florida, Gainesville, FL 32611

FSU	Florida State University, Department of Zoology, Tallahassee, FL 32306
FTU	Florida Technological University, Department of Biology, Orlando, FL 32816
LSU	Louisiana State University, Museum of Zoology, Baton Rouge, LA 70803
MGFC	Mississippi Game and Fish Commission, State Wildlife Museum, 111 N. Jefferson Street, Jackson, MS 39202
NCSM	North Carolina State Museum of Natural History, North Carolina State University, Raleigh, NC 27611
SFAU	Stephen F. Austin State University, Department of Biology, Nacogdoches, TX 75961
Texas A&I	Texas A & I University, Kingsville, TX 78363
Texas A&M	Texas A & M University, Department of Wildlife Science, College Station, TX 77843
U Ala	University of Alabama Museum of Natural History, University, AL 35486
U Dallas	University of Dallas, Department of Biology, Irving, TX 75060
UG	University of Georgia Museum of Natural History, Athens, GA 30602
U Iowa	University of Iowa, Museum of Natural History, Iowa City, IA 52240
UM	University of Miami, Biology Department, Coral Gables, FL 33124
U Mich	University of Michigan, Museum of Zoology, Ann Arbor, MI 48109
UNC	University of North Carolina at Wilmington, Biology Department, Wilmington, NC 28401
USF	University of South Florida, Department of Biology, Tampa, FL 33620
USNM	National Museum of Natural History, Washington, D.C. 20560
WWF	Welder Wildlife Foundation, Box 1400, Sinton, TX 78387

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

This section in the species accounts summarizes information given in the previous sections, often with additional data on population levels in the coastal southeastern United States. Some additional information on the worldwide status of the species may be included, but the amount given varies greatly depending on our present knowledge of the species. We also present tabular information on seasonal occurrence and abundance of the species in the southeast and indicate where seasonal concentrations have been seen; information available on these topics is generally limited and the information we present will point out where further data should be obtained.

We have used two kinds of maps to indicate where concentrations of marine birds have been reported, one dealing with breeding birds, the other with wintering populations. Breeding colony maps give an estimate of the number of breeding birds and indicate the year or period to which this estimate applies. We used the largest recent estimate instead of a range or mean since estimates are few and we wished to emphasize areas known to have contained significantly large colonies or concentrations of colonies. Not all data obtained were plotted because some species occur in so many colonies that it was not feasible to include them on our maps. These maps may contain some inaccuracies, and are not intended as an atlas; they are intended primarily to give an overview of where concentrations of breeding marine birds occur in the southeastern United States.

The material on which these maps are based is highly diverse. It includes data from the Cornell Nest Records Scheme and a considerable number of published and unpublished censuses (e.g., Portnoy 1977, Parnell and Soots 1979 ms). Other data were found in recently published papers and obtained from local ornithologists.

Most of the winter distribution maps are based on those given earlier by Bystrak (1974), whose report was based on an analysis of Christmas Bird Counts for one or more of the years from 1970-1972. We chose 45 of 58 coastal Christmas Bird Counts in the study area and compiled 5-year means for 1973-1977. In some instances fewer than 5 years of counts were available and the mean is for a shorter period. We picked the localities to show geographic variation in numbers and to emphasize where the largest concentrations were found.

These figures should not be construed as indicating the true size of local populations. The Christmas Bird Counts varied considerably in the amount of estuarine, coastal, and marine habitat covered, but we tried to allow for this by choosing counts that contained the most marine habitat. We realize that the numbers reported in any given year may not be precise because of the limitations of Christmas Bird Counts. We intend these maps to serve primarily as an index of where winter concentrations are most likely to be found and how this distribution varies throughout the southeast.

HABITAT

This section deals with habitats used by the species, and usually consists

of relatively brief remarks dealing with nesting, feeding, and winter and/or offshore habitats used. These categories are often combined when they are essentially the same, e.g., when the offshore habitat for a species is also its feeding or wintering area. As in other sections in the species accounts, the extent and detail of information reported is related to the relative importance of the species in the southeast. Accidental or vagrant species known from only a few records are often covered in only a few sentences, whereas more abundant species usually receive a more detailed treatment--particularly when recent information is available. Little information can be given for species that are important components of the avifauna but that have been little studied (primarily pelagic species such as the Bridled Tern).

FOOD AND FEEDING BEHAVIOR

We give relatively little data on food habits in southeastern waters, primarily because little or nothing is known of the diet in this area. This is particularly true for most of the species covered in Volume I of this report. If the less common species are included, one can state conservatively that nothing certain is known of the diet in the southeast for well over half the species discussed. Consequently, we have had to rely on data from other areas on the assumption that similar foods will be eaten in the southeast.

Here again, the amount of information given varies in relation to the relative importance of the species in the southeastern marine avifauna and with the amount of information available. In all cases we give at least a brief general statement of the types of foods eaten and the primary methods by which they are obtained. In some instances we include more detailed information on food habits, briefly abstracting recent studies and indicating proportions of different varieties of foods eaten. We have summarized food habits by geographic area for a few species for which much recent information is available. For species whose food habits have been relatively well documented, we have pointed out differences in food habits of adults and young, and have commented on seasonal variation of food habits as well as difference in foods eaten in different habitats.

The primary information given on feeding behavior is the means by which the species obtains its food. Many of the terms or phrases used are obvious (e.g., diving from the surface, plunging from the air); a few are not. Usually those that are unclear are explained more fully in the species accounts. We give brief definitions of these terms here, based on terminology used by Ashmole (1971) and Ainley (1977).

aerial dipping = picking prey from just above or just below the surface of the water while in flight; this includes the pattering of storm-petrels in which the feet are used to maintain the birds aloft. The body may or may not make contact with the water but usually does not do so to any great degree.

aerial seizing = seizing prey in the air while on the wing; use of this term suggests that the prey may be some distance above the substrate; roughly equivalent to the term "hawking".

deep plunging = diving into the water a substantial distance to seize underwater prey.

kleptoparasitism = piracy; stealing food from other birds or organisms. This includes aerial pursuit in which one bird chases another and forces the latter to disgorge or drop food, which is then seized. It also includes such pursuits between two birds on water or land and harassment by a flying bird of another on water or land.

plunge diving = a more general term that indicates a bird that dives into the water from the air to seize prey; it includes deep plunging, surface plunging, and pursuit plunging.

plunging = plunge diving.

pursuit diving = diving from the surface of the water with pursuit of prey augmented by the use of wings or feet.

pursuit plunging = diving from the air into the water with subsequent underwater pursuit of prey.

scoop-feeding = surface seizing as practiced by pelicans.

surface dipping = picking prey from just above or just below the surface of the water while sitting on the surface of the water; similar to surface seizing, but implying less contact of the body with the water and (usually) smaller items of prey.

surface plunging = diving into the water from the air to seize prey but the bird either does not completely submerge or submerges for only a very short distance.

surface seizing = taking living or dead prey from the surface of the sea or just beneath it while the bird swims or floats on the surface.

IMPORTANT BIOLOGICAL PARAMETERS

This section presents basic information to allow biologists to infer the effects of development of oil resources on populations and to help choose alternative courses of action in the planning of such developments. We include this information for only about half the species discussed in this report because we believe that these species are those most likely to be significantly affected by oil in southeastern waters. Much of the information is derived from studies conducted outside the southeast, because only a few studies of the breeding biology of marine birds have been conducted there. This lack of data is particularly frequent for the species (Charadriiformes) that will be covered in the third volume in this series.

The data in this section consist of brief summaries of the egg laying

period, mean clutch size, incubation period, hatching success, fledging success, age at first breeding and at fledging, mortality of eggs and young (including information on renesting), maximum natural longevity, and weight. Data on egg laying, incubation period, and age at fledging allow estimates of periods when birds breeding within the study area are most vulnerable to disturbance. Information on mortality and renesting point out those factors that lower the birds' reproductive success and suggest the potential for recovery following a nesting failure. Data on clutch size and hatching and fledging success allow an estimate of productivity. Detailed life table data are unavailable for most of the species covered in these reports. Consequently, we have provided figures for known maximum natural longevity that will in some instances allow a crude comparison of the total reproductive potential between species. The maximum natural longevity is given in terms of "estimated minimum age" in years and months following Kennard (1975), and may list information based on banding in both the United States and Canada and the Old World. Finally, we include information on weights because this and population data given elsewhere in the report will allow planners to compare species in terms of biomass affected as the result of any given oil-related activity.

The quality and quantity of this information vary from species to species and from topic to topic. Many of the waterfowl treated in the second volume of this report are among the best-studied wild birds. For such species we make no attempt to give all the information available, but confine ourselves to brief summary statements. For many other species, particularly those that would be more often regarded as seabirds, information is sparse, inadequate, or completely nonexistent. We have indicated this in each account.

SUSCEPTIBILITY TO OIL POLLUTION

Instances of oiling for a given species are documented to show that the species can be affected. We have stressed records from southeastern waters. Data are reported on the number killed in major oiling incidents and the proportion this represented of the total number of all birds killed and identified to species. We may have missed reports of oiling for some species. Much of the Old World literature reports oiled birds only by species groups (e.g., gulls, ducks) and combines information on individual species in these totals. Some information may be found in Old World regional periodicals unavailable in the United States and not covered by computer-based literature retrieval systems.

This section also refers frequently to an oil-vulnerabity index for birds in the northeastern Pacific developed by King and Sanger (1979). That publication, though valuable, has been used with caution because it refers to a different geographic area with a dissimilar environment and a different (but strongly overlapping) species complex. We include in this section some of King and Sanger's index scores, not to indicate the degree of vulnerability in the southeast (although we often think that it is similar), but rather to show the degree of vulnerability in another part of the range. The northeastern Pacific area is important to North American populations of a number of species regularly occurring in the southeast (e.g., Common Loon, Horned Grebe, Leach's Storm-Petrel) that are at moderate to high risk from oil development

activities in both areas.

In most accounts where we have referred to this index we have supplied King and Sanger's (1979) interpretation of the index. We give here a summary of their point scale and its use in determining both degree of danger to a given species and those adjustments in plans for development that may be required as a result.

Range of Scores	Interpretation of Index Values
1-20	Very low risk species; ones "where damage or future costs would not be expected"..."where problems will be fewest".
21-40	Low risk species; those "for which there is a low level of concern" and which may require consideration for only those parts of a project that might significantly influence a species.
41-60	Mid-risk species; those that may be adversely affected but not catastrophically. King and Sanger (1979) suggest that the status of these species should be monitored during project development and that palliative measures be taken if damaging effects are detected.
61-100	High-risk species; those that are almost certain to be adversely affected by oil development activities. These species will need the most additional research, additional planning for the effects of disasters, and additional consideration about possible modifications of projects.

In addition, we provide in this section our estimate of the overall potential effect of oil pollution and the development of oil resources on the species in the southeast, taking into account the known or suspected relative vulnerability of the species, its abundance in the southeast, and its abundance elsewhere.

SPECIES BIBLIOGRAPHY

All citations used in the text of the species accounts are included in the bibliography at the end of this report. Selected references to the species treated are found in the species bibliography at the end of each account. The species bibliography includes citations that provide data on the topics briefly covered in the text, as well as on other aspects of the distribution and biology of the species.

These bibliographies are not exhaustive. The emphasis in our species bibliographies is placed on the ecology and behavior of the species. More general works and some distributional literature are found in the terminal section of literature cited. Although some material on taxonomy, parasitology, hybrids, identification, disease, and other subjects, may be included, we did not specifically search for this material. We covered the world lit-

erature because little is known of the biology of most marine birds in the coastal southeastern United States.

Our search of the literature also stressed recentness of information and each species bibliography should be relatively complete through at least mid-1979, our cut-off date for inclusion of references. A few important references published subsequently may be included but these may not have been used in writing the account. We have listed other important papers dealing with the biology of the species through the early part of the century, but have been more complete with papers written in English. We include older references that are still the major source of information on the species.

The species bibliographies are arranged from present to past with authors listed alphabetically under each year, rather than the more conventional alphabetical and chronological listing used in the Literature Cited. We did so to make it easier for the reader to find the most recent information on any topic covered by the bibliography.

We have checked all references used in the text portion of the accounts as well as a large proportion of the remaining references. Some citations from secondary sources remain unchecked. We estimate that the three volumes in this series will contain on the order of 10,000 references in the terminal species bibliographies, and our temporal and fiscal limitations were too great for us to undertake complete verification of all references included.

OIL POLLUTION AND MARINE BIRDS OF THE SOUTHEASTERN UNITED STATES

With the possible exception of marine turtles, marine birds are the vertebrates most severely threatened by oil pollution and the development of oil resources. The work of Old World biologists presents clear evidence of severe and substantial damage to several populations of marine birds.

Specific, detailed information on the effects of oiling and oil spills on wild birds and their populations in the New World, and especially for the the southeastern United States, is very limited. In many instances it is unknown whether any given species has ever been oiled and what effect this may have had. Systematic gathering of data on the species composition of large seabird kills following oil spills has been done infrequently in the New World and systematic surveys of beached birds have only recently begun in the United States. Further, data on oiling of marine birds are scattered through a diverse body of literature. Many distributional notes reporting the first specimen of a species from a geographic locality parenthetically note that the specimen was oiled. Other information is scattered through regional distributional works and yet more data, which we have not had time to explore fully, lie in the banding and recovery files of the Bird Banding Laboratory of the U.S. Fish and Wildlife Service.

In Denmark, oil pollution kills thousands of seabirds each year; most of these are ducks, but many other species are also involved (Riisgard 1979). Oil has caused major losses in populations of Common Eiders in the Danish

Waddensea (Joensen 1973), in breeding populations of Common Eiders and Black Scoters in Holland (Swennen and Spaans 1970), and in populations of the Atlantic Puffin (Fratercula arctica) in France (Bourne 1976). Oil is also a major cause of death for Jackass Penguins (Spheniscus demersus) in South Africa (Randall et al. 1980).

Other losses reported include the death of an estimated 25-50% of the Common Loons wintering in Shetland after the ESSO BERNICLA oil spill on 30 December 1978 (Stowe and Morgan 1979), and the loss of all Mallards, European Coots (Fulica atra), and Moorhens (= Common Gallinule, Gallinula chloropus) following an oiling of the Amer River in the Netherlands. In the latter oil spill it was estimated that about 88% of the Greylag Geese (Anser anser) and about 71% of the Bewick's Swans (Cygnus columbianus bewickii) would ultimately be lost as well (Belterman 1972). Still other examples of major reductions in avian populations due to oil pollution are given in reviews by Croxall (1975), Vermeer and Vermeer (1975), Bourne (1968b, 1976), and FAO (1977).

VARIABILITY IN SPECIES' SUSCEPTIBILITY TO OIL POLLUTION

Surveys of beached birds are biased indicators of what proportion of a population is affected by oiling (Bourne 1976). The proportions of species found oiled does give some idea of differences in susceptibility between different groups of birds and also suggests the magnitude of the oil pollution problem for a given area. Such surveys may also provide data on seasonal variation in the incidence and extent of oil pollution. Table 1 gives the percentage of beached birds that were oiled in four different areas. Species such as loons, grebes, auks, and sea ducks are most affected, whereas more aerial species such as gulls and terns are usually among the least affected.

REGIONAL DIFFERENCES IN OILING AND MORTALITY OF BEACHED BIRDS

Although beached bird surveys in the eastern United States have been conducted for only a relatively short time, the extent of oiling in birds found dead along the southern Atlantic coast appears low compared with other areas in the United States and elsewhere. Only 4% of 400 birds found dead along the southern Atlantic coast from January 1976 through August 1978 were oiled. In contrast, oiling occurred in 82% of 667 birds found along the Polish Baltic coast from November 1974 to August 1975 (Gorski et al. 1977), in 26% of 162 found along Irish coasts from December 1977 to March 1978 (O'Keeffe 1978), in 79% of 3,431 found on the international beached bird surveys in Northwest Europe in January-March 1975 (Lloyd 1976), and in 18% of 2,420 found along the California coast in 1975 (Ainley 1976).

Bird mortality per mile of beach also tends to be less in the southeastern United States than in other areas (Table 2). Mortality figures for a fairly heavily polluted area, the Polish Baltic coast (3.2 birds/km or 5.2/mi; Gorski et al. 1977), are considerably higher than for anywhere in the southeast. Other areas in northwestern Europe vary considerably in recorded mortality during beached bird surveys, but mortalities are usually greater than those found in the southeastern United States. Lloyd (1976) reported a range

Table 1. Number and percentage of beached birds examined and oiled (a).

Kinds of birds	Great Britain		South-Atlantic Coast United States		Oregon-Washington Coast		California Coast	
	Total found	% oiled	Total found	% oiled	Total found	% oiled	Total found	% oiled
Loons (Divers)	152	94	114	4	3	33	175	10
Grebes	54	59	14	64	14	36	798	5
Albatross	--	--	0	--	0	--	8	0
Petrels (b)	337	17	0	--	2	50	0?	-
Northern Fulmar (c)	--	--	0	--	570	28	301	4
Shearwaters	--	--	14	0	0	--	623	22
Storm-petrels	--	--	0	--	4	25	40	0
Gannets	182	50	6	17	--	--	--	--
Cormorants	218	45	6	0	0	--	6=3	0.5
Brown Pelican	--	--	17	0	--	--	38	0
Wildfowl	1137	76	51	4	26	92	296	7
Phalaropes	--	--	0	--	--	--	119	3
Jaegers	--	--	1	0	0	--	8	0
Kittiwake	--	--	0	--	105	21	33	24
Gulls	2448	30	131	0	16	31	1197	2
Terns	--	--	37	0	0	--	--	--
Skimmer	--	--	1	0	--	--	--	--
Auks	6171	80	0	--	104	94	2848	19

(a) Data for Great Britain, the south-Atlantic coast of the United States, the Oregon-Washington coast, and the California coast are from Table 1 in Bourne (1976), Malcolm Simons (in litt.), Table 2 in Harrington-Tweit (1979), and Table 3 in Ainley (1976), respectively; the periods covered are 1968-1970, December 1977-August 1978, and mid-winter 1976, respectively. Data for the southeastern coast through 1 December 1977 are based on surveys from Cape Hatteras, North Carolina to Cape Canaveral, Florida, thereafter south to Jensen Beach, Florida.

(b) Although Bourne (1976) did not specifically so state, his term 'petrels' probably indicates all Procellariidae (petrels, shearwaters, fulmars, etc.), and may have included Hydrobatidae (storm-petrels) as well. His term 'gulls' probably indicates all Laridae (gulls and terns). For other material summarized here, 'petrels' refers to Pterodroma, 'shearwaters' to Puffinus, 'gulls' to Larus, and 'terns' to Sterninae.

(c) Harrington-Tweit pointed out that fulmar mortality and at least half that of Black-legged Kittiwakes was not due to oil but that most wildfowl and alcid mortality was attributable to oil.

Table 2. Comparison of regional and seasonal variation of beached bird mortality and incidence of oiling in the eastern United States (a).

Dates	Atlantic Coast N of Cape Hatteras		Atlantic Coast S of Cape Hatteras		Florida Gulf Coast	
	Dead birds/ mile	% oiled	Dead birds/ mile	% oiled	Dead birds/ mile	% oiled
SPRING						
Mar.-May 1979	----	51.4	----	20.0	----	0.0
Mar.-May. 1978	----	66.8 (b)	1.58	0.0	----	----
Mar.-May 1977	2.50	5.5	0.95	0.0	0.75	0.0
SUMMER						
Jun.-Aug. 1979	4.40	1.2	0.38	5.6	0.53	0.0
Jun.-Aug. 1978	6.37	0.0	1.00	0.0	1.50	0.0
Jun.-Aug. 1977	6.81	0.9	0.14	0.0	----	----
FALL						
Sep.-Nov. 1979	0.98	13.4	1.43	0.0	0.59	0.0
Sep.-Nov. 1978	1.05	0.0	1.49	0.0	1.00	5.6
Sep.-Nov. 1977	0.24	0.0	0.60	0.0	1.25	0.0
WINTER						
Dec.-Feb. 1978-79	2.19	2.3	1.84	1.1	1.74	0.0
Dec.-Feb. 1977-78	2.70	6.5	2.87	1.4	----	----
Dec.-Feb. 1976-77	9.33	5.5	1.75	0.0	2.88	0.0

(a) This comparison is based on information provided by the Atlantic and Gulf Coast Beach Bird Survey Project. These data, while useful, have sometimes been based on surveys of so few miles of beach that the results obtained may not be adequately comparable from region to region. Dashes indicate that we lack data.

(b) This high figure is the result of an oil spill in the Chesapeake Bay in February 1978.

of 0.17 km (0.3/mi) in part of France to 4.06/km (6.5/mi) in West Germany during the winter of 1975. For Great Britain, 1968-70, the average was 1.3 km (2.1/mi) (Bourne 1976). Reported mortality along the California coast is also apparently greater than in the southeast; surveys there averaged 3.5 birds/mi (2.2/km) from 1971 to 1975 (Ainley 1976). The disparity in beached bird mortality rates between California and Europe compared to the southeast may re-

sult partly from differences in prevailing winds and currents. In parts of North America where prevailing winds blow offshore, most mortality is found around enclosed inlets. On islands offshore North America and in Northwest Europe, where prevailing winds carry dying birds (and oil) to shore, chronic oil pollution and the recorded mortality of marine birds are greater (Bourne 1976).

MAJOR BIRD KILLS FOLLOWING OIL SPILLS IN THE SOUTHEASTERN UNITED STATES

There are few records of large bird kills after oil spills in southeastern waters, and the records that do exist are usually inadequate. A typical example occurred in late December 1968, when a barge spilled crude oil along the coast of Wakulla County, Florida. This resulted in "many ducks, snipe and other birds so covered with oil that they were unable to fly. Smaller birds were unable to walk in the heavy oil" (CSLP 1969).

We found only two reports of major oil spills in or very near the study area for which there is even fair information on the number and species of birds killed. The first of these occurred in early February 1976 in the lower Chesapeake Bay. About 250,000 gal (950,000 l) of No. 6 fuel oil entered the bay following the sinking of a barge near the mouth of the Potomac River (Roland et al. 1977). Subsequent movement of the oil resulted in the widespread contamination of marshes and beaches. Roland et al. (1977) estimated that 20,000 to 50,000 birds were killed. Horned Grebes accounted for more than half the dead birds counted; this is one of the largest known losses to oil for this species. Sea ducks, diving ducks, and Common Loons accounted for a large share of the rest of the total, but Whistling Swans, Black Ducks, Canada Geese, Double-crested Cormorants, and other species were also killed.

The second major mortality following an oil spill in the southeast was in Tampa Bay on the Florida Gulf in mid-February 1970 (Sims 1970). Some 80-100 tons of Bunker C oil were spilled from the Greek tanker DELIAN APPOLON when it ran aground and ruptured its hull (Wallace 1970, Clark 1973). Winds and tide spread the oil to cover more than 100 sq mi (259 sq km) of Tampa Bay. Sims (1970) estimated that as many as 4,500 birds were handled at cleansing and rehabilitation stations after the spill, and Clark (1973) suggested that there may have been as many as 9,000 casualties. Sims (1970) indicated that the St. Petersburg Audubon Society handled "some 500 Common Loon, 200 Horned Grebe, 200 Red-breasted Merganser, 2500 Lesser Scaup and 100 other species including several cormorant, two Mallard, a White-winged Scoter, several heron, a kingfisher and many small shore birds."

SOURCES OF VARIATION IN MORTALITY FROM OIL POLLUTION

A large number of factors are involved in determining the magnitude of detrimental effects of oil pollution to marine birds. Birds oiled in cold weather and cold waters have a much higher fatality rate than do those in warm weather and warm waters. Even minimal amounts of oil may lead quickly to death under the stress of a cold environmental regime (Levy 1980), but birds in warmer areas may well survive the same degree of oiling (R. Clapp,

pers. observ., C. Harrison, pers. comm.). Reports from Europe (Bourne and Bibby 1975, Riisgard 1979) indicate that mortality from oiling is greater during the winter months than during the summer.

Oil spilled in colder water remains liquid longer than in warmer water and is likely to cause more damage as a result. It first forms into a "chocolate mousse" water in oil emulsion and then into tar-balls. Although these forms of oil may present some hazard to the birds encountering them (Bourne and Bibby 1975), the hazard is apparently much less than with fresh oil.

Bourne (1976) summarized some of the changes in daily, annual, and life cycles of marine birds that may increase their vulnerability to oil pollution. Local currents and winds may bring drifting slicks into rafts of birds roosting on the water. Bourne and Devlin (1969) suggested that most mortality from oiling occurs when roosting or feeding birds are trapped by drifting slicks.

Breeding populations are particularly susceptible to oil. The loss of one member of a pair may mean complete loss of their reproductive potential for that year. Depending on the number of offspring usually produced, this could mean that every breeding bird killed by oil represents a theoretical loss to the population of two birds or more. Although this loss may be recouped in future generations, most marine birds have relatively low productivity and their populations may take many years to recover from one severe oiling incident. Oil in the vicinity of breeding colonies may also diminish reproductive success in other ways, such as decrease in the hatching success of contaminated eggs, and by disturbance to the colony resulting from attempts to control pollution (Bourne 1976).

Bourne also pointed out that marine birds are particularly susceptible to damage from oil when they are molting. When birds lack their usual insulation, even smaller than usual amounts of oil may lead to death from chilling, shock, and starvation. Some waterfowl perform a molt-migration in which large numbers gather away from the breeding ground to renew feathers before continuing migration. Some may molt in late summer, others in the spring just before their migration north. Birds in such concentrations would be much more likely to die in large numbers than those with normal mobility.

Relatively few observations have been reported on the behavior of birds encountering oil. Information available indicates that differences in behavior between species may increase or decrease their vulnerability. According to the ICPB (1960), Long-tailed Ducks (Old Squaw) will choose to land on oil slicks. If true, this may in part account for some of the very high oil-related mortalities that have been reported for this diving duck. On the other hand, Guillemots (Common Murres) dive to escape floating oil but suffer the risk of emerging into it and thus becoming severely contaminated (Bourne 1968b). Other species may actively avoid oil; Hainard (1959) reported that some diving ducks (Tufted Duck [*Aythya fuligula*] and Pochard [*A. ferina*]) avoided patches of oil floating down a river. Other, more aerial species, such as gulls (Bourne 1968b) and Manx Shearwaters (Casement 1966), may also actively avoid at least the thicker, more noticeable oil slicks. Some of these birds evidently avoid oil when swimming as well; a Herring Gull and a

Black-legged Kittiwake that swam into a patch of floating oil immediately took flight (Bourne 1968b, Bourne and Devlin 1969).

The number of birds that die following an oil spill is also related to the type of petroleum that was spilled and how long it has been in the environment. Crude oil is less toxic than refined oils (diesel oil, No. 2 fuel oil, Bunker "C") (Hay 1979), and fresh oil causes more damage than older, more weathered oils (Bourne and Bibby 1975). Some oils may be innocuous enough that oiled birds are not killed and are even capable of cleaning their plumage (Birkhead et al. 1973, Phillips 1974).

The number of deaths from oiling following a spill is not necessarily related to the amount of oil spilled; large spills may result in relatively small death tolls, while smaller spills may cause large losses, particularly when substantial numbers of birds are concentrated in small areas (Croxall 1975, Salomonsen 1979). In addition, large catastrophic oil spills may cause no greater loss of marine birds than does chronic oil pollution of the environment (Nelson-Smith 1973, Croxall 1975, Holmes and Cronshaw 1977).

EFFECTS OF OIL ON CONTAMINATED BIRDS AND THEIR EGGS

The primary effect of oil on birds is a loss of buoyancy and insulation when the feathers become matted (Szaro 1977). This increases the metabolic demand to maintain body heat and in cold weather quickly results in chilling. The increased amount of physical effort to remain afloat also increases the demand on the body's resources, and death from exhaustion and exposure may ensue (Bourne 1976). McEwan and Koelink (1973) reported that heat loss of experimentally oiled Mallards and scaup was 1.7 and 2 times greater than normal, respectively.

Ingestion of oil as the contaminated bird tries to preen its feathers will usually cause further harm. A pioneer study by Hartung and Hunt (1966) showed that ingestion of oil by Mallards and Black Ducks could be followed by nervous disorders, enlargement of the adrenal cortex, lipid pneumonia, diarrhea, and gastrointestinal irritation. A considerable number of experimental studies conducted on marine birds in the United States have been reviewed recently at length by Albers (1977), Holmes and Cronshaw (1977), Szaro (1977), Ohlendorf et al. (1978), Eastin and Hoffman (1979), and Stickel and Dieter (1979). Some of the findings that involve both primary and secondary effects of oiling are briefly summarized here.

(1) Physiological effects observed that result from ingestion of oil include dehydration, enteritis, fatty changes in the liver, renal tubular nephrosis, and reduction in the rates of sodium and water transfer across intestinal mucosa (various authors <u>in</u> Ohlendorf et al. 1978);

(2) A relatively low degree of mortality (under unstressed conditions) was found for adult Mallards that were fed small amounts of oil, but ducklings were more adversely affected (Stickel and Dieter 1979);

(3) Mallard hens laid only about half as many eggs as usual when fed diets containing 2.5% South Louisiana crude oil (Eastin and Hoffman 1979, Stickel and Dieter 1979);

(4) Ducklings fed 5% South Louisiana crude oil grew more poorly than controls, did not develop normal flight feathers, and exhibited liver hypertrophy and splenic atrophy (Eastin and Hoffman 1979).

Oil, even in miniscule amounts, will severely reduce the hatching success of duck, heron, gull, and tern eggs (Eastin and Hoffman 1979, Stickel and Dieter 1979). As little as 5 microliters of oil reduced hatching of Mallard eggs from 26% (for Prudhoe Bay crude oil) to 90% (for South Louisiana crude oil; Stickel and Dieter 1979). Toxicity of these and other oils is greater for less incubated eggs than for those further along in incubation, and older weathered oils are less toxic than fresh ones. Experimental oiling of the plumage of incubating gulls has revealed than this will cause significant egg mortality when the oiled feathers come in contact with the eggs. Oiling of eggs also resulted in a significant number of deformed chicks; deformed bills, incompletely ossified wing or foot bones, abnormally small liver lobes, and stunting were the most common abnormalities found in these experimental studies (Stickel and Dieter 1979).

POTENTIAL HAZARDS TO MARINE BIRDS FROM OFFSHORE OIL PRODUCTION

About two-thirds of the oil in coastal waters is derived from runoff and effluent from terrestrial sources. Tanker operations account for about 26 times more oil than offshore operations in marine waters of the United States (Ohlendorf et al. 1978), but may account for a disproportionately large share of avian mortality to oil. Ohlendorf et al. (1978) suggest that, for the marine environment, it may be safer to produce oil offshore than to import it. It seems very likely, however, that onshore habitat change and loss resulting from the development of facilities related to offshore oil production will, in the long run, have a more adverse effect on the waterbirds of the southeastern United States than will oil production itself.

Longley and Jackson (1980) have reviewed this problem for brackish marsh areas. They summarized activities related to oil production and their effects on the environment and suggested ameliorative measures that may be taken. Effects include direct loss of vegetation and animals (e.g., by dredging, construction of pipelines and roads), addition of dissolved, particulate, and toxic materials to the environment, and changes in water flows. The authors consider changes in water flow the most damaging hazard, one that may result in complete conversion of a marsh ecosystem. Such an event could be accompanied by a reduction or elimination of the populations of marine birds that use this habitat for nesting or feeding.

Similar effects are very likely when offshore barrier islands are affected by development of oil and gas resources. Changes in water flow due to dredging could easily change tidal and current patterns that would destroy islands used for nesting. Terrestrial access to larger islands may result in the introduction of predators (e.g., foxes, raccoons) that could eliminate an

entire colony in a season or two. Disturbance engendered by construction might result in the mass desertion of a traditional breeding area by some species.

Several recent reports review aspects of human activities that are relevant to development of onshore oil facilities. These reports include the Mulvihill et al. (1980) detailed review of the effects of shoreline structures on the coastal environment, Morton's (1976) review of the ecological effects of dredging, and Buckley and Buckley's (1976, 1977) reviews of the effects of human disturbance on colonially nesting birds.

Burning of natural gas at elevated flares during oil production is another potential hazard because birds migrating at night sometimes come to such lights. Considerable numbers have been killed at TV towers, lighthouses, and airport ceilometers (Howe et al. 1978), and it might be expected that the elevated flares would attract and incinerate passing birds. Bourne (1979a) has recently reviewed the problem and reported that there have been only about "half-a-dozen second hand" reports of death from this cause during the first decade of oil development in the North Sea, an area where foggy weather conditions should maximize the phenomenon. After commenting on several specific instances of relatively severe loss, including one in which "several hundred storm-petrels" reportedly died, Bourne concluded that "the losses are only an insignificant proportion of the millions of birds passing through the area..."

RECOMMENDATIONS FOR FUTURE RESEARCH

This report reveals large gaps in the body of knowledge necessary to deal effectively with problems relating to marine birds and OCS development. In some areas we know so little that the wise decisions required to maintain a healthy environment, while exploiting additional sources of energy, are not likely to be made. Consequently, we have identified below some of the problems relating to marine birds and oil pollution that we strongly believe most need attention; we point out both species and geographic areas where information is weakest and suggest investigation of some aspects that are poorly known about the effects of oiling on marine birds.

STATUS AND BIOLOGY OF BREEDING SPECIES

The size of breeding populations of marine birds in the southeast is still poorly known. When data are available, they were often taken for too short a period to allow for the annual variation in population size frequently found in marine birds. Portnoy's (1977) survey of the Louisiana, Alabama, and Mississippi coasts provides recent data on coastal breeding populations there, but these data, though useful, are based on observations made in only a single breeding season. Available information on populations breeding in the coastal areas of Georgia and South Carolina is inadequate and information on Florida populations is available only for portions of the state. In addition, the location and size of breeding colonies of more conspicuous species (e.g., Brown Pelican, Royal Tern) that occupy relatively few nesting sites,

are better known than those of others (e.g., Double-crested Cormorant, Laughing Gull, Forster's Tern) whose colonies are more numerous and widely dispersed and found in habitats less easily surveyed.

Studies of the breeding biology of many seabird species are only in their infancy. Information on regional differences in nesting success and chronology, degree of annual variation in production of young, factors influencing nest site selection, determinants of colony location (particularly in relation to food resources), and other demographic parameters, is necessary for satisfactory evaluation of the effect of managerial decisions on the well-being of populations. We urge that such studies should be undertaken over a period of several years; studies conducted during a single season simply do not provide enough information for most managerial purposes. As NERC (1977) pointed out, "...such [long-term studies are] essential as a baseline against which the results of future studies or environmental impacts can be measured."

Few marine birds of the southeastern United States are well studied in regard to their breeding biology and ecology in this area and adequate information for some of them has never been obtained anywhere. Only seven species discussed here (Least and Pied-billed grebes, Magnificent Frigatebird, Double-crested and Olivaceous cormorants, White Pelican, and the endangered Brown Pelican) breed in the southeast. Of these, the Brown Pelican is the best studied; two others (Least and Pied-billed grebes) are relatively poorly known but are probably not seriously threatened by oil pollution. The Olivaceous Cormorant has been investigated in some detail in recent years and the White Pelican has been relatively well examined, but only outside southeastern waters. Very little is known of the two remaining forms, the Magnificent Frigatebird and the Florida race of the Double-crested Cormorant. The only frigatebird colony within the United States is off southern Florida, but little information has been obtained there. The species has been little studied anywhere in the world. These birds should not be particularly susceptible to the direct effects of oil pollution, but could be affected by the ancillary effects of development of petroleum resources on the outer continental shelf. Knowledge of the biology and populations of the cormorant is scant, although this species is potentially highly susceptible to the effects of oil pollution in coastal waters and is also one of the most abundant marine birds in the southeast as a breeding bird, transient, and winter resident. The Double-crested Cormorant is clearly a species whose status, biology, and movements should be better known.

DISTRIBUTION AND STATUS OF PELAGIC SPECIES

Our awareness of the distribution and status of pelagic birds is even more inadequate than that of nesting seabirds. Most of the information on the occurrence or numbers of some species was obtained during the last 5 years, and a surprisingly large amount of information was published during the preparation of this report (1978-79). Table 3 lists ten pelagic species covered in this volume for which a particularly large proportion of the information on distributional status in the southeast has been obtained recently.

Present knowledge of the status of pelagic birds in the southeast varies

Table 3. Approximate percentage of all individuals of ten species of pelagic seabirds ever recorded in the southeastern United States from 1975 to 1979 and from 1978 to 1979.

Species	Percentage seen 1975-1979	Percentage seen 1978-1979
Northern Fulmar	96	92
Trindade Petrel	100 (1 record)	100
Black-capped Petrel	84	68
Manx Shearwater	63	37
Audubon's Shearwater	32	13
Wilson's Storm-Petrel	40	26
Leach's Storm-Petrel	31	8
Red-billed Tropicbird	100 (4 records)	75
White-tailed Tropicbird	30	9
Blue-faced Booby (a)	24	12

(a) Figures for this species are derived from those given in the species account. Perhaps as many as another 150 birds were seen in the Gulf by Duncan and Havard since 1975, but details of all these observations are not available. If this assumption is correct, it means that approximately 56% of the Blue-faced Boobies reported from southeastern waters were seen during the last 5 years.

from species to species and from state to state. Goodman and Klose (1978) stated that the second most important site for U.S. oil development on the Atlantic outer coastal shelf is in the center of the Georgia Embayment that extends from about central South Carolina to northern Florida; this is also the area where the status of marine birds is less well known than anywhere else along the Atlantic coast. This is particularly true for pelagic species, some of which may occur there in very large numbers. We compare (Table 4) the apparent status of the pelagic species covered in this volume in the northern, central, and southern portions of the southeastern Atlantic coast. This comparison indicates the lack of data from the central area. Most surveys of offshore waters have been conducted at the northern and southern ends of this region.

The only pelagic surveys that have been conducted with any thoroughness or regularity in the southeastern United States are those by David Lee in North Carolina, by John Johnson in Florida, and by Charles Duncan and Ralph Havard in Alabama. Surveys elsewhere in the southeast have been infrequent and informal. Our knowledge of the distribution and numbers of pelagic birds in the Gulf of Mexico is especially weak and is even less satisfactory than our knowledge of pelagic distribution off the Atlantic coast. Our lack of

Table 4. Apparent status of some pelagic seabirds in three Atlantic coast states (a).

Species	Probable direction of origin	Area of south Atlantic coast: North Carolina	Georgia	Florida Atlantic Coast
Black-browed Albatross	S	Accidental summer	.....	Accidental fall
Yellow-nosed Albatross	S	.....	.....	Accidental summer
Northern Fulmar	N	Rare fall-spring	.....	.....
Trindade Petrel	S	Accidental summer	.....	.....
Black-capped Petrel	SE	Uncommon spring,fall	.....	Uncommon spring-fall
Bulwer's Petrel	E	.....	.....	Accidental (Keys) spring
Cory's Shearwater	E	Common-Abundant spring-fall	Accidental fall	Common summer-fall
Greater Shearwater	S	Common spring-summer	Uncommon summer	Common summer-fall
Sooty Shearwater	S	Abundant spring-summer	Accidental spring	Uncommon ? summer-fall
Manx Shearwater	NE	Rare winter-spring	.....	Rare all year
Audubon's Shearwater	SE	Common-Abundant spring-fall	.....	Common summer-fall
Wilson's Storm-Petrel	S	Abundant spring-summer	Uncommon summer-fall	Common spring-summer
White-faced Storm-Petrel	E	Rare fall	.....	.....

Table 4. Continued.

Species	Probable direction of origin	Area of south Atlantic coast: North Carolina	Georgia	Florida Atlantic Coast
Harcourt's Storm-Petrel	E	Accidental summer	.....	Rare summer-fall
Leach's Storm-Petrel	N	Uncommon? spring,fall	.....	Rare? all year
Red-billed Tropicbird	SE	Accidental spring	.....	Accidental fall
White-tailed Tropicbird	SE	Uncommon summer	Accidental summer	Uncommon spring-summer
Magnificent Frigatebird	S,SE	Uncommon spring-summer	Rare spring-fall	Uncommon fall-spring
Northern Gannet	N	Abundant fall-spring	Common fall-spring	Abundant winter-fall
Blue-faced Booby	S,SE	.....	.....	Rare summer-fall
Red-footed Booby	SE	.....	.....	Rare (Keys) spring-fall
Brown Booby	S,SE	.....	.....	Rare all year

(a) Pelagic species unrecorded from the three areas considered are not listed but species known primarily from the Florida Keys are included. Only periods of reported peak abundance are indicated.

knowledge is shown by Duncan and Havard's (1980) study that revealed that the Blue-faced Booby, until very recently believed rare in the northern Gulf, is in fact a regular and major part of the pelagic avifauna. Consequently, we suggest that a survey to determine the status of the pelagic avifauna be conducted over a broad area of the Gulf of Mexico, both because of past exploitation of petroleum resources in this area and because further development here may be anticipated in the future.

Hope-Jones (1980) remarked that "...a knowledge of the patterns of distribution and density of seabirds at sea is vital...to help in oilspill contingency planning." We recommend more comprehensive and detailed offshore surveys of marine birds. Preferably, these should be conducted by boat on at least a monthly basis and over a carefully chosen grid. Such surveys should not be less than 2 years in duration because data from any given year may not be representative of usual conditions and will probably not be adequate for the purposes of appraising the impact of oil development on these populations.

A useful and inexpensive way of determining the potential effect of oil development would be to make observations from rigs to determine populations and species composition of passing transients and to find out what effect the rigs have on the behavior of seabirds. (Some species, such as the boobies, are probably attracted to these platforms, in some instances because the rigs may be concentrating local food resources.) In areas where the erection of oil production platforms is contemplated but where none exist nearby, surveys by boat will probably provide more useful information most rapidly.

International borders are biologically imaginary lines that tend to distort our knowlege of the distribution of birds. The status of the marine avifauna of the southern half of the Gulf of Mexico is virtually unknown, even though this area may be the primary source of several pelagic species that are common or regular in the northern Gulf. Such species (e.g., Magnificent Frigatebird) spend a substantial portion of their life cycle in U.S. waters; we need to know the year-round distribution of these species as well as their breeding localities and their status in the nesting areas in order to evaluate events that occur while the birds are off our shores. Some species that are common to abundant in our offshore waters (e.g., Audubon's Shearwater, Bridled Tern) probably come from breeding colonies in the Caribbean, and still other species are from breeding areas in the Arctic, Europe, southern South America, and the Antarctic.

Although yet unproven, "foreign" birds may form a large proportion, perhaps even a substantial majority, of the biomass of marine birds in southeastern waters during at least part of the year. This is certainly true if waterfowl are included. We cannot construct elaborate plans to preserve and protect avian species in U.S. waters if the species in question are being extirpated in their native breeding areas. It is likely that many, perhaps most, of the Blue-faced Boobies in the Gulf of Mexico come from a small cay off Yucatan some 45 mi (75 km) from the wellhead of the IXTOC I oil spill, the largest oil spill in history. To our knowledge, this colony was not examined after the spill.

It would seem the wiser course to know the extent of our wildlife resources before attempting to manage them. We strongly recommend that more extensive efforts be made to initiate cooperative international surveys of marine bird populations because marine birds are probably the most cosmopolitan of all avian groups. International surveys would not only supply a much better understanding of the overall status of the species involved, but would also permit far better insight into the consequences of local managerial decisions on a species throughout its range. Previous efforts along these

lines, particularly with respect to Canada and waterfowl, have been highly effective in producing the information needed to manage anatid populations. Similar efforts would also prove fruitful with regard to other taxa of marine birds.

DISTRIBUTION AND STATUS OF TRANSIENT AND WINTERING INSHORE POPULATIONS

The status and distribution of the transient and wintering inshore populations is of great importance to planners of oil development in the southeastern U.S. and the Gulf of Mexico. Large aggregations of birds are present at times of year when the climate makes them most susceptible to damage from oil pollution in coastal areas most likely to be threatened by oil spills.

In this report we document the temporal occurrence of rare species occurring in the southeast, but often little or no information is available for abundant species that may sometimes provide the bulk of the biomass for migrant or wintering marine birds. Seldom are any useful data available for estimating the size of these populations, and we do not have reliable information on where and when large concentrations may be found. Periods when transients occur at peak abundance in various areas along the coast are only generally understood and very little is known of local movements by wintering populations, whether these be movements to and from roosting and feeding areas or movements within an area over a more extended period of time. A better knowledge of the breeding areas from which these large wintering and transient populations derive, and a more complete awareness of the routes they follow are also needed for satisfactory management of these wildlife resources.

Morgan (1980) points out that studies based on banded birds give only the date and localities where the birds were banded and recovered. The information reveals nothing of the pattern of movement of individual populations in the interim; consequently, we strongly recommend a mass marking program that involves tagging, staining, or bleaching and banding large numbers of marine birds. By marking birds from different breeding colonies with different colors we might discern which would be most affected by oil pollution in the southeast. Such a program would also provide useful information about the timing and size of migration from and through different parts of this area. Pertinent data on local movements and foraging areas and ranges could also be obtained simultaneously. If this were done in conjunction with a program of mass marking of breeding and nonbreeding colonial birds within the southeast, we could obtain additional valuable insight into the constitution of transient and wintering populations.

Perhaps only three of the species treated in this volume are amenable to such an approach. One of these is the White Pelican, which nests in a limited number of colonies and winters in considerable numbers along the Gulf Coast and in Florida. Another is the Magnificent Frigatebird, that occurs in the thousands in southeastern waters, but whose area of origin is unknown. A third species, abundant during migration and winter, and also vulnerable to to oil pollution, is the Double-crested Cormorant. Peak abundance occurs when the local race is augmented by large numbers of migrants arriving from

the north. The proportion of local breeders in any wintering population is unknown because of problems in field identification and it is unclear whether or how different forms partition the same environment.

The status of several other species that winter inshore is poorly understood and needs elaboration. The loons and grebes, all highly vulnerable to oil pollution, are probably the species most threatened from oil in the southeastern United States. Among the four species that are regular to abundant in at least some part of the marine waters of the southeast, two (Common Loon and Eared Grebe) are "blue-listed" (Arbib 1979); i.e., they are thought to be declining in all or part of their range. Two other species (Red-necked Grebe and Western Grebe) are rare to uncommon and are also on the Blue-list; the Western Grebe breeds only in North America. Because these species are potentially threatened or endangered, survey and census of their populations followed by continued monitoring would seem worthwhile. A more accurate determination of critical periods of migration and areas of concentration also seems desirable.

RESEARCH NEEDED ON EFFECTS OF OIL ON SOUTHEASTERN MARINE BIRDS

It is our firm opinion that attempted rehabilitation of oiled birds following a major pollution incident is largely a waste of time, money, and other resources. As Philip Stanton (1977) of the Wildlife Rehabilitation Center put it, "the time has come for the public to realize that cleaning, rehabilitating, and returning oil-covered birds to the wild is often not the wisest investment of their tax dollar." The group working on ecological research on seabirds on the other side of the Atlantic is evidently of the same opinion, stating that "since the results of attempts to rehabilitate oiled birds are so poor, it may be more profitable to expend efforts at preventing birds from becoming polluted" (NERC 1977).

We consider it desirable however, to salvage these birds to find out precisely what birds were oiled and to obtain information that will allow for more prudent responses to future spills. Although there have been many major efforts to "save" oiled birds, these have resulted in little information that would aid in planning responses to subsequent incidents. On the other hand, there have been exceedingly few instances in which any systematic attempt has been made to determine the full effects of a spill on local populations of marine birds. As Nelson (1977) stated, "documentation of the effects of the spill is a vital postspill responsibility"; consequently, we recommend that every attempt be made to determine which species were affected and how many of each species died.

Obtaining this information is not easy. Even if some notion is obtained regarding which species were oiled by a given spill, counts of dead or contaminated birds (or both) may not indicate how severely a species was affected. One reason is that there is seldom adequate information on the number of birds that were present in an area before contamination. As a result, even a relatively accurate estimate of the number of birds killed will not reveal how badly local populations may have been damaged.

Assuming that the populations of each species inhabiting an area that becomes oiled were known, it would still be difficult to predict how many birds may be or were affected. For example, the time of passage of an oil slick through an area may be critical in determining the degree of contamination and mortality experienced by each species. During the contamination of the Firth of Forth in February 1978, the oil apparently passed near the main feeding area for waterbirds at night; consequently, there was a proportionately greater loss of night feeding Greater Scaup and Pochard (Aythya ferina) than there was of Common Goldeneye and Common Eider, most of which had moved elsewhere to roost (Campbell et al. 1978).

The proportion of birds found oiled or dead after a pollution incident also may vary widely between species, depending on the habitats used and the habits of the birds. The probability of finding most oiled birds that roost or loaf onshore but near their offshore feeding areas is certainly much greater than it is for finding those that spend all or most of their time offshore and that, following oiling, might simply sink from sight never to be seen again.

Further, wind and current patterns offshore as well as movements by the birds themselves could take most of the victims of an oil spill far from where they were oiled long before anyone noticed their plight. Levy (1980) analyzed the sort of oil found on dead or moribund birds in Atlantic Canada and suggested that Herring and Great Black-backed gulls obtained near Sable Island, Nova Scotia, had been contaminated by oil from the ARGO MERCHANT spill on Nantucket Shoals, some 840 km (522 mi) away. In another instance a badly oiled Pochard flew 7 km (4.4 mi) inland before becoming incapacitated (Campbell et al. 1978).

In some parts of Europe and on the west coast of the United States, prevailing winds bring victims of oiling to shore. On the Atlantic Seaboard, in contrast, winds take oiled birds out to sea. It is impossible to make a satisfactory comparison of the extent of damage from oil pollution incidents between these areas. Likewise, estimates of mortality from beached bird surveys in Europe cannot be used to predict the incidence of mortality along the western coasts of the Atlantic. At best, they only suggest that damage to wild birds from oil on the U.S. east coast may be underestimated.

Despite all these difficulties in obtaining unbiased data, we would still recommend that a better effort be made to monitor and publish reports of the effects of oil spills on marine birds. Much of the information needed to answer questions relating to oil pollution and marine birds in the southeastern United States would be available if such efforts had been made in the past.

We also recommend that more attention be paid to monitoring the long term and background effects of oil pollution in the southeast. One of the better and less expensive ways in which this may be accomplished would be a periodic censusing of birds found dead along the beaches. This lends some objective basis to speculations about the effects of oil pollution on marine birds, and also provides information about unusual or increasing mortality from other causes (e.g., pesticides). Over time, this may serve as an early warning in-

dicator of where serious problems in wildlife conservation might arise. Such surveys are being conducted presently in the eastern United States by the Atlantic and Gulf Coast Beached Bird Survey Project, but the area covered in some regions (e.g., 2 mi of the Texas coast [Simons, pers. comm.]) is so small that the information obtained may have little importance.

Many of the biases previously discussed above, in regard to oil spills, may also be applied to censuses of beached birds. An increasing rate of mortality resulting from another source, such as pesticides, might lower relative incidence rates for oiling and thus obscure patterns of mortality from that source. Nevertheless, changes in the number of individuals of a species found dead, and in the incidence and degree of oiling from year to year, should provide far more of the information needed to make decisions that would prevent or palliate deteriorating environmental conditions. Bourne (1979b) recently criticized North American work on marine birds and oil pollution (although not challenging the validity of the research per se), stating that ".....work on oil pollution, which is a simple issue of documenting the effects of human carelessness, is wandering off in search of obscure biochemical effects undetectable in nature which appear to be significant mainly as an excess for work in laboratories....". We do not entirely concur with his viewpoint, but we do feel that relatively more emphasis should be placed on determining the extent of the oil pollution problem than on discovering how it is caused.

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RED-THROATED LOON

(*Gavia stellata*)

[DA: Rodstrubet Lom, DU: Roodkeelduiker, EN: Red-throated Diver, FI: Kaakkuri, FR: Plongeon catmarin, GE: Nordseetaucher, Sterntaucher; IC: Lomur, IT: Strolaga minore, JA: Abi, NW: Smalom, PO: Nur rdzawoszyi, PR: Mergulhao, RU: (Red-cropped Loon), SP: Somorgujo Garganta Roja, Colimbo chico; SW: Smalom]

GENERAL DISTRIBUTION

North America The Red-throated Loon breeds on Arctic tundra from Labrador to western Alaska, including all of the major Canadian Arctic islands, the major islands of the Aleutians, and Kodiak Island south to northern Vancouver Island. It winters south on the Pacific coast to northern Baja California, and on the Atlantic coast commonly to North Carolina and uncommonly to Florida (Pearse 1946, AOU 1957, Palmer 1962). It is distinctly uncommon in the Gulf of Mexico, but has been recorded in all the southeastern United States bordering the gulf.

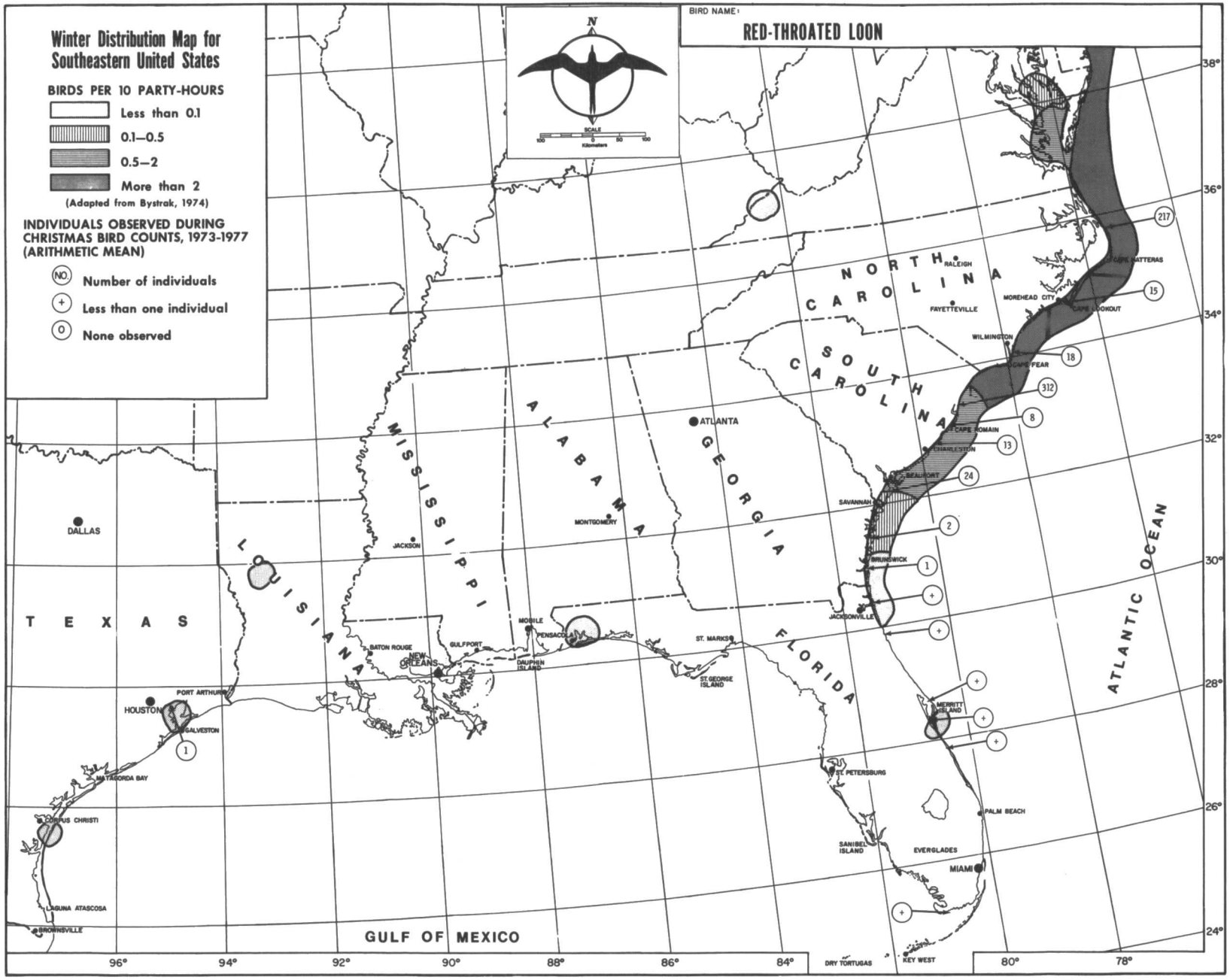
World Distribution The breeding distribution is holarctic, primarily in tundra lakes and ponds. In the Palearctic this loon breeds in coastal Greenland, Iceland, Spitzbergen, Franz Joseph Land, the Faroes, Orkneys, and Shetlands, in northern Scotland, northwestern Ireland, most of Norway, Sweden, and Finland, and in the U.S.S.R. from the Gulf of Bothnia east across northern Russia and Siberia to Kamchatka and Sahkalin Island. It winters south in Europe to Spain and Portugal, sparsely in the Mediterranean, in the Black Sea, and on the Pacific coast of Asia south to Hainan Island (AOU 1957, Palmer 1962, Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Red-throated Loons are common in winter on the Carolina coasts, fairly common on the Georgia coast, and uncommon on the Atlantic coast of Florida (Map 1). They are very uncommon in the Gulf of Mexico, but have been recorded in all the Gulf States.

North Carolina Red-throated Loons are common winter residents in saltwater areas but are rare inland. Occasionally, large concentrations are reported, such as the 500 seen from the ferry between Ocracoke and Cedar islands, 30 November 1974 (Teulings 1975a). There are a few records of summering birds (Teulings 1970b, 1971d, 1972a, 1973d). Fall migration seems to be primarily in late October and November (Teulings 1971a, 1973a, 1974a, 1976a).

South Carolina Red-throated Loons are common in winter. A concentration of "over 1,000 Red-throated Loons were counted" at the mouth of the Edisto River, Charleston County, 10 March 1962 (Burton 1970). They are recorded inland only occasionally (Sprunt and Chamberlain 1949, Burton 1970).


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1—0.5
0.5—2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
O None observed
BIRD NAME:
RED-THROATED LOON
N
SCALE
Kilometers
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
TEXAS
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
RALEIGH
FAYETTEVILLE
MOREHEAD CITY
CAPE HATTERAS
CAPE LOOKOUT
WILMINGTON
CAPE FEAR
CAPE ROMAIN
CHARLESTON
BEAUFORT
SAVANNAH
BRUNSWICK
JACKSONVILLE
ST. MARKS
ST GEORGE ISLAND
MERRITT ISLAND
ST. PETERSBURG
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
DRY TORTUGAS
KEY WEST
ATLANTA
MONTGOMERY
MOBILE
PENSACOLA
DAUPHIN ISLAND
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
DALLAS
PORT ARTHUR
HOUSTON
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
217
15
18
312
8
13
24
2
1
1
38°
36°
34°
32°
30°
28°
26°
24°
96°
94°
92°
90°
88°
86°
84°
80°
78°

Georgia Burleigh (1958) called the Red-throated Loon a "rare winter visitant", but his estimates of seabird abundance on the Georgia coast are uniformly lower than those of others to the north and south. Denton et al. (1977) called it fairly common in winter. In recent years, there have been several reports of migrants inland (Teulings 1973a, 1974a, 1976a).

Florida - Atlantic Coast This loon is uncommon but regular on the Atlantic coast of Florida (Sprunt 1954, Stevenson 1978, Kale 1979 ms a). It is casual on the Florida Keys (Edscorn 1978, Stevenson 1978, 1979).

Florida - Gulf Coast Red-throated Loons are much rarer on the west coast of Florida than on the east coast. There have been about eight reported on or near the Gulf coast since 1970 (Stevenson 1975, 1977, 1978; Hamilton 1976).

Alabama Imhof (1976b) called Red-throated Loons "rare" in winter in Alabama on the basis of about 16 sight records, and gave extreme dates of 1 November and 1 May. Purrington (1977) and Imhof (1978) provide additional records.

Mississippi The status of Red-throated Loons in Mississippi seems to be similar to that in Alabama, i.e., a rare winter visitor. There are now eight records for the state (Hamilton 1979).

Louisiana Lowery (1974) listed four Louisiana records, all in the period from December to March.

Texas The Red-throated Loon is decidedly rare in Texas. Oberholser (1974) listed four specimens and sight records for 13 locations (multiple sightings at some localities are probable). In recent years, this bird has appeared nearly every year at a few favored localities, notably the Texas City Dike, Galveston County, and Rockport and Aransas Pass, Aransas County (Webster 1970b, 1971c, 1974b, 1975b, 1976b, 1976c, 1977b).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Red-throated Loons breed on the shores of small lakes and ponds across the tundra of North America, Eurasia, Greenland, Iceland, and Spitzbergen, as well as in Scotland, the Faroes, and the Aleutian Islands. Their breeding range extends south into boreal forest areas in western North America and probably elsewhere. Estimates of the world population are not available.

Winter Red-throated Loons winter along coasts from the southern portions of their breeding range south to Baja California and Hainan Island in the Pacific, to the Florida Keys and the Iberian Peninsula in the Atlantic, and to the Baltic, Black, and northern Mediterranean seas (Cramp et al. 1977).

Migration The main migration route for Red-throated Loons wintering in the southeast is along the Atlantic coast (Palmer 1962). The route taken by the small numbers wintering in the Gulf is unknown. Scattered records inland along the Mississippi River suggest there may be a very limited overland migration. These loons begin arriving off South Carolina by mid-October and

are off Florida by mid-November. Departure from the latter area occurs in late March and April (Palmer 1962).

HABITAT

Nesting Red-throated Loons breed on freshwater lakes and ponds, usually in treeless areas (Cramp et al. 1977), although Pearse (1946) described a nest site in forested terrain. They can use smaller ponds than other loons, and may even breed on ponds of less than 1 ha (Bundy 1976). The nest is placed in grass, sedges, or other low vegetation along the margin of an island or along the shore of a pond or lake (Bundy 1976, Petersen 1976).

Feeding Red-throated Loons breeding on small ponds fly to larger bodies of fresh or saltwater to feed. At other times of year they feed in ponds, lakes, estuaries, and nearshore areas of the oceans. They probably restrict themselves to waters where they can dive to the bottom.

Winter and Offshore These loons winter almost exclusively on saltwater, and are found inland much less frequently than other loons (Palmer 1962). A majority of the inland records from the southeast appear to be of transients. Red-throated Loons tend to occupy shallower water in winter than Arctic or Common loons (Palmer 1962, W. Hoffman pers. observ.) but they probably move to deeper areas of bays and inlets at night.

FOOD AND FEEDING BEHAVIOUR

Red-throated Loons mainly eat fish. Cramp et al. (1977) listed their foods as a variety of pelagic (cod, herring, sprat), demersal (gobies, sticklebacks), and benthic (flounders, sculpins) marine fishes, in addition to such freshwater fish as trout, roach (*Rutilus*), dace, and perch. In Arctic Canada, Davis (1972) reported that food brought to young birds included capelin, blennies (*Lumpenus*), sand lances (*Ammodytes*), trout, and sculpins. Cramp et al. (1977) also listed fish spawn, frogs, crustaceans, molluscs, insects, and annelids in the diet.

Red-throated Loons feed primarily by pursuit diving. Their feet and occasionally their wings are used for propulsion (Cramp et al. 1977). They occasionally feed on the surface where they seize their prey.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying In western Alaska (Petersen 1976) and Quebec (Johnson and Johnson 1935), egg laying took place from late May into June. In the Shetland Islands, Bundy (1976) reported laying from mid-May to mid-June, 1973-74.

Mean Clutch Size Most nests of the Red-throated Loon contain two eggs, although one or three eggs are sometimes found. In 63 nests in the Shetlands, Bundy (1976) reported a mean of 1.8 eggs. In a 3 year study (1967-69) on the McConnell River, Northwest Territories, Davis (1972) found that the annual

mean clutch size varied from 1.80 to 1.87 eggs in a total of 87 nests.

Incubation Period Bundy (1976) reported incubation periods of 24-29 days. Keith (1937) and Drury (1961) reported incubation periods of 26 and 27 days for two nests.

Hatching Success In a 3-year study, the number of birds hatched per nest ranged from 0.96 to 1.47 (Davis 1972). This represented 53-78% of all the eggs laid. Lower success rates in other studies involved either much smaller samples (Petersen 1976) or excessive nest disturbance (Johnson and Johnson 1935, Bundy 1976).

Fledging Success A series of studies (Bundy 1976, 1978b) yielded figures of 0.37-0.51 birds fledged per pair, or about 0.2 fledglings per egg laid.

Age at Fledging Petersen (1976) reported fledging ages (defined as time of flight from the breeding ponds) for three birds. One fledged in 55 days, and the others in 58 days. Bundy (1976) defined fledging as the time when young assumed complete juvenile plumage and lost all visible down. He reported a range of fledging ages from 38 to 48 days (mean = 42) for 27 birds. Johnson and Johnson (1935) reported one bird which had not yet flown at age 49 days.

Age at First Breeding Age at first breeding has not been accurately established, but Palmer (1962) believed that it is probably 2 years. The molt schedule given in Cramp et al. (1977) indicates that yearlings do not breed.

Mortality of Eggs and Young Predation by gulls (Johnston and Johnston 1935), jaegers, and foxes (Petersen 1976) causes high egg and chick mortality. Bundy (1978b) found that human activity in the vicinity of nesting ponds reduced nesting success, especially in areas where avian predators were common. Davis (1972) noted predation by Sandhill Cranes (*Grus canadensis*) on Red-throated Loon eggs, and reported that one clutch was lost to flooding.

Renesting At Shetland (60° N latitude), Bundy (1976) found 14 replacement clutches for 23 pairs that lost first nests. Most of those that did not renest had initially nested late. Renesting is much rarer farther north of this latidude where the ice-free nesting season is shorter (Davis 1972, Petersen 1976).

Maximum Natural Longevity Rydzewski (1978) listed a bird banded as a juvenile that had attained an estimated minimum age of 23 years and 8 months.

Weight (in grams) Palmer (1962) gave a range of 1,600-2,000 for summer males, and 1,600-1,800 for summer females. Data from Cramp et al. (1977) show both seasonal and sexual variation in European birds:

	Summer			Winter		
Sex	N	Mean	Range	N	Mean	Range
Male	7	1,729	1,370-1,900	6	1,341	1,170-1,456
Female	5	1,477	1,410-1,613	9	1,144	988-1,302

SUSCEPTIBILITY TO OIL POLLUTION

Loons are highly susceptible to oiling, although they are often poorly represented on beached bird counts. Tanis and Morzer Bruyns (1968) reported seeing hundreds of oiled Red-throated Loons in the North Sea "sinking irretrievably at sea", but very few of them washed up on the adjacent beaches. They have appeared in small numbers in oiled bird counts from European and American beaches (Table 5). More may be oiled than this table indicates because most reports of oiling combine the several species of loons under one heading.

Peterson (1942) reported four oiled Red-throated Loons from Oregon Inlet, North Carolina, early in World War II when German submarines sank ships that subsequently spilled oil.

King and Sanger (1979) give an Oil Vulnerability Index of 49 to this species, indicating that they considered these loons a "mid-risk" species in the Pacific Northwest.

Table 5. Number of dead birds and number and percentage of dead Red-throated Loons found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Red-throated Loons	Percentage of Red-throated Loons	Source
San Francisco Bay area, California	Mar. 1937	397 (a)	14	3.53	Aldrich 1938
Island Beach, New Jersey	Jan. 1945	92 (b)	10	10.87	Kramer and Kramer 1945
North-central Kattegat, Denmark	Jan.-Feb. 1962	1,723 (a,b)	6	0.35	Joensen 1972a
Southeast Kent, England	winters of 1963-64 to 1965-66	509 (a)	10	1.96	Gibson 1966
N. Sjaelland, Denmark	Feb.-Mar. 1965	2,340 (a)	44	1.88	Joensen 1972a
North Sea coast, Denmark	1965-1966	803 (a)	43	5.35	Joensen 1972a
Northeast England	Jan. 1966	805	12	1.49	Parrack 1967

Table 5. Continued.

Area	Dates	Number of oiled dead birds	Number of dead Red-throated Loons	Percentage of Red-throated Loons	Source
Pagham Harbour area, W. Sussex, England	Jan.-Feb. 1967	91 (a,c)	2	2.20	Phillips 1967
Tay Estuary, Scotland	Mar.-Apr. 1968	1,168 (c)	6	0.51	Greenwood and Keddie 1968
N. Sealand, Denmark	Feb.-Mar. 1969	2,376 (a)	1	0.04	Joensen 1972b
Northeast Britain	Jan.-Feb. 1970	10,992 (a,b)	69	0.63	Greenwood et al. 1971
S. Kattegat, Denmark	Dec. 1970-Jan. 1971	2,311 (a)	1	0.04	Joensen 1972b
San Francisco Bay, California	Jan. 1971	3,221 (a,c)	64	1.99	Smail et al. 1972
Djursland-Anholt, Denmark	Mar. 1971	239	1	0.42	Joensen 1972b
North-central Kattegat, Denmark	Mar. 1972	4,759 (a)	26	0.55	Joensen and Hansen 1977
Waddensea, Denmark	Dec. 1972	9,151 (a)	23	0.25	Joensen and Hansen 1977

(a) Total includes only those birds identified to species.
(b) Total includes some birds that were not oiled.
(c) Total includes both live and dead oiled birds.
(d) This figure represents birds brought to cleaning/receiving stations.

BIBLIOGRAPHY

1980

Reimchen, T. E. and S. Douglas. 1980. Observations of loons (*Gavia immer* and *G. stellata*) at a bog lake on the Queen Charlotte Islands. Can. Field Nat. 94: 398-404.

1978

Bundy, G. 1978a. Possible polygamy by Red-throated Divers. Brit. Birds 71: 179-181.

Bundy, G. 1978b. Breeding Red-throated Divers in Shetland. Brit. Birds 71: 199-208.

Merrie, T. D. H. 1978. Relationship between spatial distribution of breeding divers and the availability of fishing waters. Bird Study 25: 119-122.

Weber, W. C. 1978. Red-throated Loon sightings on Ship and Horn islands, Mississippi. Mississippi Kite 8: 10-11.

1977

Bergman, R. D. and D. V. Derksen. 1977. Observations on Arctic and Red-throated loons at Storkersen Point, Alaska. Arctic 30: 41-51.

1976

Bundy, G. 1976. Breeding biology of the Red-throated Diver. Bird Study 23: 249-256.

Muller, H. 1976. "Wasserlugen" beim Sterntaucher (Gavia stellata) sowie allgameine Bemerkungen zum "Wasserlugen." Vogelwelt 97: 68-71. [In German.]

Norberg, R. A. and U. M. Norberg. 1976. Size of fish carried by flying Red-throated Divers Gavia stellata (Pont.) to nearly fledged young in nesting tarn. Ornis Fenn. 53: 92-95.

Petersen, M. R. 1976. Breeding biology of Arctic and Red-throated loons. M. S. thesis, Univ. Calif./Davis. 55 pp.

Sage, B. L. 1976. Breeding success of Red-throated Divers on Hascosay. Brit. Birds 69: 409.

1975

Cyrus, D. P. 1975. Breeding success of Red-throated Divers on Fetlar. Brit. Birds 68: 75-76.

Falk, L. F. 1975. Loons on Middle Atlantic Region Christmas counts. Delmarva Ornithol. 10: 9-11.

Gloe, P. 1975. Feindverhalten von Sterntauchern (Gavia stellata) ausserhalb der Brutzeit an Land. Ornithol. Mitt. 27: 215-217. [In German.]

1974

Jakobs, B. and M. Jakobs. 1974. Zum Verhalten des Sterntauchers (Gavia stellata) am Nest. Ornithol. Mitt. 26: 169-172. [In German.]

1973

Meltofte, H. and T. Korboe. 1973. [The occurrence of divers Gaviidae at Blavand, 1963-71.] Dan. Ornithol. Foren. Tidsskr. 67: 109-114. [In Danish with English summary.]

1972

Davis, R. A. 1972. A comparative study of the use of habitat by Arctic Loons and Red-throated Loons. Ph. D. thesis, Univ. W. Ontario/Guelph, ON. xix and 290 pp.

1971

Bylin, K. 1971. [Courtship and calls of the Red-throated Loon Gavia stellata.] Var Fagelvarld 30: 79-83. [In Swedish with English summary.]

Davis, R. A. 1971. Flight speed of Arctic and Red-throated loons. Auk 88: 169.

Norberg, R. A. and U. M. Norberg. 1971. Take-off, landing and flight speed during fishing flights of Gavia stellata (Pont.). Ornis Scand. 2: 55-67.

1968

Lindberg, P. 1968. Nagot om Storlommens (Gavia arctica L.) och Smalommens (Gavia stellata L.) ekologi. [On the ecology of the Black-throated Diver (Gavia arctica) and the Red-throated Diver (Gavia stellata).] Zool. Revy 30: 83-88. [In Swedish with English summary.]

Simkin, D. W. 1968. Red-throated Loon nesting in northern Ontario. Can. Field Nat. 82: 49.

von Braun, C., A. C. Hessle and S. Sjolander. 1968. Smalommens (Gavia stellata L.) beteende under ungvardnadstiden. [Behavior of the Red-throated Diver (Gavia stellata L.) when caring for the young.] Zool. Revy 30: 94-95. [In Swedish with English summary.]

1966

Hall, A. B. and G. P. Arnold. 1966. Brief observations on a pair of Red-throated Divers (Gavia stellata) nesting in East Greenland. Dan. Ornithol. Foren. Tidsskr. 60: 141-145. [In English with Danish summary.]

1956

Sutton, G. M. and D. F. Parmalee. 1956. On the loons of Baffin Island. Auk 73: 73-84.

1954

Pearse, T. 1954. Further notes on Red-throated Loons nesting on Vancouver Island, British Columbia. Condor 56: 308-309.

1952

Gudmundsson, F. 1952. Islenzkir fuglar II. Lomur (Colymbus stellatus Pontopp.). [Icelandic Birds II. The Red-throated Diver (Colymbus stellatus Pontopp.)]. Natturufraedingurinn 22: 76-77. [In Icelandic with English summary.]

Harle, D. F. 1952. Red-throated Diver taking off from the ground. Brit. Birds 45: 331-332.

1946

Pearse, T. 1946. The nesting of the Red-throated Loon on Vancouver Island, British Columbia. Condor 48: 262-264.

1941

Brandt, M. 1941. Uber das Brutvorkommen der Silbermowe (Larus argentatus omissus) und des Sterntauchers (Colymbus stellatus) im Ostbaltikum. J. Ornithol. 89: 257-267. [In German.]

1940

Brandt, M. 1940. An den Brut staten des Nordseetauchers in Lettland. Beitr. Fortpfl. Vogel 16: 135-139. [In German.]

1937

Keith, D. B. 1937. The Red-throated Diver in North East Land. Brit. Birds 31: 66-81.

1935

Johnson, R. A. and H. S. Johnson. 1935. A study of the nesting and family life of the Red-throated Loon. Wilson Bull. 47: 97-103.

Serle, W., Jr. 1935. Mortality amongst young Red-throated Divers. Brit. Birds 29: 181-182.

1934

Vasvari, N. 1934. Die Bedeutung der Magensteine (Gastrolithe) bei den Seetauchern (Columbus). [The importance of gastroliths in the divers (Colymbus)]. Proc. VIIIth Intern. Ornithol. Congr., Oxford 1934: 730-743. [In German.]

1931

McWilliam, J. M. 1931. On the breeding of the Black-throated and Red-throated divers in south Argyllshire. Scott. Nat. 1931: 161-164.

1929

Stevenson, J. 1929. Red-throated Loon in northern Illinois. Auk 46: 529.

1923

Huxley, J. S. 1923. Courtship activities in the Red-throated Diver (*Colymbus stellatus* Pontopp.), together with a discussion of the evolution of courtship in birds. J. Linn. Soc. Lond. (Zool.) 35: 253-292.

1922

van Oordt, G. J. and J. S. Huxley. 1922. Some observations on the habits of the Red-throated Diver in Spitsbergen. Brit. Birds 16: 34-36.

ARCTIC LOON

(*Gavia arctica*)

[DA: Sortstrubet Lom, DU: Parelduiker, EN: Black-throated Diver, FI: Kuikka, FR: Plongeon lumme, Plongeon arctique; GE: Polartaucher, Prachttaucher; IC: Glitbrusi, IT: Strolaga mezzana, JA: O-hamu, NW: Storlom, PO: Nur czarnoszyi, PR: Mergulhao, RU: (Black-cropped or Striped Loon), SP: Somorgujo Artico, Colimbo artico; SW: Storlom, US: Pacific Loon]

GENERAL DISTRIBUTION

North America The Arctic Loon breeds from St. Lawrence Island and Alaska east to Baffin Island and the west coast of the Ungava Peninsula, and south to the Alaska Peninsula, northern Mackenzie, northern Alberta and Manitoba, and northwestern Ontario (Hudson Bay). It winters on the Pacific coast from coastal southern Alaska to southern Baja California and Sonora (AOU 1957, Palmer 1962, Storer 1979a). Arctic Loons are regular but rare in winter on the New England coast (Griscom 1943), and very rare in the southeastern states.

World Distribution The form *G. a. arctica* breeds across Arctic Eurasia from Scandinavia to the Lena River, where it is replaced by *G. a. viridigularis*. The latter breeds eastward to the Bering Sea and western Alaska. The species winters in the Baltic and on the Atlantic and North Sea coasts of Europe from northern Norway to the Bay of Biscay, in the Adriatic, Aegean, Black, and Caspian seas (Vaurie 1965, Cramp et al. 1977), and in the Pacific south to Japan (Storer 1979a).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The Arctic Loon is a rare but perhaps regular winter visitor in the southeast. We have substantiated records from Florida and coastal Texas. There are also a number of sight records from Texas, two from Alabama, and one from North Carolina. We have not listed the Texas sight records because many of them clearly could have been small Common Loons.

North Carolina There is one sight record:

1974	17 Feb.	1 seen	Ocracoke, Pamlico Co.	Teulings 1974b

Florida We have four specimen records of Arctic Loons from Florida.

1959	2 Nov.	1 found dead (USNM #431142)	Palm Beach, Palm Beach Co.	Langridge 1960

Taxonomic note: Some authors have treated the form *G. a. pacifica* of northeastern Siberia and North America as a distinct species, but we follow the taxonomic treatment of Storer (1978).

1971	14 Dec.	1 coll.	Wakulla River, Wakulla Co.	Stevenson 1972
1975	20 Apr.	1 found dead	Dry Tortugas, Monroe Co.	Kittleson 1976
1976	12 Apr.	1 found sick	Indian Rocks Beach, Pinellas Co.	Hopkins and Woolfenden 1977

Alabama There are two records:

1975	27-31 Dec.	1 seen	Oak Mountain St. Park Lake, Shelby Co.	Imhof 1975b, 1977b
1977	31 Dec.	1 seen	Gulf Shores, Baldwin Co.	Hamilton 1978

Mississippi There is one sighting of a bird thought to be of this species.

1976	13 Nov.	1 seen	Sardis Lake, Sardis Co.	Purrington 1977

Texas We know of one coastal Texas specimen (and one from inland) and of about 15 sight records from the coast. Many of the latter are merely based on size and may be misidentified Common Loons. In winter plumage, Arctic Loons are extraordinarily difficult to distinguish from small Common Loons, and the Texas records fail to report the characters most useful in identification.

1963	28 Mar.	1 specimen	Rockport, Aransas Co.	Blacklock 1978 ms

HABITAT

Nesting Arctic Loons nest on lakes and ponds, usually in tundra, moorlands, or other essentially treeless habitat. They tend to use larger ponds than Red-throated Loons, apparently because they are heavier bodied and need more room for a take-off (Petersen 1976).

Feeding Arctic Loons, like other loons, feed entirely in the water. In the breeding season they usually feed on their breeding ponds, but may move to nearby lakes to feed (Davis 1972, Petersen 1976). In winter they move almost exclusively to salt water.

Winter and Offshore Wintering Arctic Loons occur in estuaries, lagoons, and in the ocean within a few km of shore. They may range a little farther offshore than Common or Red-throated loons (Baltz and Morejohn 1977).

FOOD AND FEEDING BEHAVIOR

Arctic Loons feed by pursuit diving and occasionally by surface-dipping. They eat mostly fish, but also take a variety of invertebrates and occasionally plant material (Palmer 1962).

SUSCEPTIBILITY TO OIL POLLUTION

Arctic Loons are vulnerable to floating oil, but their rarity within the southeast greatly reduces the potential for significant oiling mortality in that area. They show up regularly in small numbers on European beached bird surveys (Table 6). Loons are not identified to species in all reports of bird mortality resulting from oiling, and many loons are apparently carried away by currents or sink in deep water rather than wash ashore. King and Sanger (1979) give an Oil Vulnerability Index of 58 to this species in the Pacific Northwest.

Table 6. Number of dead birds and number and percentage of dead Arctic Loons found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Arctic Loons	Percentage of Arctic Loons	Source
San Francisco Bay area, California	Mar. 1937	397 (a)	2	0.50	Aldrich 1938
North-central Kattegat, Denmark	Jan.-Feb. 1962	1,723 (a,b)	70	4.06	Joensen 1972a
North Sea coast, Denmark	1965-1966	803 (a)	7	0.87	Joensen 1972a
TORREY CANYON (c) oil spill, SW Britain	Mar. 1967	1,223	1	0.08	Bourne et al. 1967
Bornholm, Denmark	Jan.-Feb. 1968	466 (a)	3	0.64	Joensen 1972a
N. Sealand, Denmark	Feb.-Mar. 1969	2,376 (a)	2	0.08	Joensen 1972b
Northeast Britain	Jan.-Feb. 1970	10,992 (a,b)	3	0.03	Greenwood et al. 1971
S. Kattegat, Denmark	Dec. 1970-Jan. 1971	2,311 (a)	4	0.17	Joensen 1972b

Table 6. Continued

Area	Dates	Number of oiled dead birds	Number of dead Arctic Loons	Percentage of Arctic Loons	Source
San Francisco Bay, California	Jan. 1971	3,221 (a,c)	21	0.65	Smail et al. 1972
Djursland-Anholt, Denmark	Mar. 1971	239	8	3.35	Joensen 1972b
North-central Kattegat, Denmark	Mar. 1972	4,759 (a)	14	0.29	Joensen and Hansen 1977
Waddensea, Denmark	Dec. 1972	9,151 (a)	4	0.04	Joensen and Hansen 1977
AMOCO CADIZ spill, NW France and Channel Islands	Mar. 1978	3,770 (a,e)	58	1.54	Hope Jones et al. 1978

(a) Total includes only those birds identified to species.
(b) Total includes some birds that were not oiled.
(c) This sample is from a spill that was believed to have killed more than 30,000 seabirds.
(d) This figure represents birds brought to cleaning/recieving stations.
(e) Total includes both live and dead oiled birds.

BIBLIOGRAPHY

1980

Andersson, A., P. Lindberg, S. G. Nilsson and A. Pettersson. 1980. Storlommens Gavia arctica hacknings framgang i Svenska sjoar. [Breeding success of the Black-throated Diver, Gavia arctica, in Swedish lakes.] Var Fagelvarld 39: 85-94. [In Swedish with English summary.]

Bruner, A. 1980. First fall record of Arctic Loon in Indiana. Indiana Aud. Q. 58: 61-62.

Eckert, K. R. 1980. The Arctic Loon in Minnesota: a revised look at its status and identification. Loon 52: 59-61.

Grenmyr, U. and J.-A. Sundin. 1980. Storlommens forekomst langs Norrlandskusten. [The number of breeding Black-throated Divers, Gavia arctica, along the coast of North Sweden.] Var Fagelvarld 39: 100-101. [In Swedish with English summary.]

Bundy, G. 1979. Breeding and feeding observations on the Black-throated Diver. Bird Study 26: 33-36.

Petersen, M. R. 1979. Nesting ecology of Arctic Loons. Wilson Bull. 91: 608-617.

Tessen, D. D. 1979. Arctic Loon--Ozaukee County, November 1, 1978-4:15 p.m. Passenger Pigeon 41: 140.

1978

Abraham, K. F. 1978. Adoption of Spectacled Eider ducklings by Arctic Loons. Condor 80: 339-340.

Dennis, R. H. 1978. [Letter on] Field identification of Black-throated Diver in winter. Brit. Birds 71: 225-226.

Enquist, M. 1978. Storlommons *Gavia arctica* beteende under varen i Bravi ken. [Behavior of the Black-throated Diver in Braviken during spring.] Var Fagelvarld 37: 325-332. [In Swedish with English summary.]

Faanes, C. and R. Faanes. 1978. Third Wisconsin record of the Arctic Loon. Passenger Pigeon 40: 412-413.

Fitzpatrick, J. 1978. [Letter on] Field identification of Black-throated Diver in winter. Brit. Birds 71: 226.

Jackson, S. 1978. [Letter on] Diving methods of Great Northern and Black-throated divers. Brit. Birds 71: 317.

Merrie, T. D. H. 1978. Relationship between spatial distribution of breeding divers and the availability of fishing waters. Bird Study 25: 119-122.

Nilsson, S. G. and A. Pettersson. 1978. Det svenska Storlombestandets storlek. [An estimate of the population size of the Black-throated Diver *Gavia arctica* in Sweden.] Var Fagelvarld 37: 251-253. [In Swedish with English summary.]

Schipke, R. and G. Creutz. 1978. Ubersommende Prachtaucher *Gavia arctica* (L.). [Arctic Loon *Gavia arctica* (L.).] Beitr. Vogelkd. 24: 171-173. [In German.]

Sjolander, S. 1978. Reproductive behavior of the Black-throated Diver *Gavia arctica*. Ornis Scand. 9: 51-65.

Storer, R. W. 1978. Systematic notes on the loons (Gaviidae: Aves). Breviora No. 448: 1-8.

1977

Abbott, J. M. 1977. Arctic Loon at Assateague Island, Virginia, in April 1976. Raven 48: 25-26.

Bergman, R. D. and D. V. Derksen. 1977. Observations on Arctic and Red-throated loons at Storkersen Point, Alaska. Arctic 30: 41-51.

Hopkins, L. and G. E. Woolfenden. 1977. Fourth record of the Arctic Loon from Florida. Fla. Field Nat. 5: 12.

Imhof, T. A. 1977b. Arctic Loon, a new species for Alabama. Am. Birds 31: 378.

Nilsson, S. G. 1977. Adult survival rate of the Black-throated Diver Gavia arctica. Ornis Scand. 8: 193-195.

Vermeer, K. 1977. Some observations on Arctic Loons, Brandt's Cormorants and Bonaparte's Gulls at Active Pass, British Columbia. Murrelet 58: 45-47.

1976

Bolduc, D. 1976. Arctic Loon on Lake Harriet. Loon 48: 184-185.

Kittleson, B. C. 1976. Third record of the Arctic Loon from Florida. Fla. Field Nat. 4: 17.

Petersen, M. R. 1976. Breeding biology of Arctic and Red-throated loons. M. S. thesis, Univ. Calif./Davis. 55 pp.

1975

Dunker, H. 1975. Sexual and aggressive display of the Black-throated Diver Gavia arctica (L.). Norw. J. Zool. 23: 149-163.

Gordon, S. 1975. First days in the life of a Black-throated Diver. Scott. Birds 8: 319.

Imhof, T. A. 1975b. Arctic Loon, new species for Alabama. Ala. Birdlife 23: 16.

McNicholl, M. K. 1975. Arctic Loon "checking" nest. Auk 92: 393-394.

1974

Dunker, H. 1974a. Observasjoner av populasjonstetthet hos Storlom, Gavia arctica L., i Rogen-omradet, ostre Femundsmarka, i 1967 og 1971. [Observations on the population density of the Black-throated Diver, Gavia arctica L., in the Rogen Area, eastern Femundsmarka, in 1967 and 1971.] Fauna 27: 11-16. [In Norwegian with English summary.]

Dunker, H. 1974b. Habitat selection and territory size of the Black-throated Diver, Gavia arctica (L.), in South Norway. Norw. J. Zool. 22: 15-29.

Hatler, D. F. 1974. Bald Eagle preys upon Arctic Loon. Auk 91: 825-827.

Lehtonen, L. 1974. Zur individuellen Erkennung des Prachttauchers Gavia a. arctica im Brutklied. Ornis Fenn. 51: 117-121. [In German with English summary.]

McIntyre, A. E. and J. W. McIntyre. 1974. Spots before the eyes, an aid to identifying wintering loons. Auk 91: 413-415.

Robertson, I. and M. Fraker. 1974. Apparent hybridization between a Common Loon and an Arctic Loon. Can. Field Nat. 88: 367.

Schuz, E. 1974. Uber den Zug von Gavia arctica in der Palaarktis. Ornis Fenn. 51: 183-194. [In German with English summary.]

1973

Arnold, K. A. and J. C. Henderson. 1973. First specimen of Arctic Loon from Texas. Auk 90: 420-421.

Dunker, H. and K. Elgmork. 1973. Nesting of the Black-throated Diver, Gavia arctica (L.) in small bodies of water. Norw. J. Zool. 21: 33-37.

1972

Davis, R. A. 1972. A comparative study of the use of habitat by Arctic Loons and Red-throated Loons. Ph. D. thesis, Univ. W. Ontario/Guelph, ON. xix and 290 pp.

Hohn, E. O. 1972. Arctic Loon breeding in Alberta. Can. Field Nat. 86: 372.

Schwilling, M. D. 1972. Arctic Loon taken from Wilson Reservoir. Kansas Ornithol. Soc. Bull. 23: 13-14.

1971

Carlson, C. W. 1971. Arctic Loon at Ocean City, Maryland. Md. Birdlife 27: 68-72.

Davis, R. A. 1971. Flight speed of Arctic and Red-throated loons. Auk 88: 169.

Easterla, D. A. and F. Lawhon. 1971. First specimen of Arctic Loon from Missouri. Auk 88: 175.

Pynnonen, A. 1971. On the interspecific aggressiveness of the Black-throated Diver Gavia arctica. Ornis Fenn. 48: 133-134.

1970

Jones, R. N. and M. Obbard. 1970. Canada Goose killed by Arctic Loon and subsequent pairing of its mate. Auk 87: 370-371.

Lehtonen, L. 1970. Zur Biologie des Prachttauchers, Gavia a. arctica (L.). [Biology of the Black-throated Diver, Gavia a. arctica (L.).] Ann. Zool. Fenn. 7: 25-60. [In German with English summary.]

Peck, G. K. 1970. First Ontario nest records of Arctic Loon and Snow Goose. Ont. Field Biol. 24: 25-28.

1968

Butler, R. W. 1968. Display of Black-throated Divers on sea. Brit. Birds 61: 224-226.

Lindberg, P. 1968. Nagot om Storlommens (Gavia arctica L.) och Smalommens (Gavia stellata L.) ekologi. [On the ecology of the Black-throated Diver (Gavia arctica L.) and the Red-throated Diver (Gavia stellata L.).] Zool. Revy 30: 83-88. [In Swedish with English summary.]

Sjolander, S. 1968. Iakttagelser over Storlommens (Gavia arctica L.) etologi. [Observations on the ethology of the Black-throated Diver (Gavia arctica L.).] Zool. Revy 30: 89-93. [In Swedish with English summary.]

1967

Lensink, C. J. 1967. Arctic Loon predation on ducklings. Murrelet 48: 41.

1965

Easterla, D. A. 1965. Arctic Loons invade Missouri. Condor 67: 544.

Lehtonen, L. 1965. [On the migration and the occurences at the beginning of the breeding season of Gavia arctica.] Ornis Fenn. 42: 76-89. [In Finnish with German summary.]

1960

Langridge, H. P. 1960. Arctic Loon at Palm Beach. Auk 77: 351.

1956

Sutton, G. M. and D. F. Parmalee. 1956. On the loons of Baffin Island. Auk 73: 78-84.

1955

England, M. D. 1955. Unusual nest of Black-throated Diver. Brit. Birds 48: 276.

1954

Schuz, E. 1954. Vom Zug der westsibirischen Population des Prachttauchers (Gavia arctica). Vogelwarte 17: 65-80. [In German.]

1950

Grote, H. 1950. Zur Kenntnis des Prachttauchers (Colymbus arcticus L.). [Breeding biology of Gavia arctica L.] Zool. Garten 17: 87-90. [In German.]

1948

Robinson, M. G. 1948. Behavior of Black-throated Diver. Brit. Birds 41: 27.

1947

Thomson, J. M. 1947. The display of the Black-throated Diver. Brit. Birds 40: 90.

1944

Bodenstein, G. and E. Schuz. 1944. Vom Schliefenzug des Prachttauchers. Ornithol. Monatsber. 52: 98-105. [In German.]

1943

Griscom, L. 1943. Notes on the Pacific Loon. Bull. Mass. Audubon Soc. 27: 106-109.

Pennie, I. D. 1943. Display of a Black-throated Diver. Brit. Birds 37: 18.

1938

Kleinschmidt, O. 1938. Irisfarbe und Federwechsel der alten Prachttaucher. [Iris color and molting of an old Artic Loon.] Falco 34: 11-12. [In German.]

Vasvari, N. 1938. Die Bedeutung der Magensteine (Gastrolithe) bei den Seetauchern (Colymbus). [The importance of gastroliths in the divers (Colymbus).] Proc. VIIIth Internatl. Ornithol. Congr., Oxford 1934: 730-743. [In German.]

1931

McWilliam, J. M. 1931. On the breeding of the Black-throated and Red-throated divers in south Argyllshire. Scott. Nat. 1931: 161-164.

1925

Lonnberg, E. 1925. Nagra ord om Storlommen och dess slaktinger. [The Arctic Loon and its relatives.] Fauna Flora 1925: 3-9. [In Norwegian.]

1924

von Zedlitz, O. G. 1924. Aus der Kinderstube schwedischer Brutvogel. Beitr. Fortpfl. Biol. Vogel. 1: 4-6. [In German.]

1922

von Zedlitz, O. G. 1922. Ein Beitrag zur Biologie von Colymbus arcticus. [A contribution to the life history of Colymbus arcticus.] J. Ornithol. 70: 419-423. [In German.]

1913

von Zedlitz, O. G. 1913. Ein Bietrag zur Biologie des Prachttauchers, Urinator arcticus L. [A contribution to the biology of the Black-throated Diver, Gavia arctica L.] J. Ornithol. 61: 178-188. [In German.]

Oiled Common Loon on beach, Beacon Island, North Carolina.
Photograph by R. B. Clapp.

COMMON LOON

(*Gavia immer*)

[DA: Islom, DU: IJsduiker, EN: Great Northern Diver, FI: Amerikan jaakuikka, FR: Plongeon imbrin, GE: Eistaucher, IC: Himbrimi, IT: Strolage maggiore, NW: Islom, PO: Nur lodowiec, PR: Mergulhao, RU: (Arctic Loon), SP: Somorgujo Comun, Colimbo grande; SW: Islom, US: Black-billed Loon]

GENERAL DISTRIBUTION

North America Common Loons breed in Arctic and boreal areas from Alaska and northern Canada south to northern New England, the Great Lakes region, Minnesota, Washington, and casually to California. They are absent from most of the Canadian Arctic islands, but do breed on Baffin Island.

They winter mainly in coastal areas. In the Pacific, they winter from the Aleutians east and south to northern Baja California, and in the Atlantic from Labrador south to Florida and Texas. They occur much less commonly inland on large lakes and rivers (AOU 1957, Palmer 1962).

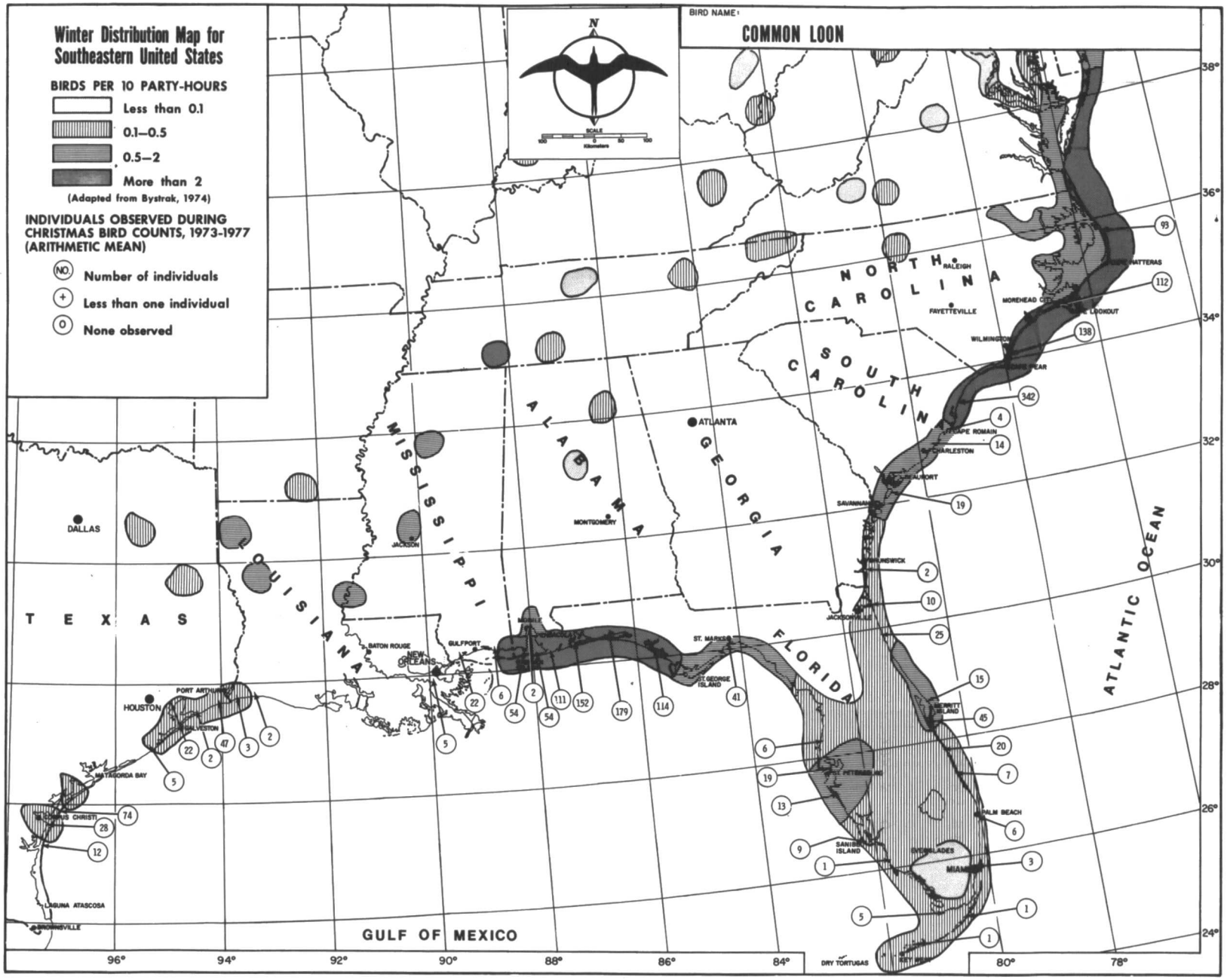
World Distribution In addition to their North American range, Common Loons breed in much of coastal Greenland and throughout Iceland. They winter in coastal Europe from Lapland south through the North Sea, around the British Isles to Spain and Portugal, to the Atlantic coast of Morocco, and to the Azores (Vaurie 1965, Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Common Loons winter along the Atlantic and upper Gulf coasts, and are regular but less common on the Texas coast and in southern Florida (Map 2). Imhof (1977b) commented that the "northern Gulf Coast from the mouth of the Mississippi R. to St. Mark's Refuge [Florida] probably winters more than 10,000 loons"; the great majority of these are Common Loons.

North Carolina Common Loons are common winter visitors along the coast (Pearson et al. 1942) but in recent years they have also been frequenting large inland impoundments (LeGrand 1978). They are normally dispersed along the coast but are occasionally seen in large concentrations, such as the 1,000 observed in the Cape Lookout Bight 8 March 1973 (Teulings 1973b), and the mixed flock of 5,000 Common and Red-throated loons reported near Ocracoke Island on 19 December 1970 (Teulings 1971b). Occasionally, nonbreeders have summered along the coast (Teulings 1972d) as well as inland.

South Carolina These loons are common in winter on the coast from mid-October to mid-May. They are much less common inland, and occur there mainly on migration (Sprunt and Chamberlain 1949). In recent years they have become more common on the piedmont impoundments, with counts as high as 47 at Lake Greenwood (Teulings 1977b), and 30 on Lake Murray (LeGrand 1977a).


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1–0.5
0.5–2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
O None observed
BIRD NAME:
COMMON LOON
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
JACKSON
MONTGOMERY
ATLANTA
BATON ROUGE
NEW ORLEANS
GULFPORT
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
MOBILE
ST. MARKS
ST. GEORGE ISLAND
JACKSONVILLE
BRUNSWICK
SAVANNAH
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
LOOKOUT
MOREHEAD CITY
HATTERAS
RALEIGH
FAYETTEVILLE
BERMUDA ISLAND
PALM BEACH
MIAMI
DRY TORTUGAS
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°
93
112
138
342
4
14
19
2
10
25
15
45
20
7
6
3
1
1
6
19
13
9
1
5
22
6
54
2
54
111
152
179
114
41
5
22
2
47
3
2
5
74
28
12

Georgia Burleigh (1958) called the Common Loon a winter resident, "possibly not uncommon, but actual records are not numerous". Recently (Teulings 1978a), concentrations have been seen on the Tugaloo River at Toccoa (89 birds, 11 April 1978). Fall arrival seems to be around 1 November, because the 1969 arrival date of 23 October was described as early (Parnell 1970), and the 1970 arrival date of 14 November was called the latest since 1963 (Teulings 1971a). Extreme dates of occurrence within the state are 30 September and 11 June (Denton et al. 1977).

Florida - Atlantic Coast Common Loons are common winter residents (Sprunt 1954). They occur from late October through May, with peak numbers in December through February (Kale 1979 ms a). They are very uncommon in the lower Florida Keys (Wetmore 1935, Hundley and Hames 1960-62, Robertson and Mason 1965). About 225 loons were found on beaches near St. Augustine in January 1974 (Stevenson 1974). In the winters of 1970-71 and 1976-77, major die-offs of Common Loons were reported for segments of the Florida east coast (Stevenson 1971, 1977).

Florida - Gulf Coast Common Loons are regular winter residents, most common in the panhandle and north peninsula, less so in the southern counties. An oil spill in Tampa Bay in 1970 apparently killed most of the loons wintering in that area, and the effects on the population were noticeable for several years (see below, under "Susceptibility to Oil Pollution"). Occasionally, nonbreeders summer in the area (Ogden 1972, 1973, 1974).

Alabama Common Loons are abundant winter residents of coastal Alabama. Imhof (1976b) gave dates of occurrence for the coast as 20 October to 27 May, and indicated that a few birds summer there. Concentrations of 426, 169, and 130 birds have been seen along the coast in November 1972, January 1973, and January 1972, respectively (Imhof 1976b, F. James 1972).

Mississippi Burleigh (1944) considered Common Loons rare to uncommon winter visitors to coastal Mississippi. Gandy and Turcotte (1970) called them common and at times abundant in the Mississippi Sound. Local concentrations of 31 and 50 were reported in coastal Mississippi in the winter of 1977-78 (Jackson and Cooley 1978a), and 45 were seen in Gulfport Harbor 16 January 1979 (Hamilton 1979). There are a few summer records (Weber and Jackson 1977, Purrington 1979), and a small die-off was reported at East Ship Island in May 1977 (three dead birds found, and "some of the living birds appeared ill", Weber and Jackson 1977). Weber and Jackson (1978) reported "many" off Horn Island, 30 October 1977, and 180 were seen along a 20 mi stretch of coast 7 December 1969 (F. James 1970).

Louisiana These loons are "moderately common only from November through mid-April" and are most common on Lake Pontchartrain and on coastal bays and lagoons (Lowery 1974). One unusually large concentration was a flock of 27 birds seen on the north shore of Lake Pontchartrain on 15 November 1970 (Purrington 1971).

Texas Common Loons are regular in winter, with extreme dates of 11 September and 10 June, but most are present from late October to late April (Oberholser 1974). They seem less common on the Texas coast than east of the

Mississippi Delta. Reports in American Birds since 1970 (Webster 1970b, 1971a, 1972b, 1973b, 1975b, 1976b) indicate a sharp decline in loon numbers since the mid-1960's. It is not clear whether this represents a shift in wintering area or a real population decline.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Common Loons breed largely in the subarctic portion of the Nearctic (AOU 1957, Cramp et al. 1977). No population estimate is available.

Winter This loon winters primarily along coasts, but is also found inland on the Great Lakes (Palmer 1962) and other large water bodies. Throughout most of the southeastern United States the Common Loon is a regular winter resident (Map 2). It is apparently less common in the Florida Keys and on the Texas coast than elsewhere in the southeast.

Migration In the southeast, fall migration seems to be concentrated in October and November. Earlier records exist (e.g., Edscorn 1975, 1978), but many of these refer to the occasional summering nonbreeders. Spring migration is much more protracted. It is well underway in March (Williams 1973), but many loons are still in the area in May. Loons on their wintering grounds apparently wait in spring until their breeding habitat is available and ice-free, and then migrate rapidly (W. Hoffman pers. observ. in Oregon, Washington, and Alaska; Petersen 1976). Thus, birds from the more southern parts of the breeding range might migrate in March, but birds breeding farther north may wait until late May, or even June, to begin their migration. Inland migrations do not seem to follow particular routes (Palmer 1962).

HABITAT

Nesting Common Loons nest solitarily on freshwater lakes in boreal forest and tundra areas. They choose lakes that are large enough for easy take-off and that have adequate food supplies (Olson and Marshall 1952). They prefer to nest on small islets (Palmer 1962).

Feeding While breeding, Common Loons apparently feed mostly in their nesting territories on freshwater lakes. In the winter they frequently defend feeding territories, but may join into rafts when not feeding (McIntyre 1978a). They feed in bays, inlets, lagoons, and nearshore areas of the ocean (B. King 1976, Baltz and Morejohn 1977, McIntyre 1978a, and W. Hoffman, pers. observ.).

Winter and Offshore Common Loons in winter are normally marine but remain within a few kilometers of shore. They regularly use enclosed harbors and inlets. Bent (1919) referred to groups of wintering loons "sometimes far out at sea", but this does not seem to agree with more recent observations.

FOOD AND FEEDING BEHAVIOR

Common Loons feed mainly on fish, but also eat crustaceans, insects, and

molluscs. Olson and Marshall (1952) found the fish Perca, Pomoxis, Lepomis, Micropterus, Stizostedion, Leucicthys, Esox, Ameiurus (Ictalurus), and unidentified catostomids and cyprinids in loon stomachs from Ontario and the Great Lakes States. Munro (1945) found that on British Columbia lakes without fish, loons could subsist on aquatic snails, insects, amphipods, and corixids. Vegetation is sometimes present in quantity in loon stomachs, but it may serve a mechanical rather than nutritive function.

In winter, loons seem to eat mostly fish and decapod crustaceans. Loons attempting to swallow flatfish and other large prey are a common sight on the Oregon coast and elsewhere (Munro 1945, McIntyre 1978b, W. Hoffman pers. observ.). Palmer (1962) summarized earlier reports of food habits on salt water. Fish eaten were "rock cod; flounder; sea trout (Salmo); herring (Clupea); surf fish (Cymatogaster aggregatus); killifish (Fundulus heteroclitus); menhaden (Brevoortia patronus); sculpin (Leptocottus armatus)."

Common Loons feed primarily by pursuit diving but also occasionally pick at items on the surface. They are excellent divers and may stay submerged for over 2 minutes. Kinnear (1978) recorded nine dives of one loon, averaging 90 seconds each, with rest periods of 20-40 seconds.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Olson and Marshall (1952) reported that nesting in Minnesota took place in June. Other studies indicate that newly laid clutches may be found in early or mid-May (Palmer 1962).

Mean Clutch Size Most clutches contain two eggs. Clutches of one are frequent, of three, rare (Palmer 1962). The average of 47 Minnesota clutches was 1.55, but all may not have been complete when checked (Olson and Marshall 1952).

Incubation Period The incubation period is 29 days (n = 2) (Olson and Marshall 1952).

Hatching Success Olson and Marshall (1952) reported that 1 of 19 one-egg nests and 15 of 22 two-egg nests succeeded. The sample of one-egg nests may have included nests in which one egg had already been removed by a predator. It is also not clear whether the hatching of one egg of a two-egg clutch is considered success.

Fledging Success In Minnesota, 21 young of 42 breeding pairs survived until 1 September (Palmer 1962).

Age at Fledging Olson and Marshall (1952) estimated 10-11 weeks to flight. They cited Wilson (1929) to the effect that young hatched in late May were not on the wing until late August. However, Wilson's comments are vague and it is not clear that he followed individuals for that period.

Age at First Breeding According to Palmer (1962), there is "no evidence

birds breed until at least 2 years old". There are however, no published records for age of first breeding based on marked birds.

Mortality of Eggs and Young Munro (1945) noted two fertile eggs that failed to hatch, and also noted two cases of nest desertion following discovery. Olson and Marshall (1952) considered predation (by crows, ravens, Herring Gulls, mink, otter, and muskrats) and desertion to be the main causes of nest failure. Desertion frequently followed human disturbance, but also occurred in areas of heavy beaver or muskrat activity. Olson and Marshall (1952) thought that early mortality of young was partly due to predation, weakness of one of the chicks, and human interference.

Renesting In the southern portions of their range, Common Loons regularly renest following loss of a clutch (Bent 1919). Olson and Marshall (1952) found 15 replacement clutches, and reported four pairs of loons that laid third clutches after losing their first two.

Maximum Natural Longevity A bird banded in Ontario was found dead in New Jersey at an estimated minimum age of 7 years, 10 months (Clapp et al. 1979 ms).

Weight (in grams) Six summer adult males in Minnesota averaged 3,510, and eight females, 3,000. These males ranged from 2,520 to 4,200, and the females from 1,600 to 3,860 (Olson and Marshall 1952; original data in pounds and ounces).

SUSCEPTIBILITY TO OIL POLLUTION

Loons are among the birds most vulnerable to oiling, which may cause considerable local mortality (Palmer 1962). They do not appear in large numbers on beached bird surveys (Table 7). They sleep on the water, and have a flightless molt period during late winter. There are at least three reasons why significant mortality of loons might be missed. First, on a worldwide basis, loon populations are much smaller and tend to be more dispersed than the auks and sea ducks that make up the bulk of reported oiling mortality. Second, loons may not seek shore as quickly when oiled, and thus are more likely to die in the water than are most other nearshore birds. Third, loons are less buoyant than other seabirds, and heavily oiled loons are more likely to sink upon death than similarly oiled ducks, auks, or other seabirds.

Indications of apparent low impact, such as the low loon totals on European beached bird surveys are probably not indicative of the actual vulnerability of loons. Combined data for three periods (1970-71, 1972-73, 1975) included only 65 loons out of 6,388 birds (Lloyd 1976, Croxall 1977).

There have been several instances of notable loon mortality from petroleum in the southeastern United States and Gulf of Mexico. Many beached Common Loons were reported from North Carolina (Peterson 1942) and Florida (Longstreet 1953-55). More recently, approximately 225 Common Loons were found dead or dying on beaches at St. Augustine, St. Johns County, Florida, between 12 and 20 January 1974 (Stevenson 1974). F. White et al. (1976) ex-

amined 124 of the dead loons found that winter; 76 (61%) had been oiled. The source of this oil was unknown.

In 1970, 10,000 gallons of Bunker C oil was spilled in Tampa Bay, Florida, and a slick of approximately 100 sq mi quickly formed. Because the spill occurred in a sheltered bay in fairly calm weather, and in an urban area, a large volunteer bird rescue and cleaning force was mobilized the day after the spill. Oiled birds were retrieved from the water by people wading from beaches and by boat. Approximately 500 Common Loons, a major fraction of the winter population, passed through the cleaning stations. Most were released shortly after cleaning, but survival was probably low. It is important to note that the circumstances of the spill, and the very quick response to it, allowed a much better assessment of the vulnerability of these birds than is usually possible. The seasonal reports in American Birds reported lower than normal numbers of Common Loons in the Tampa Bay area in subsequent winters (Woolfenden 1973, Edscorn 1974, Stevenson 1974, 1977), presumably the result of that mortality. King and Sanger (1979) give an Oil Vulnerability Index of 45 to this species in the Pacific Northwest.

Table 7. Number of dead birds and number and percentage of dead Common Loons found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Common Loons	Percentage of Common Loons	Source
Island Beach, New Jersey	Jan. 1945	92 (a)	7	7.61	Kramer and Kramer 1945
North-central Kattegat, Denmark	Jan.-Feb. 1962	1,723 (a,b)	2	0.12	Joensen 1972a
Southeast Kent, England	winters of 1963-1964 to 1965-1966	509 (b)	39	7.66	Gibson 1966
Northeast England	Jan. 1966	805	2	0.25	Parrack 1967
Pagham Harbour area, W. Sussex, England	Jan.-Feb. 1967	91 (b,c)	1	1.09	Phillips 1967
TORREY CANYON (d) oil spill, SW Britain	Mar. 1967	1,223	1	0.08	Bourne et al. 1967

Table 7. Continued.

Area	Dates	Numbers of oiled dead birds	Number of dead Common Loons	Percentage of Common Loons	Source
Tay Estuary, Scotland	Mar.-Apr. 1968	1,168 (c)	5	0.43	Greenwood and Keddie 1968
Northeast Britain	Jan.-Feb. 1970	10,992 (a,b)	16	0.15	Greenwood et al. 1971
Off Eastern Canada	Feb.-Apr. 1970	1,276 (b,c)	12	0.94	Brown et al. 1973
San Francisco Bay, California	Jan. 1971	3,221 (b,e)	28	0.87	Smail et al. 1972
Chesapeake Bay, Virginia	Feb. 1976	8,385 (b)	195	2.33	Roland et al. 1977
AMOCO CADIZ spill, NW France and Channel Islands	Mar. 1978	3,770 (b,c)	66	1.75	Hope Jones et al. 1978

(a) Total includes some birds that were not oiled.
(b) Total includes only those birds identified to species.
(c) Total includes both live and dead oiled birds.
(d) This sample is from a spill that was believed to have killed more than 30,000 seabirds.
(e) This figure represents birds brought the cleaning/receiving stations.

BIBLIOGRAPHY

1980

Dickson, R. L. 1980. Diving times of Great Northern Diver on frozen inland loch. Brit. Birds 73: 182-183.

Fox, G. A., K. S. Yonge and S. G. Sealy. 1980. Breeding performance, pollutant burden and eggshell thinning in Common Loons *Gavia immer* nesting on a boreal forest lake. Ornis Scand. 11: 243-248.

Reimchen, T. E. and S. Douglas. 1980. Observations of loons (*Gavia immer* and *G. stellata*) at a bog lake on the Queen Charlotte Islands. Can. Field Nat. 94: 398-404.

1979

Barr, J. F. 1979. Ecology of the Common Loon in a contaminated watershed. Pp. 65-69 in S. A. Sutcliffe (ed.), The Common Loon. Proc. 2nd N. Amer. Conf. on Common Loon Research and Manage., National Aud. Soc. Conserv. Pap. 162 pp.

Barklow, W. E. 1979. Graded frequency variations of the tremolo call of the Common Loon (Gavia immer). Condor 81: 53-64.

Sutcliffe, S. A. (ed.). 1979. The Common Loon. Proc. 2nd N. Am. Conf. on Common Loon Research and Management. Nat. Aud. Soc. Conserv. Pap. 162 pp.

1978

Evrard, J. O., E. A. Lombard and K. H. Larsen. 1978. Response to drought by a breeding population of Common Loons. Passenger Pigeon 40: 418.

Grant, P. J. and G. Harrison. 1978. Bill colour of Great Northern Diver. Brit. Birds 71: 127-128.

Jackson, S. 1978. [Letter on] Diving methods of Great Northern and Black-throated divers. Brit. Birds 71: 317.

Kinnear, P. K. 1978. Diving times of Great Northern Diver on the sea. Brit. Birds 71: 126-127.

McIntyre, J. W. 1978a. Wintering behavior of Common Loons. Auk 95: 396-403.

McIntyre, J. W. 1978b. The Common Loon: Part III. Population in Itasca State Park Minnesota 1957-1976. Loon 50: 38-44.

Martin, P. 1978. Are New England's loons slipping away? Bird Observ. East Mass. 6: 83-87.

Rummel, L. and C. Goetzinger. 1978. Aggressive display in the Common Loon. Auk 95: 183-186.

Sutcliffe, S. A. 1978. Pesticide levels and shell thickness of Common Loon eggs in New Hampshire. Wilson Bull. 90: 637-640.

Thiel, R. P. 1978. Common Loon breeding activity in the Sandhill and Meadow Valley Wildlife areas. Passenger Pigeon 40: 512-513.

Titus, J. R. 1978. Response of the Common Loon (Gavia immer) to recreational pressure in the Boundary Waters Canoe Area, northeastern Minnesota. Ph. D/ thesis, State Univ. New York/Syracuse, NY. 148 pp.

1977

Imhof, T. A. 1977b. Arctic Loon, a new species for Alabama. Am. Birds 31: 378.

Lafond, K. J. 1977. Winter observations of Common Loon. Loon 49: 101.

McIntyre, J. 1977a. Toe-banding of Common Loon chicks. Bird-Banding 48: 272.

McIntyre, J. 1977b. The Common Loon: Part II. Identification of potential predators on Common Loon nests. Loon 49: 96-99.

McIntyre, J. and J. E. Mathisen. 1977. Artificial islands as nest sites for Common Loons. J. Wildl. Manage. 41: 317-319.

Waltz, E. C. and A. D. Heineman. 1977. Common Loon breeding in St. Lawrence River Valley. Kingbird 27: 208-209.

1976

Carter, P. 1976. Diving rates of Great Northern Diver. Brit. Birds 69: 495-497.

Jackson, J. A. 1976b. Countershading on the feet and legs of the Common Loon. Auk 93: 384-387.

King, B. 1976. Winter feeding behavior of Great Northern Divers. Brit. Birds 69: 497-498.

McIntyre, J. 1976. The Common Loon: Part I. Loon 48: 126-127.

Petersen, M. R. 1976. Breeding biology of Arctic and Red-throated loons. M. S. thesis, Univ. Calif./Davis, CA. 55 pp.

Reams, C. H. 1976. Loon productivity, human disturbance and pesticide residues in North Dakota. Wilson Bull. 88: 427-432.

White, F. H., D. J. Forrester and S. A. Nesbitt. 1976. Salmonella and aspergillus infections in Common Loons overwintering in Florida. J. Anim. Vet. Med. Assoc. 169: 936-937.

1975

Kull, R. C., Jr. 1975. Summer record of a Common Loon inland in North Carolina. Chat 39: 39.

McIntyre, J. W. 1975. Biology and behavior of the Common Loon (*Gavia immer*) with reference to its adaptability in a man-altered environment. Ph. D. thesis, Univ. Minnesota/Minneapolis, MN. 230 pp.

Rummel, L. and C. Goetzinger. 1975. The communication of intraspecific aggression in the Common Loon. Auk 92: 333-346.

1974

Burn, D. M. and J. R. Mather. 1974. The White-billed Diver in Britain. Brit. Birds 67: 257-296.

McIntyre, J. W. 1974. Territorial affinity of a Common Loon. Bird-Banding 45: 178.

McIntyre, A. E. and J. W. McIntyre. 1974. Spots before the eyes, an aid to identifying wintering loons. Auk 91: 413-415.

Robertson, I. and M. Fraker. 1974. Apparent hybridization between a Common Loon and an Arctic Loon. Can. Field Nat. 88: 307.

1973

Barr, J. F. 1973. Feeding biology of the Common Loon (Gavia immer) in oligotrophic lakes of the Canadian Shield. Ph. D. thesis, Univ. Guelph/Guelph, ON.

Vermeer, K. 1973a. Some aspects of the breeding and mortality of Common Loons in east-central Alberta. Can. Field Nat. 87: 403-407.

Vermeer, K. 1973b. Some aspects of the nesting requirements of Common Loons in Alberta. Wilson Bull. 85: 429-435.

Williams, L. E., Jr. 1973. Spring migration of Common Loons from the Gulf of Mexico. Wilson Bull. 85: 230.

1972

Garrido, O. H. and H. Kreisel. 1972. Primer Hallazgo de un Sormorujo, Gavia immer (Brunnich), en las Costas de Cuba. Poeyana Instit. Biol. 98: 1-4. [In Spanish.]

Kohel, M. E. 1972. Migration and nesting patterns of the Common Loon in Wisconsin, 1970. Passenger Pigeon 34: 55-57.

Nero, R. W. 1972. Further records of summer flocking of Common Loons. Blue Jay 30: 85-86.

Predy, R. G. 1972. Another summer concentration of Common Loons. Blue Jay 30: 221.

Sjolander, S. and G. Agren. 1972. Reproductive behavior of the Common Loon. Wilson Bull. 84: 296-308.

1970

Anderson, D. W., H. G. Lumsden and J. J. Hickey. 1970. Geographical variation in the eggshells of Common Loons. Can. Field Nat. 84: 351-356.

Campbell, T. R. 1970. Loon concentration on Mille Lacs Lake. Loon 42: 36.

Tate, D. J. and J. Tate, Jr. 1970. Mating behavior of the Common Loon. Auk 87: 125-130.

1969

Mathisen, J. E. 1969. Use of man-made islands as nesting sites of the Common Loon. Wilson Bull. 81: 331.

Tate, J. D. 1969. Mating of the Common Loon. Proc. Nebr. Acad. Sci. 79: 50.

1967

Lister, R. 1967. Observations on embryos of Common Loons. Auk 84: 124.

Locke, L. N. and L. T. Young. 1967. Aspergillosis in a Common Loon (*Gavia immer*). Bull. Wildl. Dis. Assoc. 3: 34-35.

Stewart, P. A. 1967. Diving schedules of a Common Loon and a group of Oldsquaws. Auk 84: 122-123.

Woolfenden, G. E. 1967. Selection for a delayed simultaneous wing molt in loons (Gaviidae). Wilson Bull. 79: 416-420.

Zimmerman, D. A. and J. W. Boettcher. 1967. The Common Loon in Sonora, Mexico. Condor 69: 527.

1961

Southern, W. E. 1961. Copulatory behavior of the Common Loon. Wilson Bull. 73: 280.

1956

Sutton, G. M. and D. F. Parmalee. 1956. On the loons of Baffin Island. Auk 73: 78-84.

Taapken, J. 1956. Nieuwe vondst van een IJsduiker, *Colymbus immer* (Brunn.), en enkele nagekomen vondsten. Ardea 44: 239-241. [In Dutch.]

1955

Dorn, J. L. 1955. Birding trips to Mississippi. La. Ornithol. Soc. News 3: 3.

1953

Brodkorb, P. 1953. Subspecific status of the Common Loon in Florida. Wilson Bull. 65: 41.

Gabrielson, I. N. and F. C. Lincoln. 1953. Status of the Lesser Common Loon. Condor 55: 314-315.

Pittman, J. A. 1953. Direct observations of the flight speed of the Common Loon. Wilson Bull. 65: 213.

1952

Gudmundsson, F. 1952. Islenzkir fuglar I. Himbrimi (Colymbus immer Brunn.). [Icelandic birds I. The Great Northern Diver (Colymbus immer Brunn.).] Natturufraedingurinn 22: 44-45. [In Icelandic with English summary.]

Manville, R. H. 1952. Loons in the Huron Mountains. Jack-Pine Warbler 30: 52-53.

Olson, S. T. and W. H. Marshall. 1952. The Common Loon in Minnesota. Univ. Minne. Mus. Nat. Hist. Occas. Pap. No. 5. vi and 77 pp.

1951

Olson, S. T. 1951. A study of the Common Loon, Gavia immer sp., in the Superior National Forest of northern Minnesota. M. S. thesis, Univ. Minnesota.

Preston, F. W. 1951. Flight speed of the Common Loon (Gavia immer). Wilson Bull. 63: 198.

1950

Yeates, G. K. 1950. Field notes on the nesting habits of the Great Northern Diver. Brit. Birds 42: 5-8.

1949

Hebard, F. V. 1949. Lesser Loon in Georgia. Oriole 14: 23.

Ulmer, F. A., Jr. 1949. An albino Common Loon. Auk 66: 195.

1948

Rand, A. L. 1948. Summer flocking of the Loon, Gavia immer (Brunnich). Can. Field Nat. 62: 42-43.

1947

Rand, A. L. 1947. Geographical variation in the loon, Gavia immer (Brunnich). Can. Field Nat. 61: 193-195.

Schorger, A. W. 1947. The deep diving of the loon and Oldsquaw and its mechanism. Wilson Bull. 59: 151-159.

1945

Munro, J. A. 1945. Observations of the loon in the Cariboo Parklands, British Columbia. Auk 62: 38-49.

1944

Buchanan, F. W. 1944. Notes on molting time of loons and grebes. Wilson Bull. 56: 116.

Counce, C. C. 1944. A captive Common Loon. Kentucky Warbler 20: 30.

1938

Vasvari, N. 1938. Die Bedeutung der Magensteine (Gastrolithe) bei den Seetauchern (Colymbus). [The importance of gastroliths in the divers (Colymbus).] Proc. VIII Intern. Ornithol. Congr., Oxford 1934: 730-734. [In German.]

1935

Black, C. T. 1935. Common Loon in Illinois in July. Auk 52: 74.

Wetmore, A. 1935. The Common Loon in the Florida Keys. Auk 52: 300.

1930

May, J. B. 1930. Simultaneous loss of primaries in prenuptial molt of loon. Auk 47: 412-414.

Tyrell, W. B. 1930. Peculiar actions of the loon (Gavia immer). Auk 47: 238.

1929

Wilson, F. N. 1929. The loon at close range. Bird-Lore 31: 95-108.

1928

Wilson, F. N. 1928. Hunting loons with a camera. Bird-Lore 30: 171-177.

1925

Lincoln, F. C. 1925. Loons and Horned Grebes in pound nets. Proc. Biol. Soc. Wash. 38: 88.

1924

Brewster, W. 1924. The loon on Lake Umbagog. Bird-Lore 26: 309-314.

Townsend, C. H. 1924. Diving of loons and grebes. Auk 41: 20-41.

1923

Brown, C. A. 1923. Loon nests. Bird-Lore 25: 316-317.

Kennard, F. H. 1923. Notes on the diving of loons. Auk 40: 119-120.

Robinson, H. W. 1923. Dive of the Great Northern Diver. Brit. Birds 17: 64.

Sims, R. J. 1923. The Common Loon. Bird-Lore 25: 167-175.

1921

Anthony, A. W. 1921. A loon (Gavia immer) caught on a fishing line. Auk 38: 269.

Bagg, A. C. 1921. An oil-soaked loon (Gavia immer) at Watch Hill, R.I. Auk 38: 594-595.

Bishop, L. B. 1921. Description of a new loon. Auk 38: 364-370.

1920

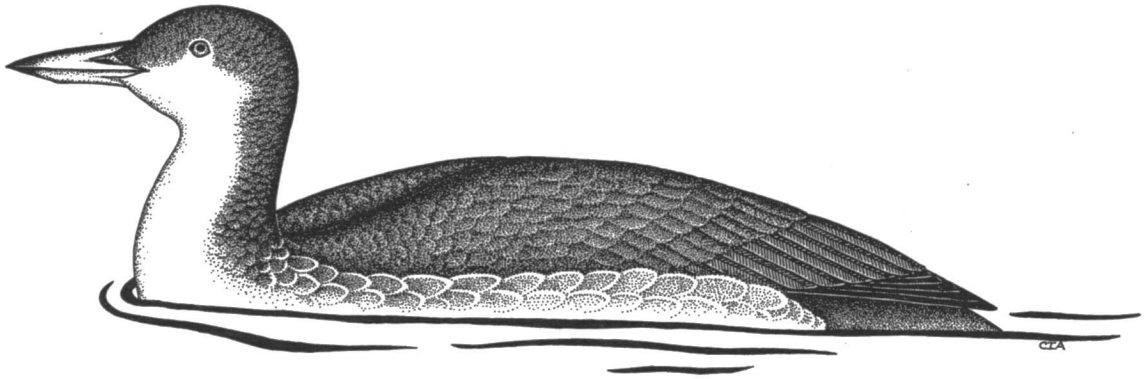
Allen, W. E. 1920. Behavior of loons and sardines. Ecology 1: 309-310.

1915

Dunlop, E. B. 1915. Notes on the Great Northern Diver. Brit. Birds 9: 142-147.

1874

Boardman, G. A. 1874. A loon-atic on ice. Forest & Stream 3: 291.



LEAST GREBE

(*Tachybaptus dominicus*)

[SP: Zambullidor chico, US: Mexican Grebe, Santo Domingo Grebe]

GENERAL DISTRIBUTION

North America The Least Grebe is resident from southern Texas south through eastern Mexico to Central America. It breeds also in southern Baja California and Sonora, once in southeastern California and has wandered to Arizona. The status of the northern form is poorly known (AOU 1957, Palmer 1962).

World Distribution Other subspecies of the Least Grebe breed in the Caribbean, in the southern Bahamas, Greater Antilles, Trinidad and (formerly) Tobago, and in South America south to western Peru, Bolivia, northern Argentina, Uruguay, and southern Brazil (Bond 1971, Blake 1977, Storer 1979b).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Least Grebes have been reported in three of the southeastern states (Florida, Louisiana, and Texas), but Texas is the only state in which they occur regularly.

Florida Least Grebes have been reported from Florida three times, but documentation for its natural occurrence in the state is still inadequate.

1966-67	4 Dec.-22 Mar.	1 seen	Lake Ariana and Saddle Creek Park, Polk Co.	Agey 1967
1970	27 Nov.	1 seen	on duck pond, Crandon Zoology Park, Miami	Robertson 1971
1976	13 Jan.	1 reportedly found dead	discarded by zoo attendant, Miami	Stevenson 1976

Louisiana The Least Grebe has been recorded only twice in Louisiana.

1947	14 Dec.	1 male, coll. (LSU 10604)	shot in lake, Baton Rouge	Lowery and Newman 1950b, Lowery 1974

Taxonomic note: This species is listed as *Podiceps dominicus* in most references (e.g., AOU 1957), but has recently been transferred to *Tachybaptus* (Storer 1976, 1979b).

1978	1-18 Dec.	1 seen	Mud Lake and near Holly Beach, Cameron Par.	Eyster 1978, Hamilton 1978

Texas In Texas, the Least Grebe is a local resident, recorded primarily from the southeastern portion of the state. It is locally common to uncommon near the central and lower coasts (Calhoun to Cameron counties), and scarce along the coast to the north.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Least Grebe is resident throughout its range, but it is evidently capable of local and occasional long distance dispersal. The species has a broad neotropical distribution, occurring throughout much of Central and South America, and in the Caribbean. In the southeastern United States it occurs and breeds regularly only in southeastern Texas.

HABITAT

Nesting Least Grebes nest solitarily, sometimes forming loose aggregations, and build floating nests on ponds, lakes, or ditches. At least some vegetation is needed to anchor the nest, but nests may be found well away from shore in open water or near shore either within or without emergent vegetation. In Texas, these grebes occur predominantly in small bodies of fresh water (Oberholser 1974). They prefer to nest in small intermittent ponds and roadside ditches and readily change nesting areas when these are lost to environmental changes (P. James in Palmer 1962, Storer 1976).

Winter and Offshore Least Grebes winter in the same freshwater habitat in which they breed and apparently seldom occur offshore in coastal areas.

FOOD AND FEEDING BEHAVIOR

Unusually little information is available on the food habits of Least Grebes in the United States (or elsewhere). That available for the United States results largely from the examination of five stomachs collected in Hidalgo County, Texas, in December 1937 (Cottam and Knappen 1939). All stomachs contained only insects, with aquatic beetles and bugs comprising nearly 90% of the diet. The only other insect group of any importance was the nymphs of Odonata.

More recently, Storer (1976) reported on the stomach contents of eight birds, five from Guatemala in April and May and three from Veracruz and Campeche, Mexico, in March and April. Insects, particularly ants, predominated in the Guatemalan birds, but fish bones, shrimp, and one crab were also found. In the Mexican birds, insects were again found most frequently. Crayfish, shrimp, and six "large, hairy spiders" also were found.

Gross (1949) also reported that adults and young in Cuba fed upon aquatic

insects, crayfish, and shrimp-like crustaceans. Young in the Rio Grande Valley, Texas, were fed almost entirely on the larvae of damselflies and dragonflies (Odonata) (P. James in Palmer 1962).

Least Grebes evidently feed primarily by diving beneath the surface. In a 3.6 ha, 2 m deep pond in Costa Rica, diving times ranged from 8.7 to 14.7 sec with a mean of 12.5 (n = 23) (Jenni 1969). A variety of other feeding methods are also used. Birds may feed by submerging only the head and neck, by picking food from the surface or emergent vegetation, and by seizing insects from the air (Storer 1976). Storer also reported an unusual technique in which a grebe dove below the surface and emerged to snap at a passing dragonfly. Least Grebes are also known to use the activities of other species inobtaining food. In Costa Rica, Paulson (1969) watched four Least Grebes closely follow a flock of domestic Mallards, dive among them, and apparently feed on fish or invertebrates disturbed by the ducks. Least Grebe feeding rates increased and decreased concomitant with the presence and absence of the Mallards.

SUSCEPTIBILITY TO OIL POLLUTION

We have not found evidence that shows this species is directly affected by oil. Although the Least Grebe belongs to a group of diving birds often severely afflicted by oil pollution, its rare occurrence in waters likely to be involved in oil spills make it considerably less vulnerable than other grebes. Further, its occurrence in the southeastern United States is extremely limited.

BIBLIOGRAPHY

1978

Eyster, M. B. 1978. Least Grebe in Louisiana. La. Ornithol. Soc. News 81: 3.

1976

Storer, R. W. 1976. The behavior and relationships of the Least Grebe. Trans. San Diego Soc. Nat. Hist. 18: 113-126.

1975

Storer, R. W. 1975. The status of the Least Grebe in Argentina. Bull. Br. Ornithol. Club 95: 148-151.

Storer, R. W., W. R. Siegfried and J. Kinahan. 1975. Sunbathing in grebes. Living Bird 14: 45-56.

1974

Jenni, D. A. and R. D. Gambs. 1974. Diving times of grebes and Masked Ducks. Auk 91: 415-417.

1969

Jenni, D. A. 1969. Diving times of the Least Grebe and Masked Duck. Auk 86: 355-356.

Paulson, D. R. 1969. Commensal feeding in grebes. Auk 86: 759.

1967

Agey, H. N. 1967. Notes on sightings of what appears to be the Least Grebe (Colymbus dominicus). Fla. Nat. 40: 101.

1963

James, P. 1963. Freeze loss in the Least Grebe (Podiceps dominicus) in Lower Rio Grande Delta of Texas. Southwest. Nat. 8: 45-46.

Meitzen, T. C. 1963. Additions to the known breeding ranges of several species in south Texas. Auk 80: 368-369.

1957

Zimmerman, D. A. 1957. Display of the Least Grebe. Auk 74: 390.

1950

Lowery, G. H., Jr. and R. J. Newman. 1950b. The Mexican Grebe, Colymbus d. brachypterus, at Baton Rouge, Louisiana. Auk 67: 505-506.

1949

Gross, A. O. 1949. The Antillean Grebe at central Soledad, Cuba. Auk 66: 42-52.

1947

McMurry, F. B. 1947. Least Grebe breeding in California. Condor 49: 125-126.

1939

Cottam, C. and P. Knappen. 1939. Food of some uncommon North American birds. Auk 56: 138-169.

1899

Chapman, F. M. 1899. Description of two new species of Colymbus dominicus Linn. Bull. Am. Mus. Nat. Hist. 12: 255-256.

PIED-BILLED GREBE

(*Podilymbus podiceps*)

[DU: Dikbekfuut, FR: Grebe a bec cercle, GE: Bindentaucher, SP: Zambullidor Pico Pinto, Maca picopinto; SW: Svartvitnabbad dopping]

GENERAL DISTRIBUTION

North America Pied-billed Grebes breed from central and southern British Columbia, central-southern Mackenzie, Alberta, Saskatchewan, Manitoba, central Ontario, southwestern Quebec, southern New Brunswick, Prince Edward Island, and Nova Scotia south throughout North America with the exception of northern Maine. They are local in occurrence in many areas (AOU 1957, Palmer 1962).

The northernmost populations are migratory, and winter in ice-free waters from southwestern British Columbia south through southwestern Idaho and western Utah, east through southern New Mexico and central Texas to Georgia, thence north to Chesapeake Bay and the Delmarva Peninsula (Palmer 1962). Scattered individuals occasionally winter in open waters throughout much of the breeding range.

World Distribution Pied-billed Grebes also breed and are apparently resident throughout the West Indies and south from Central America through most of South America to Chile and southern Argentina (Bond 1971, Blake 1977). They occur casually in the southern Yukon, James Bay, the Gulf of St. Lawrence, and Newfoundland (Godfrey 1966), and are accidental in Labrador, Baffin Island, Britain, Ireland, and the Azores (Godfrey 1966, Cramp et al. 1977, Dunbar et al. 1979).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Pied-billed Grebes occur throughout the state all year, but the largest numbers are found along the coast from September through May (Wray and Davis 1959). They breed most commonly toward the coast, almost strictly below the Fall Line (LeGrand 1977b). Coastal areas from which certain evidence of breeding has been obtained include (from north to south) Bertie, Dare, Craven, Pamlico, Onslow, New Hanover, and Brunswick counties (Pearson et al. 1942, Wray and Davis 1959, Lewis 1970, Teulings 1971e).

As in other areas of the southeast, this grebe breeds during an extended period. In the coastal area, eggs have been reported from 26 May through 26 August (Pearson et al. 1942, Lewis 1970), and juveniles have been observed from 10 June through 24 July (Lewis 1970, Teulings 1971e). It seems likely that further observations will reveal a nesting season extending from April through September.

The status of Pied-billed Grebes during migration is largely unknown, and there is little numerical information on transient or wintering popula-

tions. Examination of recent Christmas Bird Count figures (Map 3) shows that Pied-billed Grebes occur regularly in winter in North Carolina, but only in moderate numbers.

South Carolina Pied-billed Grebes are considered common throughout the year (Sprunt and Chamberlain 1949), but little information is available on either numbers present or on breeding biology. Along the coast, they have been recorded breeding in at least Beaufort and Charleston counties; eggs have been found from 11 April through 7 June. Young have been noted at Huntington Beach State Park on 18 July (Teulings 1971e). Pied-billed Grebes winter along the coast in small to moderate numbers (Map 3).

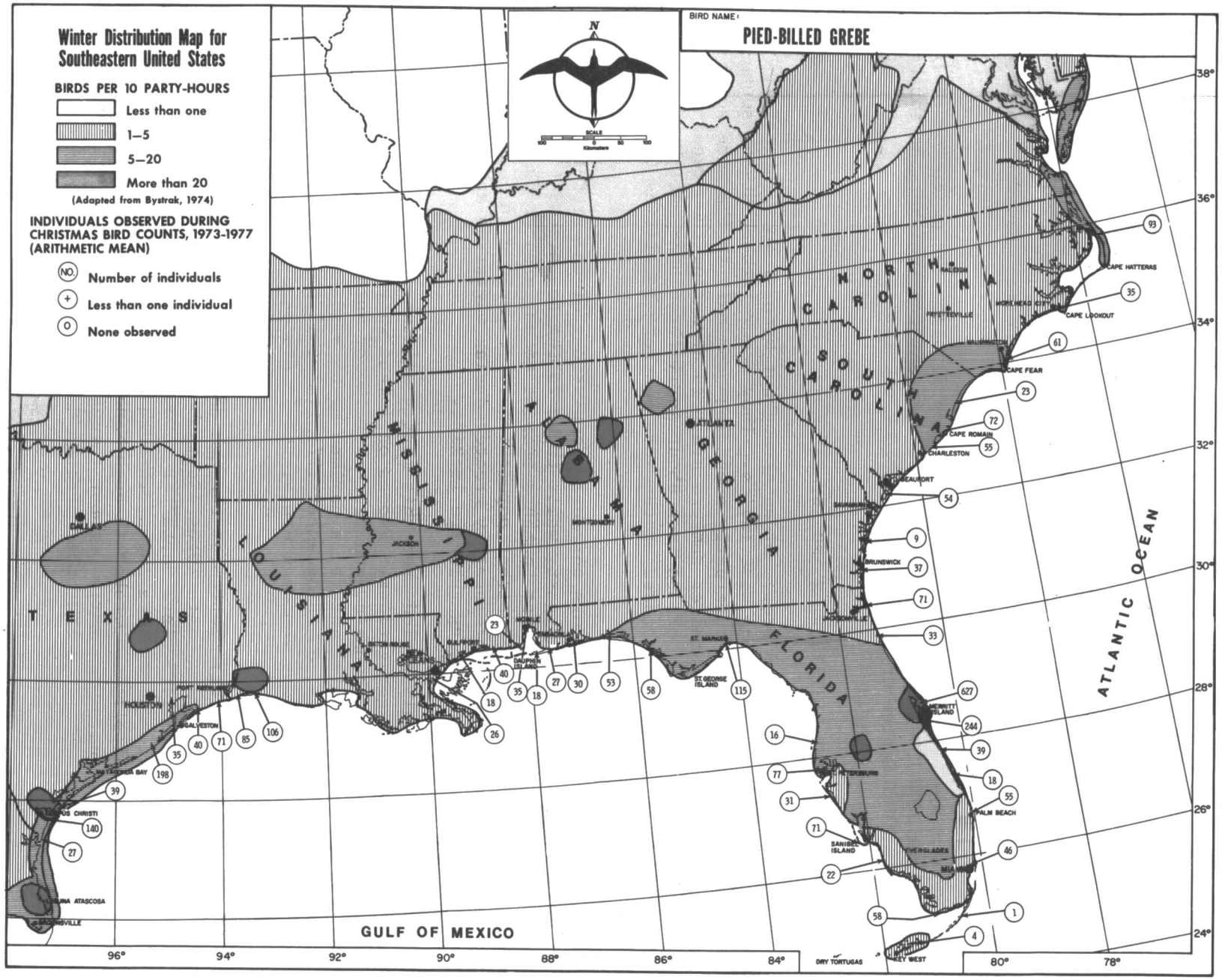
Georgia These grebes breed locally throughout the Coastal Plain and in the Appalachian Valley (Denton et al. 1977), but nest only very rarely along the coast and even then apparently only in fresh water. Pied-billed Grebes are common migrants and winter residents throughout Georgia. Peak abundance in or near coastal waters occurs from late August or September until late April (Tomkins 1958, Teal 1959). The number present along the coast in winter is relatively small. Sixteen Christmas Bird Counts held at Sapelo Island from 1958-68 (R. E. Hamilton 1969) and 1973-77 reveal a range of 0-18 birds seen, with a mean of 6.8.

Florida - Atlantic and Gulf Coasts Pied-billed Grebes breed on freshwater ponds throughout Florida, but are apparently more common in the northern portion of the state (Howell 1932, Sprunt 1954). Most breeding occurs from mid-April to early September (Sprunt 1954), but recent observations of partly grown young in early January and early February (Stevenson 1970, 1974), as well as a report of an incubating bird in late September (Edscorn 1974), suggest that breeding may occur in every month of the year. Little is known of transient or wintering populations, but the species is considerably more common during the winter (Map 3), indicating an influx of migrants from the north. It is an abundant winter resident on the Gulf coast (at Pensacola) with the largest number present from late September through mid-April (Weston in Howell 1932). In coastal areas, summer or winter, most birds are found on freshwater impoundments or ponds and not on salt water itself.

Alabama In Alabama these birds occur widely throughout the year and are common along the coast from about late August through early May. They breed locally, with about half of the certain breeding records from Baldwin County near the coast. For the state as a whole, eggs have been reported from late April to mid-May and dependent young from mid-May to early August (Stewart 1970, Imhof 1976b).

Mississippi Pied-billed Grebes are found throughout Mississippi in all seasons, but few details are known about seasonal abundance and breeding distribution. Along the coast this grebe is most abundant in the fall and winter months, and it has been found breeding near Gulfport on at least one occasion (Burleigh 1944).

Louisiana These grebes are at least moderately common locally all year in Louisiana, but are most abundant from early October to early April (Oberholser 1938, Lowery 1974). Near the coast they breed in both fresh and brack-


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than one
1–5
5–20
More than 20
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
O None observed
BIRD NAME:
PIED-BILLED GREBE
N
SCALE
Kilometers
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
TEXAS
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
CAPE HATTERAS
CAPE LOOKOUT
CAPE FEAR
CAPE ROMAIN
CHARLESTON
BEAUFORT
BRUNSWICK
ST. MARKS
ST. GEORGE ISLAND
DAUPHIN ISLAND
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
HOUSTON
JACKSON
ATLANTA
MACON
TALLAHASSEE
PENSACOLA
MOBILE
NEW ORLEANS
BATON ROUGE
FAYETTEVILLE
RALEIGH
MERRITT ISLAND
TITUSVILLE
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
KEY WEST
DRY TORTUGAS
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ish impounded waters (Chabreck 1963). At Rockefeller Wildlife Refuge, bordered on the south by the Gulf of Mexico, Chabreck found new nests from early May through late August 1961. Dependent young were present from at least May through early September. Because young from eggs laid in late August would not result in fledged young for well over a month, dependent young are probably present at least into October.

Texas Pied-billed Grebes are found in Texas year-round and may be found breeding in any month. Eggs have been recorded from March to late August, and small young have been reported from early February through mid-January (Oberholser 1974, Webster 1974c). According to Oberholser, however, most breeding occurs from March through September.

This grebe is common to fairly common (Map 3) along the coast in winter (Oberholser 1974), with the greatest numbers present (on at least the southern coast) from September through March (Blacklock 1978 ms).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Pied-billed Grebes breed throughout much of North, Central, and South America, and in the West Indies. They occur throughout the southeastern United States, but apparently breed less commonly in the more southern parts of this area. Smaller numbers are present during the breeding period which, for most areas, occurs from about April through August, but which may be considerably more extended at the more southern localities (e.g., Florida and Texas).

Migration and Winter More northerly populations of the Pied-billed Grebe are migratory in whole or in part, while those to the south tend to be resident. Throughout the southeast, numbers present become greater as migrants and winter visitors add to resident populations. Occurrence in coastal waters apparently becomes disproportionately greater during migration and winter, but detailed data documenting this are lacking.

Winter is the only period when this mostly solitary species may be found in relatively large aggregations. Flocks on inland waters in Florida have numbered as many as a thousand, and flocks of 100 or more are not uncommon (Sprunt 1954). On coastal waters, a maximum of 65 birds were reported for Dauphin Island, Alabama, on 18 December 1971 (Imhof 1976b). Periods of maximal abundance for various southeastern states in standard reference works are listed below:

North Carolina:	September through May
Georgia:	late August/September through late April
Florida-Gulf:	late September through mid April
Alabama:	late August through early May
Mississippi:	October through March
Louisiana:	early October through early April
Texas:	September through March

HABITAT

Nesting Pied-billed Grebes nest solitarily and prefer fresh water, standing or moving, with well vegetated shores and ample emergent vegetation. At least some open water is required. They may breed on ponds, sloughs, flooded areas, in marshy areas of lakes and rivers, and occasionally on estuarine waters where tidal influence is weak (Palmer 1962, Cramp et al. 1977).

These grebes prefer to nest in shallow water. In Manitoba, 31 nests were in water that averaged 35.5 cm deep. Mean distance of 25 nests from shore was 5.3 m, and from open water was 1.3 m. Bulrush (*Scirpus*) and cattail (*Typha*) was the dominant plant cover for approximately 98% of the 53 nests found (Sealy 1978). Those nesting in prairie pothole marshes near Ruthven, Iowa, also nested in shallow water; 76.8% of 138 nests were in depths of 30 in (76 cm) or less. Mean distance from the nest to open water was 25.8 ft, but 54.3% of the nests were more than 100 ft from shore (Glover 1953). In North Dakota, 82 nests were found in depths ranging from 11 to 37 in and averaging 25 in (63 cm) (R. Stewart 1975).

On an impoundment in Louisiana, most nests (52%) were in open water, the rest (46%) in small stands of wiregrass (*Spartina patens*). Distance to the nearest stand of dense emergent vegetation averaged 60 m (range = 1-183 m) (Chabreck 1963).

In North Dakota, all 48 Pied-billed Grebe nests found by Faaborg (1976) were in seasonal or semi-permanent bodies of water, 29 of them on relatively small ponds (3 ha or less). These grebes also choose relatively small bodies of water in eastern Washington. Yocum et al. (1958) reported that 80% of all broods found were on potholes 1 to 5 acres in size.

Feeding Pied-billed Grebes feed in their nesting and winter habitats.

Winter and Offshore Most birds winter in habitats similar to those used during the breeding season, but they often occur in more exposed areas. Some use brackish estuarine waters, and an even smaller proportion use salt water, where they prefer sheltered ocean inlets (Palmer 1962, Cramp et al. 1977).

FOOD AND FEEDING BEHAVIOR

Little specific information has been reported on the food habits of the Pied-billed Grebe in the southeastern United States. Howell (1928) reported that a single stomach collected in Alabama contained the remains of two or three fishes and two crayfish, and Palmer (1962) noted that leeches were the principal source of food during the breeding season in South Carolina.

Papers by Wetmore (1924) and Munro (1941) contain most of the available detailed information on the diet of the Pied-billed Grebe. Wetmore (1924) reported the stomach contents of 174 grebes collected at various localities and at different times of year. Fish (24.2% by volume), crustaceans (31.1%), and insects (46.3%), primarily aquatic forms, made up most of the diet. Among the crustaceans, crayfish (*Cambarus*, *Potamobius*) were frequently repre-

sented, and Heteroptera and Coleoptera were predominant among the insect forms taken. Spiders, snails, and small frogs were taken infrequently.

Wetmore (1924) presented little information on seasonal or geographical variation in food habits, but noted that fish were eaten only in small quantities from May to August, during the nesting season. He also remarked that consumption of damselflies and dragonflies (Odonata), representing only 8% of the diet overall, was much greater in July and August, when these insects constituted 34% of the diet.

Munro (1941) commented on the diet of the Pied-billed Grebe in British Columbia, basing his remarks primarily on the contents of eight stomachs. Fish was the major item of diet for adults and larger young, while the stomachs of three downy young contained mostly Odonata. He stated that nymphs of Odonata and aquatic insects were the principal summer foods in waters where fish were not present.

Pied-billed Grebes feed primarily by diving and pursuing their prey under water. Other feeding techniques may be used, but we have found little information on this point. Street (in Miller 1942) reported that an adult was seen swimming with only the head submerged, but did not see whether any food was obtained as a result. Pied-billed Grebes observed in shallow water in Florida used paddling movements of their feet to stir up sediment and bring prey into view (B. King 1974a).

Duration of foraging dives has been measured by several observers. Bleich (1975) timed 154 dives on two small California lakes with water depths from 2-5 m and found that dives averaged 7.6 sec (range = 1-15). Distance moved during these dives averaged 3.7 m (range = 0-12 m). Heintzelman and Newberry (1964) reported that two individuals at Brigantine NWR in New Jersey had average diving times of 12.7 sec (n = 4, range = 9-17) and 9.4 sec (n = 10, range = 6-9), but information was not given on either habitat or depth of water.

Pied-billed Grebes have reportedly used the foraging behavior of other species to obtain food. Leck (1971) observed these grebes and Snowy Egrets (Egretta thula) foraging together in a canal at Chincoteague NWR in Virginia. He suggested that this association was mutually advantageous, because the activities of each provided greater opportunities for prey capture by the other. Somewhat similar observations were made by Mueller et al. (1972) on a feeding association of three Pied-billed Grebes, a Snowy Egret, and a Louisiana Heron (Hydranassa tricolor) at a small freshwater pond in North Carolina. These observations suggested that more advantage accrued to the grebes than to the herons.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying The nesting period of the Pied-billed Grebe varies considerably according to locality over its extensive range. Nests may be initiated in North America as early as April and as late as June, and the nesting season may extend to July or August, or even later. May is probably the peak breed-

ing month in the United States. The time of nesting in the southeastern states has been detailed above in the discussions of the individual states.

Mean Clutch Size In a number of studies, average clutch size ranged from 4.3 (Wolf 1955) to 7.3 (Chabreck 1963), and the number of eggs found in individual nests ranged from 2 (Glover 1953) to 11 (R. Stewart 1975). In Minnesota, seven eggs were most frequent (Sealy 1978). Data from Louisiana (Chabreck 1963) suggest that mean clutch size decreases as the nesting season progresses.

Incubation Period Limited information suggests that the normal incubation period is about 23 days (Deusing 1939, Palmer 1962).

Hatching Success Studies in Idaho, Iowa, and Louisiana revealed a high degree of success, with 90-97% of the eggs hatching in successful nests, i.e., those in which some young hatched (Glover 1953, Wolf 1955, Chabreck 1963).

Fledging Success Data on fledging success in terms of young fledged per egg, per nest, and other measures, are virtually unavailable for this species. Often the only information available is a strong suspicion that a particular nest fledged at least some young. On this basis, Chabreck (1963) reported that 96 of 107 (89.6%) nests examined in a Louisiana impoundment produced young. In south Texas, young were produced in 78.3% (n = 23) and 91.7% (n = 12) of nests observed in 1957 and 1958, respectively (Cottam and Glazener 1959 *in* Chabreck 1963).

Age at Fledging Unknown (Palmer 1962).

Age at First Breeding Unknown (Palmer 1962).

Mortality of Eggs and Young In British Columbia, Iowa, and Louisiana, nests were primarily lost to the effects of wind, rain, storm, and fluctuating water levels (Munro 1941, Glover 1953, Chabreck 1963). Egg loss may also be caused by predation by other waterbirds nesting in the same area. Jerome Stoudt saw an American Coot (*Fulica americana*) pecking at the eggs in a Pied-billed Grebe nest, and on further inspection found all eggs opened and the contents gone from one or two (Burger 1974). Mammals may also be important predators; Glover (1953) estimated that 25% of nest loss in Iowa in 1948 was due to predation by Raccoons (*Procyon lotor*).

Renesting Pied-billed Grebes are indeterminate layers (Fugle and Rothstein 1977) and may replace lost clutches, but our information on this point is inadequate. The extent to which they are multi-brooded appears to be poorly known. In at least one instance, a pair in Pennsylvania is known to have produced two broods (Miller 1942).

Maximum Natural Longevity No data are available.

Weight (in grams) Few data are available on weights of Pied-billed Grebes. The most adequate information, provided by Storer (*in* Palmer 1962), is as follows:

N	Age	Sex	Range
5	adult	male	485-559
3	adult	female	281-435
20	immature	male	282-556
13	immature	female	189-389

SUSCEPTIBILITY TO OIL POLLUTION

The preference of Pied-billed Grebes for habitats less likely to receive the brunt of oil pollution, as well as their tendency to occur solitarily or in small groups, make it unlikely that a major proportion of a wintering population will be lost as the result of an oil spill. One Pied-billed Grebe was among more than 3,000 birds found after an oil spill in San Francisco Bay in 1971 (Smail et al. 1972).

BIBLIOGRAPHY

1980

Ryan, M. R. and P. A. Heagy. 1980. Sunbathing behavior of the Pied-billed Grebe. Wilson Bull. 92: 409-412.

1979

Ackerman, R. A. and M. Platter-Rieger. 1979. Water loss by Pied-billed Grebe (Podilymbus podiceps) eggs. [Abstract only]. Amer. Zool. 19: 921.

Dunbar, J., S. Curtis and R. Cardno. 1979. Pied-billed Grebe in Grampian. Brit. Birds 72: 329.

1978

Sealy, S. G. 1978. Clutch size and nest placement of the Pied-Billed Grebe in Manitoba. Wilson Bull. 90: 301-302

1977

Fugle, G. N. and S. I. Rothstein. 1977. Clutch size determination, egg size and egg-shell thickness in the Pied-billed Grebe. Auk 94: 371-373.

Scott, C. M. 1977. Food stealing behavior in the Ring-billed Gull. Bull. Okla. Ornithol. Soc. 10: 33.

Urquhart, L. A. 1977. Pied-billed Grebe in Kircudbrightshire. Scott. Birds 9: 297-298.

1976

Faaborg, J. 1976. Habitat selection and territorial behavior of the small grebes of North Dakota. Wilson Bull. 88: 390-399.

1975

Bleich, V. C. 1975. Diving times and distances in the Pied-billed Grebe. Wilson Bull. 87: 278-280.

1974

Burger, J. 1974. Breeding adaptations of Franklin's Gull (Larus pipixcan) to a marsh habitat. Anim. Behav. 22: 521-567.

King, B. 1974a. "Foot-paddling" behavior of Pied-billed Grebes. Brit. Birds 67: 439.

1973

McCowan, M. 1973. Pied-billed Grebe nesting observations. Blue Jay 31: 97-98.

1972

Mueller, H. C., M. G. Biben and H. F. Sears. 1972. Feeding interactions between Pied-billed Grebes and herons. Auk 89: 190.

1971

Leck, C. F. 1971. Cooperative feeding in Leucophoyx thula and Podilymbus podiceps (Aves). Am. Midl. Nat. 86: 241-242.

1969

Post, W. 1969. Breeding birds of Williston Bay. Chat 33: 83-84.

Zusi, R. L. and R. W. Storer. 1969. Osteology and myology of the head and neck of the Pied-billed Grebes (Podilymbus). Misc. Publ. Mus. Zool. Univ. Mich No. 139. 49 pp.

1968

Kleiman, J. P. 1968. A late nesting of the Pied-billed Grebe in Monroe County. Jack-Pine Warbler 46: 15.

Ladhams, D. E. 1968. Diving times of grebes. Brit. Birds 61: 27-30.

1967

Mather, J. R. 1967. Pied-billed Grebe in Yorkshire. Brit. Birds 60: 290-295.

Ladhams, D. E., R. J. Prytherch and K. E. L. Simmons. 1967. Pied-billed Grebe in Somerset. Brit. Birds 60: 295-299.

Simmons, K. E. L. 1967. Pied-billed Grebe behaviour. Brit. Birds 60: 530-531.

Storer, R. W. 1967. Pied-billed Grebe behaviour. Brit. Birds 60: 531-532.

1965

Prytherch, R. J. 1965. Pied-billed Grebe in Somerset: a bird new to Great Britain and Ireland. Brit. Birds 58: 305-309.

1963

Chabreck, R. H. 1963. Breeding habits of the Pied-billed Grebe in an impounded coastal marsh in Louisiana. Auk 80: 447-452.

McAllister, N. M. and R. W. Storer. 1963. Copulation in the Pied-billed Grebe. Wilson Bull. 75: 166-173.

1961

Storer, R. W. 1961. Observations of pellet-casting by Horned and Pied-billed grebes. Auk 78: 90-92.

1958

Short, H. L. and D. E. Craigie. 1958. Pied-billed Grebes mistake highway for water. Auk 75: 473-474.

Yocum, L. F., S. W. Harris and H. A. Hanson. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

1957

Leavitt, B. B. 1957. Water Moccasin preys on Pied-billed Grebe. Wilson Bull. 69: 112-113.

1956

Atkeson, T. Z., Jr. 1956. Pied-billed Grebe nesting records from the Tennessee Valley. Ala. Birdlife 4: 6.

Laughlin, R. M. 1956. Unusual behavior of a Pied-billed Grebe (*Podilymbus podiceps*). Auk 73: 134

1955

Wolf, K. 1955. Some effects of fluctuating and falling water levels on waterfowl production. J. Wildl. Manage. 19: 13-23.

1954

Cuthbert, N. L. 1954. Pied-billed Grebe taking flight from land. Wilson Bull. 66: 272-273.

Kilham, L. 1954a. Courtship behavior of the Pied-billed Grebe. Wilson Bull. 66: 65.

Kilham, L. 1954b. Repeated territorial attacks of Pied-billed Grebe on Ring-necked Duck. Wilson Bull 66: 265-267.

1953

Glover, F. A. 1953. Nesting ecology of the Pied-billed Grebe in northwestern Iowa. Wilson Bull. 65: 32-39.

Wolf, K. 1953. Grebe-duck nesting parasitism. Auk 70: 84.

1948

Buckalew, J. H. 1948. Pied-billed Grebe escapes Duck Hawk. Wood Thrush 4: 59.

1947

Provost, M. W. 1947. Nesting of birds in the marshes of northern Iowa. Am. Midl. Nat. 38: 485-503.

1942

Miller, R. F. 1942 [1943]. The Pied-billed Grebe, a breeding bird of the Philadelphia region. Cassinia 32: 22-34.

1941

Higman, H. W. and E. J. Larrison. 1941. Late nesting of the Pied-billed Grebe. Murrelet 22: 19.

Munro, J. A. 1941. Studies of waterfowl in British Columbia. The Grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

1939

Deusing, M. 1939. Nesting habits of the Pied-billed Grebe. Auk 56: 367-373.

1935

Snyder, L. L. 1935. Pied-billed Grebe from Baffin Island. Can. Field Nat. 49: 123.

1932

Weydemeyer, W. 1932. Notes on the food of grebes. Auk 49: 456.

1914

Gabrielson, I. N. 1914. Pied-billed Grebe notes. Wilson Bull. 26: 13-14.

HORNED GREBE

(*Podiceps auritus*)

[DA: Hornet Lappedyyker, Nordisk Lappedykker; DU: Kuifduiker, EN: Slavonian Grebe, FI: Mustakurkkuuikku, FR: Grebe esclavon, GE: Ohrentaucher, IC: Florgodi, IT: Svasso cornuto, JA: Mimi Kaitsuburi, NW: Horndykker, PO: Perkoz rogaty, PR: Mergulhao, RU: (Red-necked Grebe), SP: Zambullidor Cornudo, Noveleta cuelliroja, Zampullin cuellirrojo, Zampullin orejudo; SW: Svarthakedopping]

GENERAL DISTRIBUTION

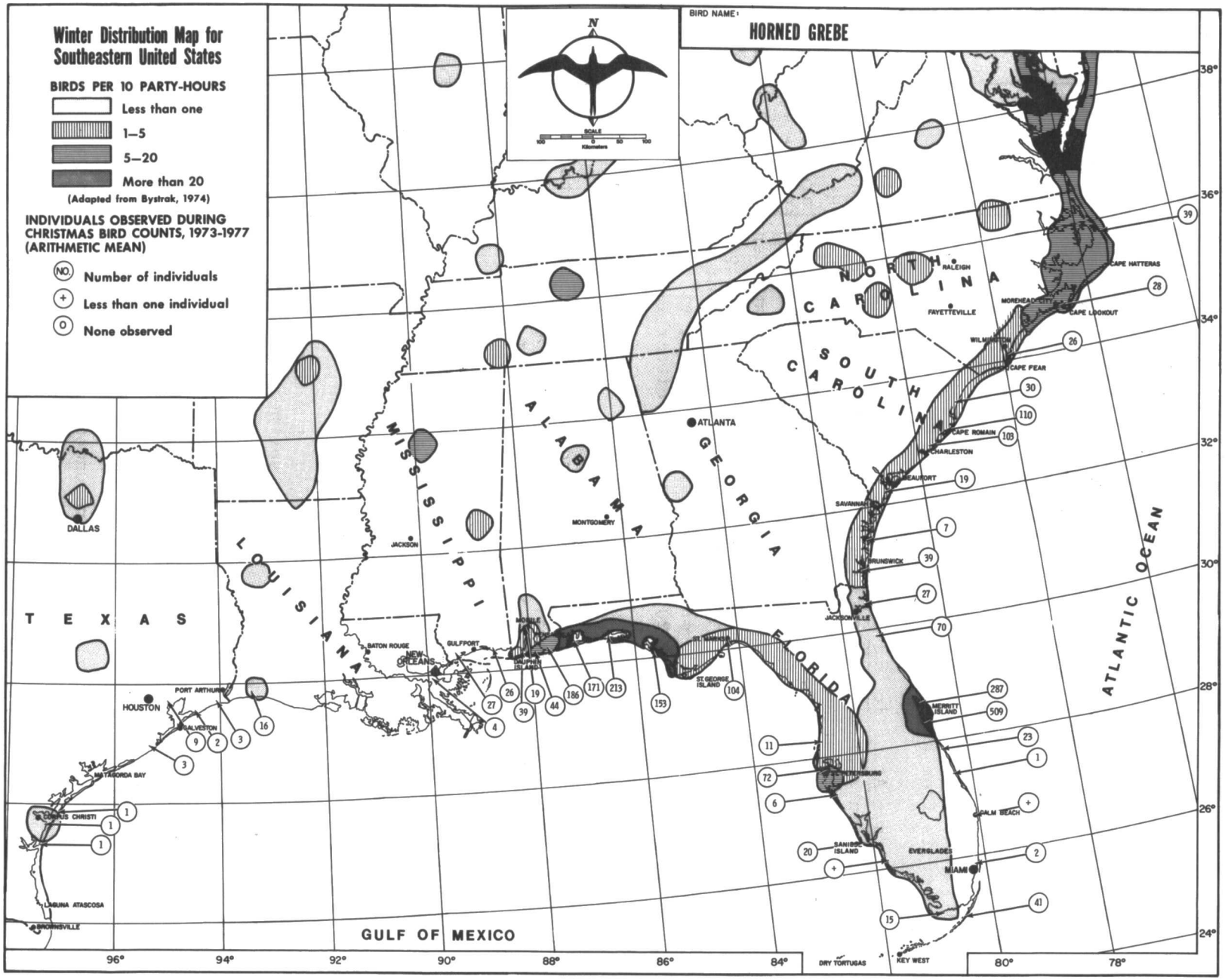
North America Horned Grebes breed from central Alaska to northern Manitoba and south to eastern Washington, northern Idaho, northern South Dakota, and central Minnesota. The breeding range was more extensive formerly, extending south to northern Utah, Iowa, and Indiana, and east to northwestern New York, the Gulf of St. Lawrence, New Brunswick, and Maine. Presently, breeding is sporadic and local in this area (Palmer 1962, Vaurie 1965, Godfrey 1966, Storer 1979b).

Horned Grebes winter primarily along the coasts. They are sound from the Aleutian Islands south to southern California in the Pacific, and from Nova Scotia to southern Florida in the Atlantic, and along the northern coast of the Gulf of Mexico (primarily in the eastern half) (AOU 1957, Map 4). They are found sporadically along the coast of southern Greenland, Newfoundland, Bermuda, and Baja California (AOU 1957, Storer 1979b).

World Distribution In addition to North America, Horned Grebes breed from Iceland, Scotland, Scandinavia, and the Baltic States east across Siberia to Kamchatka and Amurland, primarily between latitudes 63°and 50°N (BOU 1971). They winter from the North Sea south to Great Britain and France, to the Iberian Peninsula, on the Black, Caspian, and Aral seas, and from Japan and Korea south to southeastern China (Vaurie 1965). They have wandered to the Mediterranean and Greenland (Vaurie 1965), and are accidental in Jan Mayen (island north of Iceland), Spitsbergen (Norwegian archipelago north of Norway), Switzerland, Rumania, Bulgaria, Israel, Cyprus, Tunisia, the Azores (off Portugal), and Madeira (off coast of Morocco) (Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Horned Grebes winter abundantly along the coast (Map 4), occurring in smaller numbers inland (Pearson et al. 1942). Along the coast they have been recorded from as early as 26 September (Parnell 1966d) to late May (Pearson et al. 1942, Wray and Davis 1959). There are occasional reports of summering birds; one was seen 18 June 1975 at Beaufort Inlet (Teulings 1975d), and another was seen at Wrightsville Beach, 10 June 1970 (Teulings 1970b).


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than one
1–5
5–20
More than 20
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
O None observed
BIRD NAME:
HORNED GREBE
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
NORTH CAROLINA
SOUTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
MONTGOMERY
ATLANTA
ST. GEORGE ISLAND
JACKSONVILLE
SAVANNAH
BRUNSWICK
CHARLESTON
BEAUFORT
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
MERRITT ISLAND
PALM BEACH
EVERGLADES
MIAMI
SANIBEL ISLAND
DRY TORTUGAS
KEY WEST
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°

South Carolina The status of the Horned Grebe in South Carolina is similar to that in North Carolina. It is an abundant winter resident along the coast and much less common inland (Sprunt and Chamberlain 1949), although large concentrations have been seen on inland lakes (Table 8). It has been recorded from as early as 10 October (Burton 1970) to 5 June (Sprunt and Chamberlain 1949). A bird seen 3 August 1975 at Charleston was regarded as an early migrant (Teulings 1976a), but it may have been a summering bird overlooked earlier in the season.

Georgia Horned Grebes are common along the Georgia coast in winter, but rare as migrants and winter residents in the interior (Denton et al. 1977). Extreme dates of occurrence for the state are 26 September and 7 May (Denton et al. 1977), both at inland localities (Burleigh 1958). The period of peak abundance is from about November through April.

Florida - Atlantic and Gulf Coasts Horned Grebes in Florida occur as winter residents primarily in the northern part of the state, and are common on the coasts as far south as Merritt Island and Sarasota Bay (Howell 1932, Sprunt 1954, Map 4). As in other areas of the southeast, they are found primarily along the coast, with smaller numbers occurring inland (Sprunt 1954). The species has been reported from as early as 10 August (Kennedy 1973) to as late as 30 May (Kale 1976) and, as elsewhere, a few birds occasionally remain during the summer (Sprunt 1954). Some birds in partial or full breeding plumage during the early summer months (e.g., 7 June 1972 at Bayport, 9 June 1972 at Merritt Island; Ogden 1972) could have been either late migrants or summering birds.

Alabama In Alabama, the Horned Grebe is an abundant winter resident along the coast and uncommon to rare inland in migration and winter (Imhof 1976b). It has been recorded as early as 10 September inland (Purrington 1978) and from 3 October to 22 May along the Gulf coast (Imhof 1976b).

Mississippi Horned Grebes are relatively uncommon winter residents along the Mississippi Gulf coast. Extreme dates of occurrence for migrants and wintering birds are 11 September and 17 May (Gandy and Turcotte 1970). Inland migrants have been recorded as early as 31 August at Hattiesburg (Jackson and Weber 1976). Occasional birds remain in the area during the summer months and have been recorded from 5 June to 10 August (Gandy and Turcotte 1970).

Louisiana According to Lowery (1974), the Horned Grebe is a fairly common winter resident, particularly in the southeastern part of the state. Lowery suggested that the species is most abundant on large lakes (e.g., Lake Pontchartrain) and bays. Its presence in Louisiana has been recorded from as early as 14 October to as late as 16 April (Lowery 1974). There are also records for August (Oberholser 1938) and 9 June (J. Stewart 1975) that might have been very early and very late migrants, respectively, but perhaps were summering birds.

Texas In Texas, Horned Grebes are uncommon to rare winter residents, most common on the upper coast (Oberholser 1974). Even peak numbers recorded (Table 8) are far less than in states to the east. They have occurred in the state from 1 October through 3 May (Oberholser 1974).

Table 8. Peak concentrations of migrant and wintering Horned Grebes in the coastal southeastern United States.

Date seen	Number seen	Locality	Source
		NORTH CAROLINA	
1972 3 Feb.	6,000+	in surf off Nag's Head	Teulings 1972b
1978 23 Mar.	1,000+	off Bodie Island	Teulings 1978a
		SOUTH CAROLINA	
1977 9 Jan.	1,457	Lake Murray (includes flock of 1,400)	LeGrand 1977a
1979 26 Jan.	1,000 (ca.)	Lake Moultrie	LeGrand 1979b
1979 26 Jan.	580	Lake Murray	LeGrand 1979b
1978 5 Feb.	1,350	Lake Murray	LeGrand 1978
		GEORGIA	
1951 8 Dec.	500	Cumberland Sound	Burleigh 1958
		FLORIDA	
1970 29 Dec.	250	near Lakeland (inland)	Stevenson 1971
1956 12 Jan.	40	Bear Lake	Stevenson 1956b
1957 12 Jan.	59	Florida Bay	Stevenson 1957a
1973 13 Jan.	400	Mexico Beach	Purrington 1973a
1969-70 winter	50-100	Lake Adrianna	Stevenson 1970
1969 13 Mar.	85	Lake Jackson	Stevenson 1969
		ALABAMA	
1957 8 Feb.	1,350+	Bon Secour and Perdido bays	Imhof 1976b
		MISSISSIPPI	
1969 7 Dec.	215	seen in 20 mi, W of Gulfport	F. James 1970
1977 31 Dec.	87	Sardis Lake	Jackson and Cooley 1978a
1975-76 5 Dec.-18 Jan.	140-120	Sardis Lake	Hamilton 1976
1978 15 Jan.	250	Horn Island	Hamilton 1978
1975 15-16 Jan.	80	Sardis Lake	Hamilton 1975

Table 8. Continued.

Date seen	Number seen	Locality	Source
		LOUISIANA	
1970 15 Nov.	89	counted in 2 mi of beach at Mandeville	Purrington 1971
1976-77 winter	20-30	Clear Lake	Hamilton 1977
1963 24 Jan.	16	Cross Lake	F. James 1963
		TEXAS	
1959 17 Nov.	35	Laguna Atascosa NWR	Oberholser 1974
1962 22 Nov.	15	Bayshore (LaPorte area on Galveston Bay)	Webster 1963a
1976-77 winter	5	Cove area	Webster 1977b
1966-67 winter	50	San Jacinto Bay, Harris Co.	Oberholser 1974
1932 6 Feb.	21	Aransas Bay	Oberholser 1963 ms
1932 14 Feb.	10	N end Laguna Madre	Oberholser 1963 ms

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Horned Grebes are a widespread holarctic species breeding primarily in northern North America and in two largely disjunct areas in northwestern and northeastern Eurasia.

Winter The Horned Grebe is primarily a winter resident throughout the southeastern area, with abundance progressively decreasing from the northeast to the southwest (Map 4, Table 8). The few band recoveries (Palmer 1962) indicate that wintering birds in North Carolina, Louisiana, and Florida originated in Alberta, Saskatchewan, and Minnesota. Although extreme dates of occurrence (Table 9) suggest that these grebes usually occur in the southeast from September or early October through mid-May, periods of peak occurrence are generally from late October or early November through mid-April. Peak numbers in more southern areas, particularly the gulf, begin a week or so later in the autumn and end a week or so earlier in the spring.

Migration In migration, these birds move south to winter on inland lakes and along the coasts. In North America the majority apparently move to either the Atlantic or Pacific coast and then travel south along the coasts to their ultimate destinations. Some apparently move through the mid-continent to win-

Table 9. Dates of occurrence for Horned Grebes in the coastal southeastern United States, exclusive of sightings attributed to summering birds.

State	Area	Dates of occurrence
North Carolina	Coast	26 September - late May
South Carolina	State	10 October - 5 June
Georgia	Inland	26 September - 7 May
Florida	State	10 August - 30 May
Alabama	Coast	3 October - 22 May
Mississippi	Coast	11 September - 17 May
Louisiana	State	14 October - 16 April
Texas	State	1 October - 3 May

tering grounds in the northern Gulf of Mexico (Palmer 1962).

HABITAT

Nesting Horned Grebes usually nest solitarily on small ponds, potholes, in open portions of flooded marshes, in sheltered bays of larger lakes, in sloughs, backwaters of streams and rivers, and sometimes in sterile crater lakes (Palmer 1962, Fjeldsa 1973b, 1973d).

Choices of nesting habitat vary with area. In the parklands of Saskatchewan, Horned Grebes preferred to nest in permanent ponds that were more than 2 ha in area. Such ponds usually had vegetation only at the periphery, leaving most of the water area open (Sugden 1977). Birds in a pothole area in North Dakota preferred very small ponds (60% of them less than 1 ha) that had open water (Faaborg 1976). In the Baltic area, these grebes occurred mainly on smaller ponds of 1-10 ha. In Norway and Iceland, however, the size of the nesting pond did not seem to be important with Horned Grebes nesting in potholes (one as small as 0.033 ha) and in pools that were usually 1 ha or larger. In both Finland and Sweden, these grebes occasionally breed on brackish water sounds between islands with rocky shores (Fjeldsa 1973c).

Horned Grebes usually build a floating nest anchored to and within emergent vegetation and as far from shore from possible. Uncommonly, nests may be found on open water anchored to submerged plants (Fjeldsa 1973d).

Principal emergent vegetation used as cover in Iceland and Norway was sedge (*Carex*), horsetail (*Equisetum*), willow (*Salix*), and reed (*Phragmites*) (Fjeldsa 1973c). The most common emergent species in Saskatchewan were whitetop (*Scolochloa*) and cattail (*Typha*), as well as sedge and willow (Sudgen 1977).

Nests are mainly found in shallow water. Fifty nests in Saskatchewan were at water depths of 25-140 cm (mean = 86) (Sugden 1977); 11 in North Dakota were at depths of 15-122 cm (mean = 41) (R. Stewart 1975). For the Old

World, Fjeldsa (1973c) reported 573 Norwegian nests and platforms at depths of from 0-120 cm (mean = 43), and 615 Icelandic nests and platforms at depths of from 0-125 cm (mean = 45).

Rarely, Horned Grebes breed in loose colonies. These have been reported from the U.S.S.R., the Baltic, Scotland, Gotland, Norway, and Iceland (Fjeldsa 1973d). For Iceland and Norway, Fjeldsa (1973d) reported colony sizes of from 5 to 10 pairs and up to 16 pairs, respectively, while Clase et al. (1960) reported one colony with at least 36 pairs in Iceland. The closest two nests found in the latter colony were only 3 m apart. As a rule, however, nests were well spaced, with the nearest nest usually 5 m or more away (Fjeldsa 1973d).

Feeding On the breeding grounds feeding usually occurs near the nest site but these grebes may forage far offshore if food resources there are insufficient. Birds breeding in potholes in Iceland have been noted flying to a nearby body of water (Lake Myvatn) to feed (Fjeldsa 1973c).

In Norway, Horned Grebes clearly preferred to feed in shallow areas 0.3 to 1.5 m deep (Fjeldsa 1973c). Palmer (1962) reported that they usually feed in water about 5 to 25 ft deep.

Winter and Offshore Migrant Horned Grebes may be found on almost any body of water, but during the winter the species is primarily marine, found "off ocean beaches and rocky shores as well as in sheltered inlets and bays". Some are occasionally found well offshore (Palmer 1962).

FOOD AND FEEDING BEHAVIOR

This species feeds mostly on aquatic insects on the breeding grounds, and on crustaceans and fish on the wintering grounds (Storer 1969). Most of the detailed information on food habits in North America comes from studies by Wetmore (1924) and Munro (1941).

Wetmore (1924) examined 122 stomachs collected in all months but July. Eight contained only feathers but animal food made up 99% of the diet in the remaining 114. Fish (34.6%), insects (46.0%), and crustaceans (17.9%) were the principal groups upon which the Horned Grebes had fed (see Palmer 1962 for a list of fish species eaten). Beetles were the most important insect food taken, with a large proportion being the aquatic forms. Among the crustaceans, crawfish (10.4%) were a particularly important food item and shrimp, prawns (*Palaemonetes* sp., *Penaeus* sp., *Crago* sp.), and amphipods were taken relatively frequently. Other items taken in minor amounts and evidently unimportant in the diet were spiders and marine worms.

Munro (1941) reported on food habits in British Columbia, basing his remarks partly on observation and partly on the analysis of 23 stomachs. On the wintering grounds the principal food was fish and crustaceans, the latter considered the more important. Summer birds from the interior had subsisted primarily upon aquatic insects, with damselfly and dragonfly nymphs and larvae (Odonata), Corixidae, and Coleoptera the most important groups.

Reports on food habits from the Old World suggest that the diet is similar there. Madon (1931 in Cramp et al. 1977) examined 126 stomachs, most of them from wintering birds. He found fish in 51 stomachs and crustaceans in 32. Fifty-six stomachs from Estonia contained mainly amphipods and aerial insects (Onno 1958 in Cramp et al. 1977). Fjeldsa (1973c) examined 49 stomachs from northern Norway and Iceland. In terms of frequency of occurrence, insects (primarily aquatic forms--58.1%) and crustaceans (17.7%) predominated, while by weight, fish (69.1%) were the most significant part of the diet.

Fjeldsa also examined the stomach contents of 14 young, only 8 of which contained food. In these, insects [beetles, 37.2%, midges (Chironomidae), 28.4%, and caddis-flies (Trichoptera), 14.1%] were the most important food items. Fjeldsa noted, however, that young were mainly fed small fish at other localities.

Horned Grebes feed primarily by pursuit diving, using the feet for propulsion. Other feeding techniques are used to a lesser extent. These grebes may seize insects from the air or from emergent vegetation, and will also skim with their bills when insect life at the surface is particularly abundant. They may also forage with only the head or with the head and neck submerged (Storer 1969, Fjeldsa 1973c).

Horned Grebes usually feed solitarily in shallow water near the bottom. Fjeldsa (1973c) stated that he had seen them feeding in flocks only where large shoals of small fish were found. Synchronized diving was noted by King (1971) while observing a party of 12 grebes off Devon, England. When one bird dove, it was invariably followed by the other members of the flock. Synchronous diving of flocks into large swells along the coastline of a lake in Korea has also been reported (Bergman 1936 in Fjeldsa 1973c).

Diving times may vary considerably with local conditions. Fjeldsa (1973c) reported diving times ranging from 1 to 73 seconds, but remarked that most were between 7 and 25 seconds. At two localities in Great Britain, Ladhams (1968) recorded dives of 15-30 seconds (n = 82, mean = 17.5) at one locality in winter, and of 10-25 seconds (n = 39, mean = 9.5) at another in April. Heintzelman and Newberry (1964) timed the dives of two birds off New Jersey in late November. One grebe made dives ranging from 8-26 seconds (n = 11, mean = 19.2), the other 8-22 seconds (n = 25, mean = 17.4). In contrast, a bird diving in a deep area of Par Pond, Barnwell County, North Carolina (Fatora and Fatora 1967), made dives ranging from 36-55 seconds (n = 9, mean = 46.1).

Feeding relationships with several other species of birds have been recorded. Dusi (1968) noted immature and adult Bonaparte's Gulls (*Larus philadelphia*) off West Panama City Beach, Florida, feeding on food brought to the surface by Horned Grebes. Horned Grebes in British Columbia have also been seen following Surf Scoters (*Melanitta perspicillata*), diving when the latter did and apparently feeding on food dislodged by the ducks (Pearse 1950). Similar behavior of these two species was also seen off Washington (Paulson 1969).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Sugden (1977) reported the peak of egg laying in Saskatchewan was in late May and early June; Ytreberg (1957) recorded the same peak in Norway. In North Dakota, R. Stewart (1975) recorded eggs present from late May to late July, although Bent (1919) reported eggs as early as early April. Fjeldsa (1973d) recorded first clutches were laid from mid-May to late July in Iceland and Norway.

Mean Clutch Size In North Dakota, R. Stewart (1975) found clutches to average 4.5 eggs. This figure is derived from numbers of eggs found in nests and does not include any eggs lost before nests were observed. Fjeldsa (1973d) reported means of 3.8 in Norway and Iceland. The number of eggs found in nests ranged 1-7 in these studies.

Incubation Period DuBois (1919) reported 24-25 days in Montana, but Fjeldsa (1973d) suggested a mean of 22.8 days in Iceland and Norway.

Hatching Success Fjeldsa (1973d) reported that in the years 1958-1971, 63.8% (n = 1,332) of the eggs laid hatched; 95.3% (n = 85) of the eggs hatched in the area with the best nesting success.

Fledging Success In an area in Norway with good nesting success, Fjeldsa (1973d) found that 0.53 chicks fledged per egg laid.

Age at Fledging Fjeldsa (1973d) recorded the age at fledging at 55 to 60 days, with young becoming independent at 45 days or less (Cramp et al. 1977).

Age at First Breeding According to Palmer (1962), this grebe "evidently breeds when [a] year old."

Mortality of Eggs and Young In Iceland and Norway 37.8% of the total cause of egg loss (n = 479) was by humans, while other predators (Mink *Mustela vison*, gulls *Larus* spp., and Hooded Crow *Corvus corone*) accounted for 19.4%. Flooding or destruction of the nest by wave action caused 16.7% of the egg loss, and desiccation of the nest site another 3.1%. Desertion, infertility, or embryonic mortality of eggs, and loss of one adult of a nesting pair were other causes of egg mortality (Fjeldsa 1973d).

Chicks disperse from the nest shortly after hatching, consequently sources of mortality for young birds are not as well known as for eggs. Fjeldsa (1973d) suggested that young might be killed by oversized food items, by being trodden to death in the nest, or by being pecked to death by neighboring adults.

Renesting Horned Grebes are indeterminate layers that will readily renest if eggs are lost. In Iceland and Norway, most pairs that lost a clutch attempted to renest at least once, with 88% (n = 86) known to do so (Fjeldsa 1973d). Renesting may occur in the original nest or in another nest built nearby, or the birds may desert the nesting area and set up a new territory elsewhere. Initiation of replacement clutches usually occurred within 2 to 3 weeks after the loss of the original nest in Iceland and Norway (Fjeldsa

1973d), but in one instance in Montana renesting began 6 days after eggs were lost (DuBois 1919). Lost second clutches are replaced much less frequently than first nests, but some pairs have been known to lay as many as three or four clutches (Fjeldsa 1973d).

Renesting after a successful nesting may occur in Horned Grebes but is very uncommon. Fjeldsa (1973d) found only nine instances of second nests in his 13 year study in Iceland and Norway.

Maximum Natural Longevity A bird banded as an adult attained a minimum age of 5 years and 2 months (Clapp et al. 1979 ms). Additional banding would almost certainly reveal a longer life span.

Weight (in grams) Six breeding season males from North America reported by Irving (1960) and Palmer (1962) averaged 462 (range = 432-485); three females averaged 383 (range = 351-433). Fourteen summer birds from Iceland and Norway averaged 449 (range = 415-470), and five from the Baltic area averaged 375 (range = 300-450); sex was not indicated for the last two samples (Fjeldsa 1973d). The few available weights of winter adults and young birds suggest that there is little seasonal or age variation (Bauer and Glutz von Blotzheim 1966, Stewart and Skinner 1967).

SUSCEPTIBILITY TO OIL POLLUTION

We consider the Horned Grebe one of the species most vulnerable to oiling in the southeastern United States. King and Sanger (1979) give an Oil Vulnerability Index of 48 to this species in the Pacific Northwest. This figure indicates a species moderately vulnerable to oiling in that area. Although little quantitative data is available in the North American literature, scattered comments indicate that the species is frequently oiled, both within the southeast and elsewhere.

An oil spill off Chedabucto Bay, Nova Scotia, in February 1970 resulted in the discovery of 28 oiled birds on the beaches. This represented 2.41 birds per mile of beach searched, and 8% of all birds oiled (Brown et al. 1973). Brown et al. estimated that at least 450 grebes died as a result of this spill; of these, probably 380 were Horned Grebes. These grebes, as well as murres, Dovekies, Red-breasted Mergansers, and Oldsquaws were the species most adversely affected by this spill.

Oiled Horned Grebes have also been recorded within or near the southeastern states. Perhaps the largest oil-related mortality of this species followed the sinking of a barge near the mouth of the Potomac River in February 1976. Subsequent contamination of the lower Chesapeake Bay caused the death of at least 4,347 grebes, which represented 51.8% of all dead birds found that were identified to species (Roland et al. 1977).

On 13 April 1943, 15 oiled grebes, most of them dead, were found in a stretch of seashore from Oregon Inlet, North Carolina, to about 9 miles north (Peterson 1942). Next to Common Loons, the Horned Grebe was the primary species affected.

One major mortality occurred in the southeast following the wreck of the DELIAN APOLLO in Tampa Bay in 1970. Total numbers killed will never be known, but some 200 Horned Grebes were brought to treatment centers (Sims 1970). This represented approximately 6% of all birds treated.

Oiled birds have been noted in New Jersey (Woolfenden 1956), Great Britain (Greenwood et al. 1971), Connecticut (CSLP 1971), and off Texas (Payne, pers. comm.). Effects of some of these, and other spills, are given in Table 10.

Table 10. Number of dead birds and number and percentage of dead Horned Grebes found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Horned Grebes	Percentage of Horned Grebes	Source
Poole Harbour, Dorset, England	Jan. 1961	433 (a,b)	3	0.69	Bourne 1968b
Pagham Harbour area, W. Sussex, England	Jan.-Feb. 1967	91 (a,b)	1	1.10	Phillips 1967
Tay Estuary, Scotland	Mar.-Apr. 1968	1,168 (b)	1	0.09	Greenwood and Keddie 1968
Northeast Britain	Jan.-Feb. 1970	10,992 (a,c)	7	0.06	Greenwood et al. 1971
Off Eastern Canada	Feb.-Mar. 1970	1,276 (a,b)	28	2.19	Brown et al. 1973
San Francisco Bay, California	Jan. 1971	3,221 (a,d)	13	0.40	Smail et al. 1972
Waddensea, Denmark	Dec. 1972	9,151 (a)	1	0.01	Joensen and Hansen 1977
Chesapeake Bay, Virginia	Feb. 1976	8,385 (a)	4,347	51.84	Roland et al. 1977

(a) Total includes only those birds identified to species.
(b) Total includes both live and dead oiled birds.
(c) Total includes some birds that were not oiled.
(d) This figure represents birds brought to cleaning/receiving stations.

BIBLIOGRAPHY

1981

Regnall, S. 1981a. Svarthakedopping: en bildserie. [Drawings of the Horned Grebe]. Var Fagelvarld 40: 33-46. [In Swedish with English summary.]

Regnall, S. 1981b. Hackningsbestandet av svarthakedopping Podiceps auritus i Sverige. [The breeding population of the Horned Grebe, Podiceps auritus, in Sweden.] Var Fagelvarld 40: 13-22. [In Swedish with English summary.]

Regnall, S. 1981c. Att taxera hackningsbestand av svartdopping Podiceps auritus. [How to census breeding populations of the Horned Grebe, Podiceps auritus.] Var Fagelvarld 40: 23-32. [In Swedish with English summary.]

1980

Bell, R. K. 1980. Horned Grebes forced down by ice storm. Redstart 47: 152-144.

Ferguson, R. S. 1980. A technique for live-trapping nesting Horned Grebes. J. Field Ornithol. 51: 179-180.

Fjeldsa, J. 1980. Post-mortem changes in measurements of grebes. Bull. Br. Ornithol. Club 100: 151-154.

Kobus, D. 1980. Aussergewohnlicher Brutplatz und Neststand des Ohrentauchers (Podiceps auritus). Ornithol. Mitt. 32: 80. [In German.]

1979

Bayer, R. D. 1979. Great Blue Heron attacks Horned Grebe. Bird-Banding 50: 264-265.

Hogdon, K. Y. 1979. Operation Horned Grebe. N. Am. Bird Bander 4: 110.

1978

Potvliege, R. 1978. Origine geographique possible des Grebes esclavons, (Podiceps auritus), captures en Belgique. [Possible geographic origin of Horned Grebe (Podiceps auritus) captured in Belgium.] Gerfaut 68: 121-123. [In French with Dutch and English summaries.]

1977

Borodulina, T. L. 1977. [Specific features of the flight apparatus of grebes in connection with their aquatic mode of life.] Ornithologiya 13: 160-172. [In Russian.]

Ferguson, R. S. 1977. Adaptations of the Horned Grebe for breeding in prairie pothole marshes. M. S. thesis, Univ. Manitoba. 95 pp.

Sugden, L. G. 1977. Horned Grebe breeding habitat in Saskatchewan parklands. Can. Field Nat. 91: 371-376.

1976

Faaborg, J. 1976. Habitat selection and territorial behavior of the small grebes in North Dakota. Wilson Bull. 88: 390-399.

1974

Potter, J. M., Jr. 1974. Horned Grebes in mutual display during northward migration. Chat 38: 22.

1973

Fjeldsa, J. 1973a. Antagonistic and heterosexual behaviour of the Horned Grebe *Podiceps auritus*. Sterna 12: 161-217.

Fjeldsa, J. 1973b. Distribution and geographical variation of the Horned Grebe *Podiceps auritus* (Linnaeus, 1758). Ornis Scand. 4: 55-86.

Fjeldsa, J. 1973c. Feeding and habitat selection of the Horned Grebe, *Podiceps auritus* (Aves), in the breeding season. Vidensk Medd. Dan. Naturhist. Foren. 136: 57-95.

Fjeldsa, J. 1973d. Territory and the regulation of population density and recruitment in the Horned Grebe (*Podiceps auritus auritus* Boje 1922). Vidensk. Medd. Dan. Naturhist. Foren. 136: 117-189.

1971

Huber, L. N. 1971. Horned Grebe specimen from Arizona. Condor 73: 486.

King, B. 1971. Group feeding by Slavonian Grebes. Brit. Birds 64: 372.

1970

Fjeldsa, J. 1970. Den reproduktive utvikling from til rugingen hos Horndykker, *Podiceps auritus*, med saerlig vek pa bestandsregulerende mekanismer. Unpubl. diss., Univ. Bergen. 230 pp. [In Norwegian.]

Hogstrom, S. 1970. Svarthakedoppingen *Podiceps auritus* pa Gotland. [Slavonian Grebe *Podiceps auritus* on the island of Gotland in the Baltic.] Var Fagelvarld 29: 60-66. [In Swedish with English summary.]

1969

Hagvar, G. 1969. [On *Podiceps auritus* in Co. Troms, N-Norway.] Sterna 8: 383-386. [In Norwegian with English summary.]

Paulson, D. R. 1969. Commensal feeding in grebes. Auk 86: 759.

Storer, R. W. 1969. The behavior of the Horned Grebe in spring. Condor 71: 180-205.

1968

Dusi, J. L. 1968. Feeding interaction between Bonaparte's Gulls and Horned Grebes. Auk 85: 129.

Keskpaik, Y., S. Onno and A. Davydov. 1968. [Development of the heat regulations in the fledglings Podiceps cristatus and Podiceps auritus in ontogenesis.] Izvest. Akad. Nauk Est. SSR Ser. Biol. 17: 192-206. [In Russian with English summary.]

Ladhams, D. E. 1968. Diving times of grebes. Brit. Birds 61: 27-30.

1967

Bub, H. 1967. Ohrentaucher (Podiceps auritus) an der lybischen Kuste. Ornithol. Mitt. 19: 219. [In German.]

Fatora, J. R. and E. K. Fatora. 1967. Observations on the diving abilities of some common species of diving birds. Chat 31: 31-36.

Rogers, M. J. 1967. Call notes of Slavonian and Black-necked grebes in autumn. Brit. Birds 60: 300.

1966

Hederstrom, L. 1966. Fynd av hackande Svarthakedopping (Podiceps auritus) i Oster-gotlands skargard. Var Fagelvarld 25: 277-278. [In Swedish.]

1965

Regnell, S. 1965. [Horned Grebe (Podiceps auritus) and Little Grebe (Podiceps ruficollis) breeding on islands in the archipelago.] Var Fagelvarld 24: 401-402. [In Swedish with English summary.]

Wehner, R. 1965. Das Auftreten des Ohrentauchers--Podiceps auritus--am Oberrhein und in der Wetterau. (Mit vergleichenden Angaben uber Podiceps nigricollis und die Gavia-Arten). Luscinia 38: 59-68. [In German with English summary.]

1964

Potter, E. F. 1964. Behavior of captive Horned Grebe. Chat 28: 43-45.

1963

Haller, W. and R. Pletscher. 1963. Horntaucher verteidigt sein Nest mit Wasserspritzen. Ornithol. Beob. 60: 111-112. [In German.]

Nero, R. W. 1963. Detergents--a new hazard for water birds. Blue Jay 21: 91-93.

Potter, J. 1963. Horned Grebe in breeding plumage. Chat 27: 53.

1962

Nokleby, P. 1962. Reirfunn av Horndykker, Podiceps auritus (L.), i Stange. [Breeding of Podiceps auritus in S. E. Norway.] Sterna 5: 62-64. [In Norwegian.]

1961

Storer, R. W. 1961. Observations of pellet-casting by Horned and Pied-billed grebes. Auk 78: 90-92.

1960

Clase, H. J., F. Cooke, T. A. Hill and W. J. Roff. 1960. A survey of the Slavonian Grebe at Myvatn, Iceland. Bird Study 7: 76-81.

Onnó, S. 1960. Zur Okologie der Lappentaucher (Podiceps cristatus, griseigena und auritus) in Estland. Proc. XIIth Intern. Ornithol. Congr. Helsinki 1958: 577-582. [In German.]

1958

Poyhonen, O. 1958. Harkalinnum (Podiceps griseigena) ja Mustakurkku-uikun (P. auritus) Kayttaytymisesta soidinaikana. Luonnon Tutkija 62: 103-105. [In Finnish.]

Yocum, C. F., S. W. Harris and H. A. Hansen. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

1957

Willgohs, J. F. 1957. Litt om Horndykkeren Podiceps auritus i Norge og et par nye funn. Naturen 81: 24-29. [In Norwegian.]

Ytreberg, N. J. 1957. Horndykkerens (Podiceps auritus (L.)) forekomst i Norge og noen trekk fra dens biologi. [The occurence of the Slavonian Grebe (Podiceps auritus (L.)) in Norway and some data of its breeding biology.] Det Kgl. Norske vidsk. Selsk. Museet Arbok 1956-57: 49-74. [In Norwegian.]

1956

Woolfenden, G. E. 1956. Preening and other behavior of a captive Horned Grebe. Wilson Bull. 68: 154-156.

1955

Dorn, J. L. 1955. Birding trips to Mississippi. La. Ornithol. Soc. News 3: 3.

Geroudet, P. 1955. Notes sur le Grebe jougris et la Grebe esclavon. Nos Oiseaux 23: 138-142. [In French.]

1953

Loppenthin, B. 1953. Nordisk Lappedykker (Podiceps auritius (L.)) som ynglefugl i Danmark. Dan. Ornithol. Foren. Tidsskr. 47: 1-15. [In Danish.]

Nicholson, D. J. 1953. Horned Grebe, Colymbus auritus, rises from ground and flies. Fla. Nat. 26: 190.

1952

Gudmundsson, F. 1952. Islenzkir fuglar III. Sefond (Podiceps auritus (L.)). [Icelandic Birds III. The Slavonian Grebe (Podiceps auritus (L.)).] Natuurfraedingurinn 22: 134-136. [In Icelandic with English summary.]

Parkes, K. C. 1952. Geographical variation in the Horned Grebe. Condor 54: 314-315.

1949

Hosking, E. J. 1949. Horned Grebe--courtship and display. Can. Nature 11: 150-153.

Wotton, M. J. 1949. Display of Slavonian Grebes in winter. Brit. Birds 42: 296.

1948

Bispham, T. 1948. Nest-building by unpaired Slavonian Grebe. Brit. Birds 41: 351.

Knowles, C. 1948. Slavonian Grebe rearing two broods. Brit. Birds 41: 56.

1941

Munro, J. A. 1941. Studies of waterfowl in British Columbia. The Grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

1939

Hosking, E. J. 1939. Courtship and display of the Slavonian Grebe. Brit. Birds 33: 170-173.

1932

North, M. E. W. 1932. Slavonian Grebe breeding in north Scotland. Brit. Birds 26: 166.

1929

Cottam, C. 1929. A shower of grebes. Condor 30: 80-81.

1928

Gordon, S. and A. S. Gordon. 1928. Notes on the nesting of the Slavonian Grebe in Scotland. Brit. Birds 22: 2-5.

Olsoni, B. 1928. Om svarthakedoppingens (Podiceps auritus L.) hackning. Ornis Fenn. 5: 65-72. [In Swedish.]

1927

Brimley, H. H. 1927. Horned Grebe in breeding plumage in North Carolina. Auk 44: 415.

1925

Lincoln, F. C. 1925. Loons and Horned Grebes in pound nets. Proc. Biol. Soc. Wash. 38: 88.

1923

Lonnberg, E. 1923. Nagra ord om svarthakedoppingen, Podiceps auritus, och dess utbredning i Sverige. Fauna Flora 18: 221-227. [In Swedish.]

1922

Alexander, G. 1922. Horned Grebe (Colymbus auritus) in central Missouri. Auk 39: 562-563.

1921

Mousley, H. 1921. The Horned Grebe (Colymbus auritus) at Hatley, Stanstead County, Quebec. Auk 38: 108.

1920

DuBois, A. D. 1920. Notes on the breeding habits of the Slavonian Grebe. Brit. Birds 14: 2-10.

1919

DuBois, A. D. 1919. An experience with Horned Grebes (Colymbus auritus). Auk 36: 170-180.

RED-NECKED GREBE

(*Podiceps grisegena*)

[DA: Grastrubet Lappedykker, DU: Roodhalsfuut, FI: Harkalintu, FR: Grebe jougris, GE: Rothalstaucher, IC: Sefgodi, IT: Svasso collorosso, JA: Aka-en Kaitsuburi, NW: Grastrupedykker, PO: Perkoz rdzawoszyi, PR: Mergulhao, RU: (Grey-cheeked Grebe), SP: Somormujo cuellirrojo, SW: Grahakedopping, US: Holboell's Grebe]

GENERAL DISTRIBUTION

North America Red-necked Grebes breed from Kotzebue Sound in northwestern Alaska across the northern Yukon, northwestern and southern MacKenzie to southern Ontario (locally) and south through interior British Columbia to northeastern Washington (at times in Oregon), northern Idaho, Montana, North Dakota, northeastern South Dakota, and northern and central Minnesota (Palmer 1962, Vaurie 1965, Godfrey 1966). Apparently, they formerly bred east into southern Quebec and perhaps New Hampshire (Vaurie 1965).

These grebes winter mostly along the coasts, in the Pacific from the Aleutian Islands south to central California, and on the Atlantic from Newfoundland to Georgia and central Florida, rarely to southern Florida (Palmer 1962, Godfrey 1966, Small 1974). They occur rarely on the Great Lakes and inland (AOU 1957).

World Distribution The race inhabiting North America, *P. g. holboellii*, has straggled to Greenland, Iceland, Scotland, southern Sweden, and France (Vaurie 1965) and also breeds in eastern Asia from eastern Siberia south to Manchuria, the Kurile Islands (group of 56 islands off east coast of Asia), and Japan (Hokkaido) (AOU 1957, BOU 1971). The nominate race, *P. g. grisegena* breeds in western Eurasia from Sweden, Finland, and north Russia south to Germany, the Balkans, and the Ukraine, and east to the Kirghiz Steppes (BOU 1971). Birds breeding in western Eurasia winter primarily on the western coasts from Norway and Britain to the Bay of Biscay, in the Baltic and the Caspian seas, to a lesser extent in the Black Sea, and apparently in the Adriatic and Aegean seas (Cramp et al. 1977). Those breeding in eastern Asia winter in Japan and Korea and south to southeastern China (Vaurie 1965, BOU 1971).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina The Red-necked Grebe is a scarce but apparently fairly regular winter resident in small numbers along the coast. Fifteen individuals were recorded in *American Birds* in seven of the nine winters from 1969-70 through 1977-78. Its occurrence has been recorded in every month from November through April, with at least one inland record as late as 5 May (Wray and Davis 1959).

South Carolina This species is a rare but fairly regular winter resident in very small numbers along the coast, apparently somewhat less common than in North Carolina. Ten individuals were recorded in American Birds in six of the nine winters from 1969-70 through 1977-78. Along the coast, the species has been recorded from as early as 20 December to as late as 23 May (Teulings 1971c, 1973b).

Georgia Burleigh (1958) reported that the Red-necked Grebe had previously been known as a rare winter visitant on the coast but was now "apparently fairly common on the coast during the winter months." The reassessment was evidently based on reports (in Burleigh 1958) from Cumberland Sound. Subsequent checklists stated that this grebe was common (Masters 1973) to uncommon (Johnson and Hillestad 1974, Denton et al. 1977).

Examination of the literature subsequent to Burleigh's (1958) monograph indicates that the Red-necked Grebe is considerably less common in Georgia than recent summary statements suggest. From 1970 through mid-1978, a single bird was reported in the coastal area [late October 1972 at St. Simon's Island (Teulings 1973a)]. Three papers dealing with Sapelo Island and vicinity (Teal 1959, Kale and Hyypio 1966, R. E. Hamilton 1969) fail to mention the species, and it has gone unrecorded on Christmas Bird Counts from then through the count of 1977-78. Tomkins (1958) considered the Red-necked Grebe rare in the Savannah River Delta area and listed only one observation. This lack of recent observations from the Georgia coast suggests that the Red-necked Grebe should be considered rare to casual rather than uncommon to common in that area.

Florida - Atlantic Coast and Keys Judging from the 27 records we have found, the Red-necked Grebe is a rare winter resident in Florida, relatively less common than in the Carolinas to the north. Only two individuals were reported from the Florida Atlantic coast in American Birds for the period 1970-78 during which 15 and 10 individuals were recorded in North and South Carolina, respectively. Howell (1932) and Sprunt (1954) summarized six early records for the Florida Atlantic coast and inland. More recent observations and one omitted by Sprunt are listed below:

1955	12 Mar.	1 seen	near New Smyrna	Stevenson 1955b
1962	22 Dec.	1 seen	Tavernier	Stevenson 1963b
1977	5 Jan.	1 seen	10 mi off Melbourne	Stevenson 1977
1977	27 Dec.	1 seen	Merritt Island NWR	Stevenson 1978

Florida - Gulf Coast The considerably greater number of Gulf Coast records (Table 11) probably indicates a real difference in frequency of occurrence between there and the Atlantic coast, where it has been much less frequently seen. The difference in the ranges of dates of occurrence between the Gulf Coast (11 October to 24 April) and the Atlantic coast (6 December to 8 April) is probably not significant, and merely reflects the greater number of records from the former area. Howell (1932) and Sprunt (1954) detailed eight early records from the Gulf Coast; more recent ones are as follows:

1952	27 Dec.	2 seen	off Alligator Point	Stevenson 1953a
1958	27 Dec.	2 seen	off St. Marks	Stevenson 1958b
1959	4 Mar.	1 seen	Shell Point, Wakulla County	Stevenson 1959a
1959	26 Dec.	1 seen	near Spring Creek	Stevenson 1960b
1964	22 Nov.	1 seen	off Alligator Point	Cunningham 1965a
1966	24 Apr.	1 seen	near Flamingo, Everglades	Cunningham 1966b
1967	6-8,11 Apr.	1 seen	Pensacola	Imhof 1967
1968	3 Feb.	1 seen	near Panacea	Stevenson 1968a
1975	11 Oct.	1 seen	near St. Marks Light	Edscorn 1976

Table 11. Dates of occurrence for Red-necked Grebes in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence
North Carolina	18	12 November - April
South Carolina	18	20 December - 5 May
Georgia	--	2 December - 18 February
Florida-Atlantic Coast	8	6 December - 8 April
Florida-Gulf Coast	19	11 October - 24 April
Alabama	3	18 December - 3rd week Jan.
Mississippi	1	9-12 December
Louisiana	3	17 December - 20 December
Texas	19	1 September - 24 March

Alabama The Red-necked Grebe is rare to accidental in Alabama, with approximately seven records for both inland and coastal areas (Hamilton 1977). None of these records is documented by a specimen or photographic record. The three coastal records are for mid-winter.

1964	26 Dec.	1 seen	Mobile	Imhof 1976b
1971	18 Dec.	1 seen	Dauphin Island	F. James 1972
1974	3rd week Jan.	1 seen	Fairhope	Imhof 1976b

Mississippi As in most states bordering the western Gulf of Mexico, this grebe occurs accidentally in Mississippi. There is apparently only a single sight record, a bird seen inland 9-12 December 1978 at the Hattiesburg sewage lagoons (Gates and Moore 1978).

Louisiana This grebe is rare to accidental in Louisiana with only four records for the state, the earliest inland, the other three more recent and near the coast.

1937	2 Dec.	1 spec.	Catahoula Lake	Lowery 1974
1975	20 Dec.	1 photogr.	Sabine NWR	Hamilton 1976
1976	18 Dec.	1 seen	Sabine NWR	Hamilton 1977
1977	17 Dec.	1 seen	Sabine NWR	Zinn 1978

Texas The Red-necked Grebe is a rare winter resident along the Texas coast but occurs more frequently there than anywhere else in the western Gulf of Mexico. There are 19 sight records for the coast (Webster 1972a, 1973a, Oberholser 1974), but we lack detailed information for most of these. This species has occurred considerably more frequently along the central coast than elsewhere. Dates of occurrence range from 1 September to 24 March (Oberholser 1974).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Red-necked Grebe is a species of wide distribution in the Northern Hemisphere. Total populations are unknown. Data presented by Palmer (1962) and Cramp et al. (1977) suggest that the North American population is larger than that of Western Europe. The largest numbers are apparently present in the western Palearctic, where hundreds of thousands winter in Iran (Cramp et al. 1977).

In the southeastern United States, the Red-necked Grebe is an uncommon to very rare winter resident. It is most abundant in the Carolinas and apparently least abundant in the northern Gulf of Mexico. Recorded extreme dates of occurrence along the coasts of the southeastern states are summarized in Table 11.

HABITAT

Nesting Red-necked Grebes nest solitarily but are occasionally found in

loose colonies (Palmer 1962). They usually nest in shallow lakes or ponds of moderate size (seldom less than 10 ac), or in shallow marshy areas on larger lakes. In smaller ponds, the presence of an abundance of emergent plants is not a nesting requirement (Munro 1941), but in larger ponds such vegetation as cattails (Typha), sedges, and bulrush (Scirpus)(Oberholser 1974) is used to anchor the floating nest of decaying vegetation and provides concealment for nest and birds alike. This grebe has been recorded using the side of a muskrat house as a nesting substrate (Palmer 1962) and, in two instances, renesting birds used man-made wooden floats for this purpose (Speirs et al. 1944).

Feeding Palmer (1962) reported that this species "evidently feeds mainly near and at bottom". This remark presumably refers primarily to feeding in the nesting habitat. These grebes evidently feed largely in the near vicinity of where they nest or winter, but Munro (1941) indicated that on the Pacific coast wintering Red-necked Grebes may congregate where food resources are particularly abundant and follow such resources from area to area. Munro noted (1941) that this species may follow schools of Pacific Herring (Clupea pallasii) "during the spring spawning period when these fish are in relatively shallow water."

Winter and Offshore Wintering birds occur primarily in saltwater along the coasts, mostly on the ocean but to some extent in large estuaries and bays. Occasional birds winter inland on large bodies of water. On the ocean these grebes usually stay well offshore, at times many miles out in the open ocean (Palmer 1962, Oberholser 1974).

FOOD AND FEEDING BEHAVIOR

During the summer the food is apparently invertebrates, particularly terrestrial and aquatic insects; fish are consumed to a lesser extent, and other foods (e.g., tadpoles, salamanders) are taken occasionally (Palmer 1962, Oberholser 1974, Cramp et al. 1977). In marine situations fish are the most important item of diet, but crustacea and annelids are also taken.

Wetmore's (1924) report on the stomach contents of 36 birds collected in nearly all months in two provinces and nine states, and Munro's (1941) report on food habits in British Columbia are the primary sources of information on the diet of this species in North America. Wetmore found that fish made up 55.5% of the total, crustaceans 20%, and insects (primarily aquatic forms) 21.5%. The only data given on birds from the southeastern United States is the comment that remains of percoid fishes were found in stomachs of grebes taken in Currituck Sound, North Carolina, at an unspecified time of year. Munro's field observations in British Columbia suggested that fish were a primary food in winter, and that in summer Red-necked Grebes took fish, crayfish, and aquatic insects.

In the Old World, this species feeds primarily on invertebrates, particularly insects, during the summer months, but also takes crustaceans, tadpoles, molluscs, and aquatic worms. Fish represent a relatively small proportion of the diet in summer, but may constitute a major item during the winter when

birds are in marine areas (Cramp et al. 1977). In Denmark, fish species taken in marine areas included young herring (Clupea), pipefish (Synegnathidae), rockwrasse (Ctenolabrus), sculpin (Cottidae), sticklebacks (Gasterosteus and Spinachia), blenny (Zoarces), butterfish (Pholis), cod (Gadus), and gobies (Gobius). Other items in marine habitats include prawns (Palaemon) and small crabs (Madsen 1957).

According to Chamberlin (1977), young birds in Michigan were primarily fed fish, which increased in size as the young grew. Munro (1941), however, stated that he found no difference in the food eaten by summer adults and young in British Columbia.

Most food is caught by pursuit diving using the feet for propulsion, or by swimming along the surface with the head submerged. Insects may be picked from aquatic vegetation either above or below the surface, or directly from the surface (Cramp et al. 1977). At Berkshire, England, Hancock and Bacon (1970) found that diving times averaged 25 seconds (range = 8.2-40.9) for 155 dives. Simmons (1970) timed 59 dives on the Danish island of Zealand and 130 in Somerset, England. Mean diving times for these two localities was 24.8 seconds (range = 14-34) and 30.0 seconds (range = 16-42), respectively, the difference apparently reflecting the water depth between the two localities.

According to Wobus (1964 in Cramp et al. 1977), the Red-necked Grebe normally feeds during the day with periods of inactivity at mid-day and in the afternoon. Wintering or migrant birds in Connecticut were recorded feeding as late as 10:00 P.M. (Forbush 1925 in Palmer 1962).

SUSCEPTIBILITY TO OIL POLLUTION

Direct mortality from oil pollution has been recorded for this species in several instances (Table 12). Its solitary habits should make it less susceptibile to oil spills than gregarious species like the Horned Grebe; King and Sanger (1979) gave it an Oil Vulnerability Index of 44 in the Northeast Pacific, a figure slightly less than that for the Horned Grebe. Because of the infrequency with which the species occurs in the southeast, oil spill incidents in that area are unlikely to have an important effect on Red-necked Grebes.

BIBLIOGRAPHY

1980

Davis, A. H. and K. E. Vinicombe. 1980. Diving action of Red-necked Grebes. Brit. Birds 73: 31-32.

Fjeldsa, J. 1980. Post-mortem changes in the measurements of grebes. Bull. Br. Ornithol. Club 100: 151-154.

Simmons, K. E. L. 1980. Diving actions of grebes. Brit. Birds 73: 32.

Table 12. Number of dead birds and number and percentage of dead Red-necked Grebes found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Red-necked Grebes	Percentage of Red-necked Grebes	Source
Poole Harbour, Dorset, England	Jan. 1961	433 (a,b)	1	0.23	Bourne 1968b
North-central Kattegat, Denmark	Jan.-Feb. 1962	1,723 (b,c)	1	0.06	Joensen 1972a
North Sea coast, Denmark	1965-1966	803 (b)	7	0.87	Joensen 1972a
Bornholm, Denmark	Jan.-Feb. 1968	466 (b)	4	0.86	Joensen 1972a
N. Sealand, Denmark	Feb.-Mar. 1969	2,376 (b)	4	0.17	Joensen 1972b
Northeast Britain	Jan.-Feb. 1970	10,992 (b,c)	3	0.03	Greenwood et al. 1971
Off Eastern Canada	Feb.-Mar. 1970	1,276 (a,b)	7	0.55	Brown et al. 1973
S. Kattegat, Denmark	Dec. 1970 Jan. 1971	2,311 (b)	8	0.35	Joensen 1972b
San Francisco Bay, California	Jan. 1971	3,221 (b,d)	20	0.62	Smail et al. 1972
Djursland-Anholt, Denmark	Mar. 1971	239	8	3.35	Joensen 1972b
North-central Kattegat, Denmark	Mar. 1972	4,759 (b)	112	2.35	Joensen and Hansen 1977
Waddensea, Denmark	Dec. 1972	9,151 (b)	11	0.12	Joensen and Hansen 1977

(a) Total includes both live and dead oiled birds.
(b) Total includes only those birds identified to species.
(c) Total includes some birds that were not oiled.
(d) This figure represents birds brought to cleaning/receiving stations.

1978

Folkstead, A. O. 1978. [Winter censuses and studies on the Red-necked Grebe Podiceps griseigena along the Norwegian coast.] Anser Suppl. 3: 84-89. [In Norwegian with English summary.]

Gates, L. and J. R. Moore. 1978. A Red-necked Grebe in Hattiesburg, Mississippi. Mississippi Kite 8: 40.

Hanson, D. 1978. A Red-necked Grebe census on Lake Edward in Crow Wing County [Minnesota]. Loon 50: 222-223.

Spahn, R. 1978. Red-necked Grebe invasion. Kingbird 28: 95-96.

Stallings, P. 1978. Two Red-necked Grebes at Nashville. Migrant 49: 76-77.

Zach, P. 1978. Erster brutversuch des Rothalstauchers Podiceps griseigena in Bayern. [First breeding studies of the Red-necked Grebe Podiceps griseigena in Bavaria.] Anz. Ornithol. Ges. Bayern 17: 329-330. [In German.]

1977

Borodulina, T. L. 1977. [Specific features of the flight apparatus of grebes in connection with their aquatic mode of life.] Ornitologiya 13: 160-172. [In Russian.]

Chamberlin, M. L. 1977. Observations on the Red-necked Grebe nesting in Michigan. Wilson Bull. 89: 33-46.

Price, R. E., Jr. and R. C. Ruiz. 1977. Red-necked Grebe in Buncombe County, N.C. Chat 41: 47.

1976

Stalmach, J. 1976. Potapka rudokrka v Jesenikach. [The Red-necked Grebe in the Jesenicky Mountains.] Zpravy MOS 1976 18: 129-130. [In Czechoslovakian with German summary.]

1975

Dubke, K. H. and L. H. Dubke. 1975. Red-necked Grebe sighted on Chickamauga Lake. Migrant 46: 75-76.

Simmons, K. E. L. 1975. Helminth-eating in grebes. Wildfowl 26: 58-63.

1974

Fiala, V. 1974. Populationsdynamik und Brutbiologie des Lappentaucher, Podicipedidae im Teichgebiet von Namest'n. Osl./CSSR. Anz. Ornithol. Ges. Bayern 13: 198-218. [In German with English summary.]

1972

Heldt, R., Jr. 1972. Rothalstaucher, Podiceps grisegena, und Zwergtaucher, Podiceps ruficollis, Brutvogel im Hauke-Haien-Koog. Corax 4: 65-66. [In German.]

Scholl, D. 1972. Das Vorkommen des Rothalstauchers Podiceps griseigena, in Schleswig-Holstein und Hamburg. Corax 4: 14-29. [In German.]

1971

Menzel, F. 1971. Beobachtungen zum Verlauf einer Zweitbrut beim Rothalstaucher (Podiceps griseigena Bodd.). Beitr. Vogelkd. 17: 171-172. [In German.]

1970

Ahlen, I. 1970. Grahakedoppingen Podiceps griseigena som hackfagel i Skane 1960-1968. [Breeding population of Red-necked Grebe Podiceps griseigena in Skane 1960-1968.] Var Fagelvarld 29: 57-59. [In Swedish with English summary.]

Hancock, C. G. and P. J. Bacon. 1970. Diving times of Red-necked Grebe. Brit. Birds 63: 299-300.

Macha, Z. 1970. [The nesting of Podiceps grisigensa (sic) Bodd.]. Ziva 18: 153-154. [In Czechloslovakian.]

Schmidt, T. 1970. Parringsadfaerden hos grastrubet leppedykker. Nat. Verden. 1970: 347-351. [In Danish.]

Simmons, K. E. L. 1970. Duration of dives in the Red-necked Grebe. Brit. Birds 63: 300-302.

Spillner, W. 1970. "Rothalse" Lebensbilder aus der Rothalstaucherpopulation des NSG Dambecker Seen. Falke 17: 270-277. [In German.]

1968

Dick, W. and H. Holupirek. 1968. Zur Tauchdauer beim Rothalstaucher (Podiceps griseigena). Beitr. Vogelkd. 14: 178. [In German.]

Hemming, J. D. 1968. Copulatory behavior of the Red-necked Grebe on open water. Wilson Bull. 80: 326-327.

Savage, C. D. W. 1968. Rednecked Grebe Podiceps griseigena (Boddaert) again sighted in West Pakistan. J. Bombay Nat. Hist. Soc. 65: 773.

1967

Duiven, P. 1967. Een nieuw broedgeval van de Roodhalsfuut (Podiceps griseigena) in Nederland. [A new breeding case of the Red-necked Grebe (Pod-

iceps griseigena) in the Netherlands.] Limosa 40: 135-136. [In Dutch with English summary.]

Holmes, J. R. S., T. J. Roberts and C. D. W. Savage. 1967. Red-necked Grebe Podiceps griseigena (Boddaert) sighted in West Pakistan. J. Bombay Nat. Hist. Soc. 64: 555-557.

1966

Kaestner, P. 1966. Red-necked Grebe and albino Black Duck at Loch Raven. Md. Birdlife 22: 107.

1965

Menzel, H. 1965. Der Rothalstaucher (Podiceps griseigena) Brutvogel im Restloch eines Braunkohlenbergbaues. Beitr. Vogelkd. 10: 405-406. [In German.]

1964

de Vos, A., and A. E. Allin. 1964. Winter mortality among Red-necked Grebes (Colymbus grisegena) in Ontario. Can. Field Nat. 78: 67-69.

Wobus, U. 1964. Der Rothalstaucher (Podiceps grisegena (Boddaert)). [The Red-necked Grebe.] Die Neue Brehm-Bucherei, A. Ziemsen Verlag (Wittenberg). 103 pp. [In German.]

1963

Allin, A. E. 1963. A winter record of the Red-necked Grebe at Fort William. Newsl. Thunder Bay Field Nat. Club 17: 22-23.

1961

Ahlen, I. 1961. [Holboell's Grebe (Podiceps griseigena holboelli) found in Sweden.] Var Fagelvarld 20: 296-302. [In Swedish.]

Wobus, U. 1961. Normale Zweitbruten beim Rothalstaucher (Podiceps griseigena). J. Ornithol. 102: 484-485. [In German.]

1960

Onno, S. 1960. Zur Okologie der Lappentaucher (Podiceps cristatus, griseigena, und auritus) in Estland. Proc. XIIth Intern. Ornithol. Congr., Helsinki, 1958: 577-582. [In German.]

Wobus, U. 1960. Nestbau und Balz des Rothalstauchers. [Nest building and copulation of the Red-necked Grebe.] Vogelwelt 81: 61-62. [In German.]

1959

Mate, L. 1959. Nesting of the Red-necked Grebe. Aquila 65: 337-338.

Stott, K., Jr. 1959. Red-necked Grebe in San Diego County, California. Condor 61: 299.

Weller, M. W. 1959. Albinism in Podiceps grisegena and other grebes. Auk 76: 520-521.

1958

Poyhonen, O. 1958. Harkalinnum (Podiceps griseigena) ja Mustakurkkuuikun (P. auritus) Kayttaytymisesta soidinaikana. Luonnon Tutkija 62: 103-105. [In Finnish.]

Yocum, C. F., S. W. Harris and H. A. Hansen. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

1957

Basecke, K. 1957. Zur Brutbiologie des Rothalstauchers (Podiceps griseigena). Vogelring 26: 9-11. [In German.]

Cringan, A. T. 1957. Notes on the biology of the Red-necked Grebe in western Ontario. Can. Field Nat. 71: 72-73.

Madsen, F. J. 1957. On the food habits of some fish-eating birds in Denmark. Dan. Rev. Game Biol. 32: 19-83.

1956

Packard, C. M. 1956. Holboell's Grebes wintering in Maine. Maine Field Nat. 12: 40-41.

Soding, K. 1956. Auffalliges auftreten ziehender Rothalstaucher (Podiceps griseigena) in jungster Zeit. Natur und Heimat 16: 15-17. [In German.]

1955

Geroudet, P. 1955. Notes sur le Grebe jougris et le Grebe esclavon. Nos Oiseaux 23: 138-142. [In French.]

1954

Andersson, T. 1954. Simflyttning hos Skaggdopping (Podiceps cristatus) och Grahakedopping (P. griseigena). [Migration by swimming in two Podiceps species.] Var Fagelvarld 13: 133-142. [In Swedish with English summary.]

Harbert, D. D. 1954. Red-necked Grebes with entirely yellow bills. Brit. Birds 47: 169.

Snyder, L. L. 1954. On the distribution of Colymbus grisegena holbollii. Can. Field Nat. 68: 41-42.

1953

Nelson, U. C. 1953. Northern record of nesting of Red-necked Grebe. Condor dor 55: 220.

Thomasson, K. 1953. Die Verbreitung des Rothalstauchers, Podiceps g. grisei-gena Bodd. in NW-Europa. Zool. Bidr. Uppsala 30: 157-168. [In German.]

1951

Gunn, W. W. H. 1951. The changing status of the Red-necked Grebe in southern Ontario. Can. Field Nat. 65: 143-145.

1948

Basecke, K. 1948. Beitrag zur Vogelwelt der naheren und weiteren Umgebung Braunscheigs. 2. Rothalstaucher. Beitr. Naturkde Niedersachsen 1: 9-13. [In German.]

1947

Holdom, M. W. 1947. Holboell's Grebe's strange death. Can. Field Nat. 61: 21.

1945

Jacobs, D. and E. Jacobs. 1945. A nesting of Holboell's Grebe and a problem in parentage. Flicker 17: 76-78.

1944

Buchanan, F. W. 1944. Notes on molting time of loons and grebes. Wilson Bull. 56: 116.

Clark, C. F. 1944. Summer occurrence of Holboell's Grebe in Ohio. Wilson Bull. 56: 169.

Speirs, J. M., G. W. North and J. A. Crosby. 1944. Holboell's Grebe nesting in southern Ontario. Wilson Bull. 56: 206-208.

1943

Wood, N. A. 1943. Many Holboell's Grebes caught in fishermen's nets at James Bay. Jack-Pine Warbler 21: 88.

1941

Munro, J. A. 1941. Studies in waterfowl in British Columbia. The Grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

1940

Wahn, R. 1940. Vom Rothalstaucher. Beitr. Avifauna Mitteldeutschland 4: 32-37. [In German.]

1938

Jones, S. P. 1938. Holboell's Grebe and American Brant in Wisconsin. Auk 55: 666.

1936

Lonnberg, E. 1936. Nagra ord om grahakedoppingen, Podiceps grisegena Bodd., och dess variation. Fauna Flora 1936: 73-78. [In Swedish.]

1933

von Kalitsch, L. 1933. Brutzeit vom Rothalstaucher. Beitr. Fortpfl. Vogel 9: 59. [In German.]

1931

Madon, P. 1931. Le secret du grebe. Alauda 3: 264-310. [In French.]

White, F. B. 1931. Manners of Holboell's Grebe in captivity. Auk 48: 559-563.

1930

Greene, E. R. 1930. Holboell's Grebe (Colymbus holboelli) in Georgia. Auk 47: 412.

Shelley, L. O. 1930. Notes on Holboell's Grebe in captivity. Auk 47: 238-240.

1929

von Kalitsch, L. 1929. Brutbiologisches vom Rothalstaucher. Beitr. Fortpfl. Vogel. 5: 225-226. [In German.]

1928

[Witherby, H. F.] 1928. Albino Red-necked Grebe in Lincolnshire and other albinstic birds. Brit. Birds 21: 264.

1904

Sim, R. J. 1904. Notes on the Holboell Grebe (Colymbus holboelli). Wilson Bull. 16: 67-74.

EARED GREBE

(*Podiceps nigricollis*)

[DA: Sorthalset Lappedykker, DU: Geoorde Fuut, EN: Black-necked Grebe, FI: Mustakaulauikku, FR: Grebe a cou noir, GE: Schwarzhalstaucher, IC: Stargodi, IT: Svasso piccolo, JA: Hajiro Kaitsuburi, NW: Svarthalsdykker, PO: Zausznik, PR: Mergulhao, SP: Zambullidor Orejudo, Noveleta cuellinegra, Zampullin cuellinegro, SW: Svarthalsad dopping]

GENERAL DISTRIBUTION

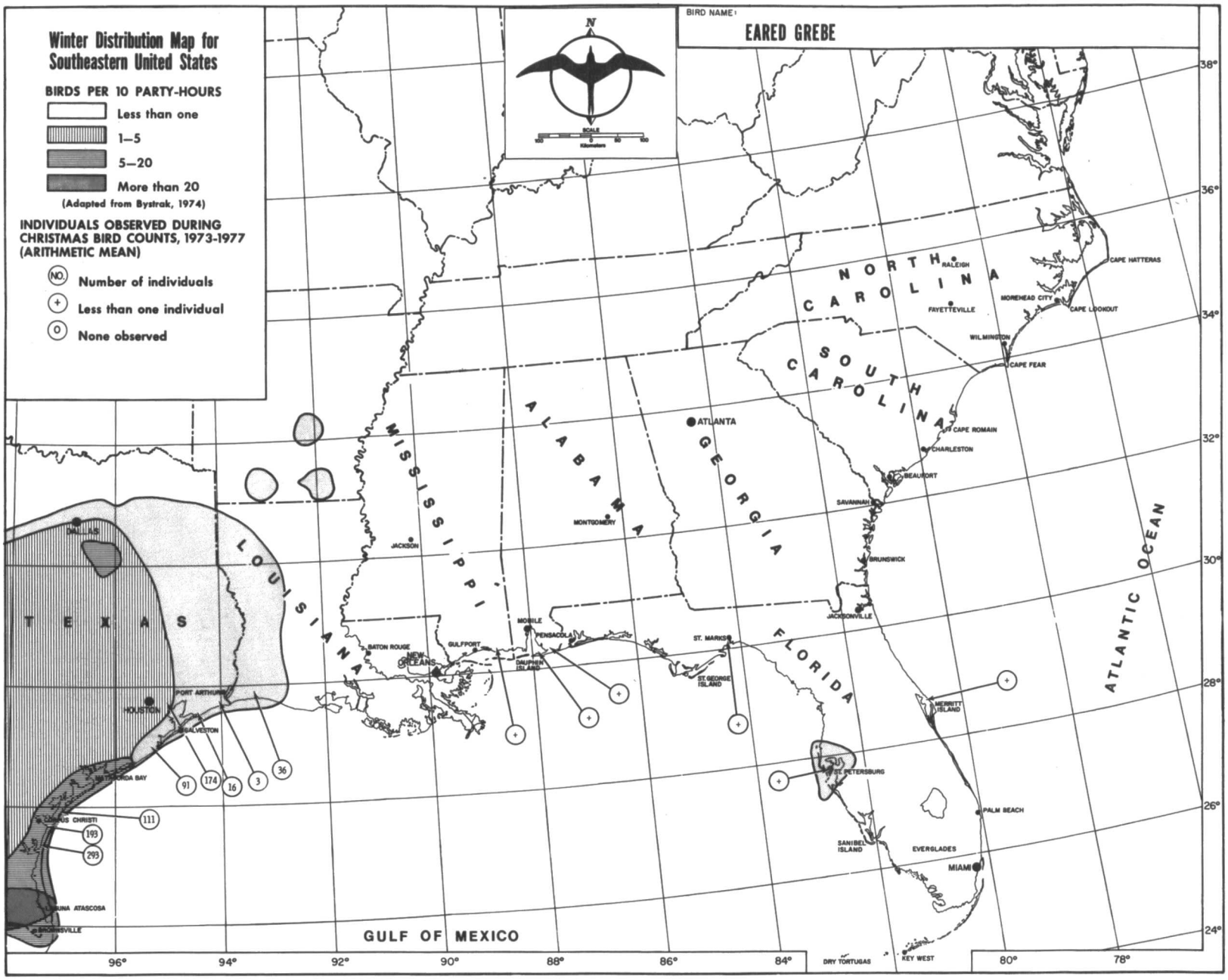
North America Eared Grebes breed from central interior British Columbia, central Alberta and Saskatchewan, and southwestern Manitoba south to northwestern Baja California, central Arizona and New Mexico, and southern Texas. They breed east to western Minnesota, northwestern Iowa, east-central Kansas, central Oklahoma, and east-central Texas (AOU 1957, Palmer 1962, Godfrey 1966), and breeding has also occurred in Puebla and Jalisco, Mexico (Dickerman 1969). These grebes winter primarily in coastal waters from southern British Columbia south to Guatemala and to a much lesser extent in the western Gulf of Mexico (Map 5). Smaller numbers winter inland in California, Nevada, Utah, Arizona, and southwestern New Mexico and Texas south through Mexico to Guatemala (AOU 1957, Palmer 1962).

World Distribution In South America, a different race, *P. n. andinus*, thought by some to possibly be a distinct species, breeds and is apparently resident on lakes in the Eastern Andes of Colombia (Blake 1977). In the Old World, the Eared Grebe breeds locally and discontinuously across southern and central Europe east through Asia Minor to central Asia, and in the Far East in southern Ussuriland and probably eastern and central Manchuria (Vaurie 1965, BOU 1971). These birds winter in western and southern Europe south to the Mediterranean Basin, the Iranian region, northern India, and southeastern China (Vaurie 1965). This grebe formerly bred in northwest Africa, but its present status there is uncertain (Cramp et al. 1977). Other populations breed in eastern and southern Africa (Vaurie 1965) and in the Andes of Colombia (Storer 1979b).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The Eared Grebe is a recent and perhaps increasingly abundant addition to the avifauna of the southeastern states. Its presence is unrecorded in early state bird books, even on hypothetical lists. Texas has been within the limits of the species' historical range, but it appears that its abundance in the eastern part of that state has been increasing. First records of occurrence in southeastern states are Louisiana, 1948 (Lowery 1974); Florida, 1953 (Sprunt 1954); South Carolina, 1959 (Burton 1970); Alabama, 1960 (Imhof 1962b); Mississippi, 1962 (Williams and Clawson 1963); North Carolina, 1964

Taxonomic note: Also appears in recent literature as *Podiceps caspicus*.


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than one
1–5
5–20
More than 20
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
BIRD NAME:
EARED GREBE
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
NORTH CAROLINA
SOUTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
BATON ROUGE
NEW ORLEANS
GULFPORT
JACKSON
MOBILE
DAUPHIN ISLAND
PENSACOLA
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
ST. PETERSBURG
SANIBEL ISLAND
EVERGLADES
MIAMI
PALM BEACH
MERRITT ISLAND
JACKSONVILLE
BRUNSWICK
SAVANNAH
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
DRY TORTUGAS
KEY WEST
91
174
16
3
36
111
193
293
38°
36°
34°
32°
30°
28°
26°
24°
96°
94°
92°
90°
88°
86°
84°
80°
78°

(Parnell 1966e); and Georgia, 1979 (LeGrand 1979c). Buckley (1968a) discussed the increasing frequency of records in the eastern United States. As shown in the state accounts, the species now occurs almost annually in many of the southeastern states, although still in very small numbers. Its importance as a wintering bird may increase in the next few decades.

North Carolina The Eared Grebe is rare but probably fairly regular in very small numbers along the coast. There are 9 records from the coast involving at least 13 individuals, and a few inland records.

1964	13 Dec.	1 seen, photogr.	Banks Channel, Wrightsville Beach	Parnell 1965b, 1966d
1967	31 Dec.	1 seen	Pea Island	Parnell 1968b
1971	25 Apr.	1 seen	near Smith Island	Teulings 1971c
1971	30 Dec.	1 female found dead (NCSM #4431)	Oregon Inlet	Browne 1976
1972	9 Jan.	1 seen	Oregon Inlet	Teulings 1972b
1972	4-7 Mar.	1 male coll. (UNC #B282)	Inland Waterway near Wrightsville Beach	Parnell et al. 1974
1972	28-30 Mar., 10 Apr.	2-4 seen, 1 seen	Banks Channel, Wrightsville Beach	Parnell et al. 1974
1974	24 Feb.	2 seen	Pea Island	Teulings 1974b
1974-75	21 Dec.-13 Jan.	2 seen	Lake Benson (inland)	Teulings 1975b
1975	17 Apr.	1 seen	Lake Wheeler (inland)	Teulings 1975c
1975	mid-Dec.	1 seen	Lake Wheeler	Teulings 1976b
1976	25 Jan.	1 seen	Salvo, on Outer Banks	Teulings 1976b

South Carolina We have found but three records from the state, only one from the coast.

1959	13-14 Jan.	1 imm. female coll. (CM #59.8)	Old Yacht Basin, Charleston	Dawn 1959
1973	27-28 Jan.	1 seen	Lake Hartwell (inland)	Teulings 1973b
1975	10-15 May	1 seen	sewage pond, Pendleton (inland)	LeGrand 1975

Georgia There is only one record for Georgia.

1979	22 Mar.	1 seen	Eufala NWR (inland)	LeGrand 1979c

Florida - Atlantic and Gulf Coasts Eared Grebes are rare in winter in Florida, but have occurred on both Atlantic and Gulf coasts as well as inland. Of 45 records of the species in the past three decades, 42 have been of single individuals, and the others of 2-4 birds. Twelve Atlantic coastal records are from November through February; birds were seen each year 1973-77, indicating a high degree of regularity of occurrence, although in very small numbers. Twelve inland records span the months from September to April; some individuals remained at a locality for more than two months. In recent years (1973-1978), inland occurrence has been observed annually. There are 21 records for the Gulf coast from October to April, with occurrence of small numbers recorded annually, 1971-79. It is possible that some inland and coastal records for a given year represent a single bird that moved about during the winter months.

Florida - Atlantic Coast

1957	25 Jan.- 8 Feb.	1 seen	near Fort Pierce	Sprunt 1963
1964	21 Nov., 19 Dec.	1 seen	near Miami	Olson and Stimson 1966
1966	23 Jan.- 13 Feb.	1 seen	near Miami	Olson and Stimson 1966
1973	11 Jan.	1 seen	Courtney-Campbell	Woolfenden 1973
1973	10 Dec.	1 seen	Merritt Island	Stevenson 1974
1974	1 Feb.	1 seen	near Titusville	Stevenson 1974
1975	18 Feb.	1 seen	Merritt Island	Stevenson 1975
1975	1 Nov.- 27 Dec.	2-4 seen	Melbourne Beach	Edscorn 1976
1976	26 Nov. et seq.	1 seen	Fort Lauderdale	Edscorn 1977
1976	27 Nov.	1 seen	Jacksonville	Edscorn 1977
1976	28 Dec.	1 seen	Merritt Island NWR	Stevenson 1977
1977	20 Nov.	1 seen	Titusville	Edscorn 1978

Florida - Gulf Coast

1953	20 Dec.	1 seen	Santa Rosa Island, near Pensacola	Sprunt 1954
1959	12-15 Apr.	1 spec. coll. 15 Apr.	Pensacola	Newman and Warter 1959b, Sprunt 1963
1959-60	30 Oct., 1 Nov., 5 Jan.	1 seen	Pensacola	Newman 1960a, F. James 1960
1961	25-30 Apr.	1 seen	St. Marks Light	Abramson and Stevenson 1961
1971	Jan.-Mar.	1 seen	Pass-a-grille	Stevenson 1971
1972	16 Dec. et seq.	1 seen	Tierra Verde	Woolfenden 1973
1974	9 Apr.	1 seen	Panama City	Imhof 1974
1973	24 Dec.	1 seen	St. Petersburg	Stevenson 1974
1974-75	26 Dec.-17 Mar.	1 seen	near St. Petersburg	Stevenson 1975
1974	19 Dec.	1 coll.	near St. James, Franklin Co.	Stevenson 1975
1975	fall	1 seen	St. Petersburg	Edscorn 1976
1975	29 Nov.	1 seen	off St. Marks Light	Edscorn 1976
1976	to 6 Mar.	1 seen	St. Petersburg	Stevenson 1976
1976	28 Dec.	1 seen	Fort Walton Beach	Hamilton 1977
1977	22 Dec.	1 seen	Portland	Hamilton 1977
1977	21 Feb.	1 seen	St. Petersburg	Stevenson 1977
1977	8 Oct.	1 seen	Tampa	Edscorn 1978
1977	16 Nov.	1 seen	Sarasota	Edscorn 1978
1977	31 Dec.	1 seen	near Summerland Key	Stevenson 1978
1978	15 Dec.	1 seen	Pinellas Co.	Stevenson 1979
1979	23 Jan.	1 seen	Pinellas Co.	Stevenson 1979

Alabama The Eared Grebe is rare in winter and migration in Alabama. We know of 21 records, a third of them from inland areas. All of these records have occurred within the last 20 years, two-thirds of them since 1970. Most reports are from mid-winter, although birds have been seen from late fall through the end of April, and one exceptional bird was seen in June at Gulf Shores (Imhof 1976b). Imhof (1976b) listed many of the records through 1973, but we have included only those not given there.

1960	1 Jan.-26 Mar.	1 seen	Dauphin Island	F. James 1960
1964	4 Jan.	2 seen	Lake Shelby, Gulf Shores	Stevenson 1964b
1966	31 Dec.	6 seen	Mobile	F. James 1967
1970	26 Dec.	1 seen	Mobile	Hamilton 1971, Hayward 1971
1971	2 Jan.	1 seen	Dauphin Island	Hamilton 1971, Gaillard 1971
1972	8-22 Jan.	2 seen	Gulf Shores	F. James 1972
1973	7-8 Apr.	1 seen	Dauphin Island	Imhof 1973
1975	12 Apr.	1 seen	Wheeler NWR (inland)	Imhof 1975a
1975	12 Aug.	1 seen	Lake Purdy (inland)	J. Stewart 1975
1975	24 Sep.	1 seen	Marion (inland)	Purrington 1976
1976	3 Jan.	1 seen	Gulf Shores	Hamilton 1976
1976	15 Feb.	1 seen	Fairhope	Hamilton 1976

Mississippi The Eared Grebe is an uncommon to rare winter resident in Mississippi. Most recent records are from inland, perhaps reflecting more intensive observation in that area. Coastal occurrence may be regular, although observations are few.

1962	11 Mar.	1 coll. (MGFC Ab #4871)	Pascagoula, E river mouth	Gandy and Turcotte 1970, Williams and Clawson 1963
1963	13 Mar.	1 seen	Gulfport Harbor	F. James 1963
1977	17 Dec.	2 seen	Jackson Co.	Jackson and Cooley 1978a

1977-78	20 Dec.-1 Jan.	1 seen	Gulfport Harbor	Jackson and Cooley 1978a
1978	16-21 Dec.	1 seen	Pascagoula River marsh	Hamilton 1979
1978	22 Dec.	2 seen	Horn Island	Hamilton 1979

Louisiana The Eared Grebe is now regarded as regular at least in small numbers in winter in Louisiana, but it is more common in the western part of the state. Through 1955, it had been recorded from the state less than a dozen times (Lowery 1974). Two Eared Grebes in breeding plumage "and apparently paired" (J. Stewart 1970) were seen 13 June 1970 in a marsh near Holly Beach, Cameron Parish; this led Lowery (1974) to speculate that the species may actually have nested in the state. To date there have been no more midsummer records, which suggests that these birds were merely nonbreeding birds "summering-over" in an area well removed from the breeding range. Excluding the anomalous summer record, the species has been recorded from 30 August (Purrington 1976) through 17 May (Imhof 1970), but the primary period of occurrence is from late October through late April (Lowery 1974).

Texas In winter, Eared Grebes are locally very common (e.g., 500 at Cove in early January 1970; Webster 1970b) to fairly common along the coast from Chambers County to Brownsville. Winter occurrence is primarily from October to May, with extremes of 30 August and 5 June (Oberholser 1974, Blacklock 1978 ms). Peak numbers are found along the coast in November and December and in February through April (Blacklock 1978 ms). There are four well-documented breeding records from inland, the latest in 1968 (Oberholser 1974).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Eared Grebes breed widely throughout the holarctic with isolated populations in South America and Africa. Within the southeastern United States, its status varies from rare winter visitor on the Atlantic coast to resident in Texas, although it may be becoming more abundant in winter throughout the area. In all coastal areas, the primary time of occurrence is winter. Table 13 summarizes periods of occurrence for the coastal regions of the southeastern states.

Migration and Winter In North America and Europe, most Eared Grebes migrate south and to the coasts from their inland breeding areas; South African and South American birds may be resident (Palmer 1962, Cramp et al. 1977, Storer 1979b). Those in North America winter south along the Pacific coast to Guatemala, less frequently to the Atlantic and Gulf coasts (Storer 1979b). Relatively small numbers winter in the southeastern United States; the great majority occur along the Texas coast (Map 5, Table 14).

HABITAT

Nesting Faaborg (1976), who studied habitat selection in nesting Pied-billed, Horned, and Eared grebes in North Dakota, found that Eared Grebes

Table 13. Dates of occurrence for Eared Grebes in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence (a)
North Carolina	12	13 December - 25 April
South Carolina	3	13-28 January
Georgia	1	22 March
Florida - Atlantic Coast	12	1 November - 18 February
Florida - Gulf Coast	21	8 October - 30 April
Alabama	14	15 October - 29 April
Mississippi	at least 6	17 December - 13 March
Louisiana	regularly	October - late April
Texas	many	October - May

(a) We do not include exceptionally unseasonal reports because we do not believe that they represent the usual period of occurrence in the region.

Table 14. Peak concentrations of wintering Eared Grebes in states bordering the northwestern Gulf of Mexico.

Date seen	Number seen	Locality	Source
		MISSISSIPPI	
1977 1 Oct.	10	Hattiesburg sewage ponds (inland)	Weber and Jackson 1978
1965 24 Dec.	17	Lake Serene (inland)	Woodard 1966
1978 18 Dec.	12	Hattiesburg sewage ponds	Hamilton 1979
		LOUISIANA	
1955 26 Dec.	16	Shreveport CBC (inland)	Jeter 1956
1955 31 Dec.	16	Sabine NWR CBC	Newman 1956a
1971-72 winter	10	Clear Lake (inland)	F. James 1972
1976 winter	10-15	Clear Lake	Hamilton 1977
1963 19-24 Jan.	10-13	Cross Lake (inland)	F. James 1963
1969 19 Apr.	57	Cameron	Imhof 1969
		TEXAS	
1965 26 Nov.	150+	in surf off N. Padre Island	Webster 1966a

Table 14. Continued.

Date seen		Number seen	Locality	Source
1970	early Jan.	500	Cove	Webster 1970b
1967	17 Feb.	400 (ca.)	off Mustang and Padre islands	Webster 1967b
1960	19 Feb.	500+	Texas City Dike	Webster 1961a
1964	29 Feb.	120	Cove	Webster 1964b
1968	21 Mar.	438	Mustang Island	Webster 1968a
1958	27 Mar.	157	Texas City Dike	Webster 1959

strongly preferred larger, more open lakes and ponds, which has been noted in other areas as well (Munro 1941, Palmer 1962, Cramp et al. 1977). This species is strongly colonial; colonies in North America range in size from under 10 nests to as many as thousands (Palmer 1962). In Faaborg's study in North Dakota, all but four (1.8%, n = 222) nests found were in colonies, one of them containing 110 nests.

The floating nests are usually in shallow water within emergent patches of vegetation such as reeds. McAllister (1958) reported that nests in British Columbia were set on or anchored to a foundation of bent-over reeds in the center of a small clump of reeds or at the side of a large clump, and were situated 1 to 3 ft apart in water 1 to 3.5 ft deep.

Winter and Offshore Unlike the comparably sized Horned Grebe which is predominantly marine in winter, the Eared Grebe is found regularly on inland freshwater lakes, usually larger ones, as well as along the coasts (Palmer 1962). Similar habitat distinctions have also been noted in wintering Old World populations of these species (Cramp et al. 1977).

FOOD AND FEEDING BEHAVIOR

In both Old and New Worlds, the Eared Grebe is primarily insectivorous in its feeding habits. Wetmore (1924) reported on the stomach contents of 27 birds taken in the western United States from March to July and from September to December. Insects, largely aquatic forms, made up 84.7% of the diet and fish represented another 9.8%. Other forms taken in small amounts included annelids, mysid shrimp, centipedes, spiders, snails, and frogs. Munro (1941) reported the stomach contents of 4 birds wintering on the coast of British Columbia and those from 13 adults and young from interior lakes. In the birds from the coasts the main food was mysid shrimp and the rest was amphipods. Nymphs and larvae of aquatic insects were the principal food of both adults and young in the interior.

Very similar information has been reported from the Old World. In 79

stomachs obtained in Europe, Madon (1931 in Cramp et al. 1977) found insects and their larvae in 81.0% of the stomachs and fish in 7.6%.

The Eared Grebe feeds primarily by diving from the surface using the feet for propulsion. Cramp et al. (1977) suggested, however, that this species takes more food from the surface than do other grebes. The birds prefer to feed in shallow water and apparently spend relatively little time underwater (ca. 1/3 - 2/3 minutes). In one instance in England, Carden (1960) timed 10 dives that had a mean of 62 seconds, suggesting that birds may have been diving deeper than usual.

Several other feeding techniques have been described (Van IJzendoorn 1944). For example, food is collected from the water's surface by skimming with the head (and sometimes the neck) moving backwards and forwards. The head and neck may also be immersed as the bird swims along looking for food beneath the surface, but Van IJzendoorn (1944) remarked that he seldom saw this method used. More frequently, small items are picked from the surface of the water.

Birds feed singly or in small flocks but do not tend to raft up. Munro (1941) reported that birds wintering in marine waters preferred to winter close inshore. He noted that the most productive feeding ground appeared to be the zone of smooth water just outside the breaking surf. Munro also observed birds feeding in the surf and thought that they were less likely to come inshore on a receding tide than on a rising tide.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying McAllister (1958) and Yocum et al. (1958) reported that egg laying in British Columbia and Washington took place from mid-May to late June. Dates from clutches in collections from various parts of the United States range from late April to early August (Bent 1919, R. Stewart 1975); some of these may have been renesting attempts. June is probably the peak month for initiation of first nests in North America. In the western Palearctic, eggs are found mostly in May and June (Cramp et al. 1977); in southern Africa, egg laying occurs from early September to late October (Broekhuysen and Frost 1968b).

Mean Clutch Size In British Columbia in 1955, clutch size ranged from one to six, with a mode of four eggs and a mean of 3.59 (n = 150); in 1956, the mode was 3 and the mean was 3.36 (n = 143) (McAllister 1958). Reported mean size for clutches in North Dakota (R. Stewart 1975) and Iowa (Friley and Hendrickson 1937) were 3.8 and 3.2, respectively. Clutches of similar size were reported for both European (Bochenski 1961) and African (Broekhuysen and Frost 1968b) populations.

Incubation Period McAllister (in Palmer 1962) gave a range of 20.5-21.5 days for North American birds. Broekhuysen and Frost (1968b) gave a range of about 20-22 days for birds in southern Africa.

Hatching Success Friley and Hendrickson (1937) found that 2.8 eggs

hatched per nest (87.5% of all eggs laid) in a study of 15 nests in Iowa.

Fledging Success No adequate information is available.

Age at Fledging Unknown.

Age at First Breeding Not adequately known; Cramp et al. (1977) suggested that age of maturity was 2 years, but possibly only 1 year.

Mortality of Eggs and Young We have relatively little information on nest loss, but available data indicate that the predominant cause of loss is adverse weather conditions. Loss of eggs during incubation to storms and wind causing swamping of nests has been reported for South Africa by Broekhuysen and Frost (1968b), for British Columbia by McAllister (1958), and by others. Broekhuysen and Frost indicated that predators accounted for a considerable amount of egg loss, but no instances of predation were actually observed. They suspected, however, that the primary predator was Hartlaub's Gull (*Larus hartlaubii*). Little is known about mortality in young birds but McAllister (1958) noted that "many young died of exposure during the first few days after hatching."

Renesting This species, an indeterminate layer (McAllister 1958), will lay replacement clutches if eggs are lost. One brood, sometimes two, may be produced within one nesting season (Cramp et al. 1977).

Maximum Natural Longevity A bird banded as an adult in British Columbia attained a minimum age of 5 years, 2 months (Clapp et al. 1979 ms).

Weight (in grams) Information on weights of New World birds is scant. A breeding male in California weighed 336 (Grinnell et al. 1930). A female taken in Virginia in November weighed 243 (Buckley 1968b). Information available for Old World birds is little better. Three breeding males from Germany weighed 265-402, a breeding female 298. Two winter males from Switzerland weighed 400, and 500, two males collected in April had a mean weight of 396, and a female collected there in May weighed 213 (Bauer and Glutz von Blotzheim 1966).

SUSCEPTIBILITY TO OIL POLLUTION

Eared Grebes have succumbed to oiling (Table 15) in both New World (Moffitt and Orr 1938, Smail et al. 1972) and Old World (Spencer 1967) oiling incidents, and at least one fatality to oiling has been noted along the Texas coast (E. Payne, pers. comm.). Most reports of bird mortality from oil spills have merely listed "grebes" rather than more precisely indicating which species were affected. However, less than 10% of those Eared Grebes treated for comtamination with petroleum in the San Francisco Bay area in 1973 survived (Holmes and Cronshaw 1977).

In the southeastern United States, Eared Grebes would be vulnerable from October to April along the Texas coast where they are relatively abundant. At

present, only small numbers occur elsewhere in the southeast, but if the species increases in numbers there in winter, the problem could intensify.

Table 15. Number of dead birds and number and percentage of dead Eared Grebes found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Eared Grebes	Percentage of Eared Grebes	Source
San Francisco Bay, California	Mar. 1937	397 (a)	1	0.25	Aldrich 1938
Poole Harbour, Dorset, England	Jan. 1961	433 (a,b)	5	1.15	Bourne 1968a
Pagham Harbour area, W. Sussex, England	Jan.-Feb. 1967	91 (a,b)	3	3.29	Phillips 1967
Northeast Britain	Jan.-Feb. 1970	10,992 (a,c)	1	0.009	Greenwood et al. 1971

(a) Total includes only those birds identified to species.
(b) Total includes both live and dead oiled birds.
(c) Total includes some birds that were not oiled.

BIBLIOGRAPHY

1980

Hines, R. E. and D. Watson. 1980. Eared Grebe sighting on Lake Cumberland. Kentucky Warbler 56: 88.

Ryan, P. 1980. Black-necked Grebes Podiceps nigricollis at sea in southern Africa. Cormorant 8: 24-25.

Fjeldsa, J. 1980. Post-mortem changes in measurements of grebes. Bull. Br. Ornithol. Club 100: 151-154.

1979

Jansen, W. I. 1979. An outbreak of streptococcosis in Eared Grebes (Podiceps nigricollis.). Avian Dis. 23: 543-546.

Prinzinger, R. 1979. Ei- und Nestdaten vom Schwarzhalstaucher (Podiceps nigricollis). Eine vergleichend zusammen fassende Darstelling. Ornithol. Mitt. 31: 35-40. [In German.]

1977

Borodulina, T. L. 1977. [Specific features of the flight apparatus of grebes in connection with their aquatic mode of life.] Ornitologiya 13: 160-172. [In Russian.]

Clark, A. 1977. Courtship behaviour in the Black-necked Grebe Podiceps nigricollis. Ostrich 48: 47.

Houst, M. 1977. Prispevek k hnizdeni potapky rohace (Podiceps cristatus L.) a potapky cernokrke (Podiceps nigricollis Brehm) na rybnicich u Zahlinic. [Report on the nests of Great Crested Grebe (Podiceps cristatus L.) and Eared Grebe (Podiceps nigricollis Brehm) in the ponds near Zahlinic. Zpravy MOS 1977 19: 27-31. [In Czech with German summary.]

1976

Browne, M. M. 1976. An Eared Grebe collected in North Carolina. Chat 40: 44.

Faaborg, J. 1976. Habitat selection and territorial behavior of the small grebes of North Dakota. Wilson Bull. 88: 390-399.

Jensen, W. I. and S. E. Cotter. 1976. An outbreak of erysipelas in Eared Grebes (Podiceps nigricollis). J. Wildl. Dis. 12: 583-586.

Prinzinger, R. 1976. Zur Unter-Wasser-Futterun bei Lappentauchern (Podicepididae). [On the feeding under water by Podicepididae.] Ornithol. Beob. 73: 243. [In German.]

1975

LeGrand, H. E., Jr. 1975. Spring record of Eared Grebe in northwestern South Carolina. Chat 39: 90-91.

Storer, R. W., W. R. Siegfried and J. Kinahan. 1975. Sunbathing in grebes. Living Bird 14: 45-56.

1974

Fiala, V. 1974. Populationsdynamik und Brutbiologie des Lappentaucher, Podicepididae im Teichgebiet von Namest'n. Osl./CSSR. Anz. Ornithol. Ges. Bayern 13: 198-218. [In German.]

Parnell, J. F., R. F. Soots and J. H. Carter, III. 1974. Eared Grebe collected at Wrightsville Beach, N.C. Chat 38: 21-22.

Prinzinger, R. 1974. Untersuchungen uber das Verhalten des Schwarzhalstauchers Podiceps n. nigricollis, Brehm (1831). Anz. Ornithol. Ges. Bayern 13: 1-34. [In German with English summary.]

Utschiek, H. 1974. Erste Brut des Schwarzhalstauchers Podiceps nigricollis an den Innstauseen. Anz. Ornithol. Ges. Bayern 13: 314-315. [In German.]

1971

Becuwe, M. 1971. De Geoorde Fuut (Podiceps nigricollis) en de Dodaars (Podiceps ruficollis) als doortrecker en wintergast op De Spuikom te Oostende. Gerfaut 61: 303-306. [In Dutch with English summary.]

Hafft, J. H. J. 1971. Herring Gull attacks Eared Grebe. Condor 73: 253.

Holzinger, F., G. Holzwarth and R. Prinzinger. 1971. Ornithologischer Sammelbericht fur Baden-Wurttemberg (6). Untersuchungen uber Verbreitung und Brutbestand von Schwarzhalstaucher, Tupfelsumpfhuhn und Turteltaube in Baden-Wurttemberg. Anz. Ornithol. Ges. Bayern 10: 174-182. [In German.]

Wolters, H. E. 1971. Some additions to the bird fauna of the south west African Sandveld Kalahari. Ostrich 42: 82.

1970

Mees, G. F. 1970. On some birds from southern Mexico. Zool. Meded. R. Mus. Nat. Hist. Leiden 44: 285-304.

Schenk, H. 1970. Uber Vorkommen, Salztoleranz, Vergellschaftung und Mauser des Schwarzhalstauchers (Podiceps nigricollis) auf Sardinien. [On the occurrence, salt-tolerance, association between birds and moult of the Black-necked Grebe (Podiceps nigricollis) in Sardinia.] Vogelwelt 91: 230-235. [In German with Italian and English summaries.]

Smith, A. J. 1970. Black-necked Grebes nesting in Selkirkshire. Scott. Birds 6: 26.

1969

Dickerman, R. W. 1969. Nesting records of the Eared Grebe in Mexico. Auk 86: 144.

Franke, H. 1969. Die Paarungsballz des Schwarzhalstauchers. [The pairing behavior of the Black-necked Grebe.] J. Ornithol. 110: 286-:90. [In German with English summary.]

Post, P. W. 1969. Photographs of New York State rarities. 16. Eared Grebe. Kingbird 19: 132-134.

Van Impe, J. 1969. Concentration enorme de Podiceps nigricollis Brehm en Dobroudja-Roumanie. Alauda 37: 77-79. [In French.]

1968

Bezzel, E. 1968. Neue Beobachtungen zum Vorkommen des Schwarzhalstauchers in Sudbayern. Anz. Ornithol. Ges. Bayern 8: 365-368. [In German with English summary.]

Broekhuysen, G. J. and P. G. H. Frost. 1968a. Nesting behaviour of the Black-necked Grebe Podiceps nigricollis (Brehm) in southern Africa: I. The reaction of disturbed incubating birds. Bonn. Zool. Beitr. 19: 350-361.

Broekhuysen, G. J. and P. G. H. Frost. 1968b. Nesting behaviour of the Black-necked Grebe Podiceps nigricollis in southern Africa: II. Laying, clutch size, egg sizes, incubation and nesting success. Ostrich 39: 242-252.

Browne, M. M. and P. H. Warren. 1968. Eared Grebe at Pea Island, N.C. Chat 32: 45.

Buckley, P. A. 1968a. The status of the Eared Grebe on the eastern Great Lakes and the Atlantic Coast. Aud. Field Notes 22: 536-542.

Buckley, P. A. 1968b. An Eared Grebe specimen from coastal Virginia. Wilson Bull. 80: 487.

Gauckler, A. and M. Kraus. 1968. Zum Vorkommen und zur Brutbiologie des Schwarzhalstauchers (Podiceps nigricollis) in Nordbayern. [On the distribution and the breeding biology of the Black-necked Grebe (Podiceps nigricollis) in north Bavaria.] Anz. Ornithol. Ges. Bayern 8: 349-364. [In German with English summary.]

Green, J. C. 1968. Late record for the Eared Grebe. Loon 40: 53.

Grzybowski, J. A. and S. W. Eaton. 1968. Eared Grebe collected at Olean. Kingbird 18: 23.

Ladhams, D. E. 1968. Diving times of grebes. Brit. Birds 61: 27-30.

1967

Heim, P. J. 1967. Brutversuch des Schwartzhalstauchers bei Nuolen. Ornithol. Beob. 64: 91-92. [In German.]

King, B. 1967. Winter calling of Black-necked Grebe. Brit. Birds 60: 50.

Rogers, M. J. 1967. Call notes of Slavonian and Black-necked grebes in autumn. Brit. Birds 60: 300.

1966

Olson, C. S. and L. A. Stimson. 1966. Eared Grebe (Podiceps caspicus) near Miami. Fla. Nat. 39: 57.

Parnell, J. F. 1966e. Eared Grebe in North Carolina. Chat 30: 25-26.

Siegfried, W. R. 1966. Black-necked Grebe moulting wing feathers. Ostrich 37: 236.

1965

Hortique, M. 1965. Quelques observations de Grebe a cou noir (Podiceps nigricollis) en Cote d'Or. Jean le Blanc 4: 14. [In French.]

Lahrman, F. W. 1965. Eared Grebe colony at Regina, 1964. Blue Jay 23: 19.

Lamb, W. A. 1965. First Michigan specimen of the Eared Grebe. Jack-Pine Warbler 43: 146.

Wehner, R. 1965. Das Auftreten des Ohrentauchers--Podiceps auritus--am Oberrhein und in der Wetterau. Mit vergleichenden Angaben uber Podiceps nigricollis und die Gavia-Arten. Luscinia 38: 59-68. [In German with English summary.]

1964

Morey, A. 1964. Nidification du Grebe a cou noir dans le Doubs. Jean le Blanc 3: 89. [In French.]

Stevenson, H. M. 1964b. Additional records and a specimen of the Eared Grebe in Alabama. Ala. Birdlife 12: 11.

1963

Sykes, P. W., Jr. 1963. Eared Grebe in Virginia. Raven 34: 4.

1962

Broekhuysen, G. J. 1962. Does Black-necked Grebe cover its eggs? Bokmakiere 14: 2-4.

Williams, L. E. 1962. Eared Grebe and Black-legged Kittiwake at Pascagoula, Mississippi. MOS Newsl. 7: 14.

Wittgen, A. B. 1962. Paarvorming en Balts van de Geoorde Fuut (Podiceps caspicus). [Courtship behaviour in the Black-necked Grebe (Podiceps caspicus).] Levende Nat. 65: 64-72. [In Dutch.]

1961

Bochenski, Z. 1961. Nesting biology of the Black-necked Grebe. Bird Study 8: 6-15.

Dathe, H. 1961. Kleiner Beitrag zur Brutbiologie des Schwarzhalstauchers, Podiceps nigricollis. Beitr. Vogelkd. 7: 377-379. [In German.]

1960

Brown, A. R. and A. Morris. 1960. Breeding of Black-necked Grebe Podiceps nigricollis in South West Cape. Ostrich 31: 175.

Carden, R. 1960. Duration of dives of Black-necked Grebes. Brit. Birds 53: 127.

Ferguson-Lees, I. J. 1960. Studies of less familiar birds. 103. Black-necked Grebe. Brit. Birds 53: 77-81.

1959

Dawn, W. 1959. Eared Grebe in South Carolina. Auk 76: 521.

Weston, F. M. 1959. Eared Grebe (Podiceps caspicus) at Pensacola. Fla. Nat. 32: 201.

1958

Gollop, J. B. 1958. Do Eared Grebes have dump nests? Blue Jay 16: 151.

McAllister, N. M. 1958. Courtship, hostile behavior, nest-establishment, and egg laying in the Eared Grebe (Podiceps caspicus). Auk 75: 290-311.

Yocum, C. F., S. W. Harris and H. A. Hansen. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

1957

Liversidge, R. and G. R. McLachan. 1957. Breeding notes on the Black-necked Grebe Podiceps nigricollis Brehm. Ostrich 28: 233-234.

Regnall, S. 1957. En liten fagels jo i Ostergotland med hackande Svarthhalsad dopping (Podiceps nigricollis). [Comparative behavior of Eared and Horned grebes in feeding young.] Var Fagelvarld 16: 299-303. [In Swedish with English summary.]

1955

McAllister, N. M. 1955. Reproductive behavior of the Eared Grebe, Podiceps caspicus. M. S. thesis, Univ. Brit. Columbia.

1954

Snyder, D. E. 1954. The Eared Grebe in Massachusetts. Auk 71: 313.

1952

Lebret, T. 1952. Ongewone neststand bij de Geoorde Fuut, Podiceps caspicus (Habl.). Ardea 40: 93-94. [In Dutch.]

1950

Snyder, L. L. and C. E. Hope. 1950. First Ontario specimen of the Eared Grebe, Colymbus caspicus californicus. Auk 67: 506.

1948

Steiniger, F. 1948. Zwergmowe und Schwarzhalstaucher auf dem Babit-See in Lettland. Nat. Volk (Frank.) 78: 116-121. [In German.]

Stott, K., Jr. 1948. An albino Eared Grebe at Mono Lake. Condor 50: 46.

1946

Trautman, M. B. 1946. A second Ohio record for the Eared Grebe. Wilson Bull. 58: 216.

1944

Askey, P. J. and A. W. Boyd. 1944. Display of the Black-necked Grebe. Brit. Birds 38: 136-137.

van IJzendoorn, A. L. J. 1944. Some remarks on the life-history of the Black-necked Grebe (Podiceps n. nigricollis Brehm.) Limosa 17: 8-13.

1942

Niven, P. N. F. 1942. Notes on birds from Coega River. Ostrich 13: 165-167.

1941

Munro, J. A. 1941. Studies of waterfowl in British Columbia. The Grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

1937

Friley, C. E., Jr. and G. O. Hendrickson. 1937. Eared Grebes nesting in northwest Iowa. Iowa Bird Life 7: 2-3.

1934

Wust, W. 1934. Am Nest des Schwarzhalstauchers (Podiceps n. nigricollis Brehm). J. Ornithol. 82: 311-318. [In German.]

1933

Frieling, H. 1933. Die Ausbreitung des Schwarzhalstauchers Podiceps nigricollis nigricollis Brehm. Zoogeographica 1: 485-550. [In German.]

1932

Wust, W. 1932. Beobachtungen an einer neuentstandenen Kolonie des Schwarzhalstauchers. Beitr. Fortpfl. Biol. Vogel 8: 205-208. [In German.]

1931

Madon, P. 1931. Le secret du grebe. Alauda 3: 264-310. [In French.]

1930

Stoney, C. V. and G. R. Humphreys. 1930. Breeding of the Black-necked Grebe in Ireland. Brit. Birds 24: 170-173.

1924

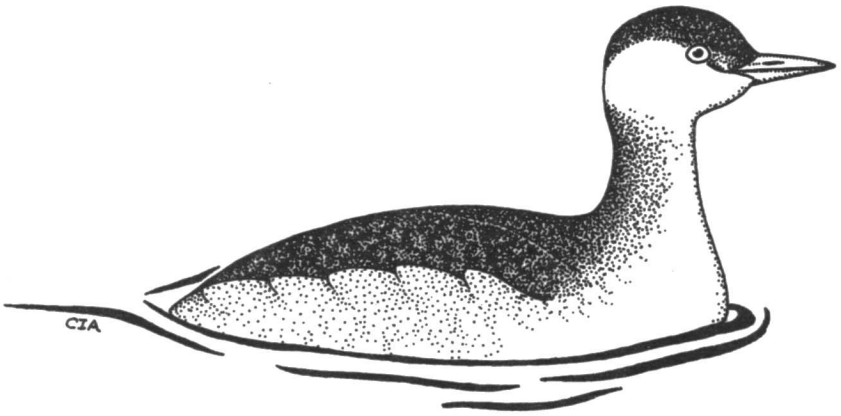
Heyder, R. 1924. Uber Stimme und Jungenphlege des Schwarzhalstauchers. [On the voice and care of young in the Black-necked Grebe.] Ornithol. Monatsber. 32: 40-42. [In German.]

1919

Pike, O. G. 1919. The Black-necked Grebe. Brit. Birds 13: 146-154.

1884

Goss, N. S. 1884. Notes on the breeding habits of the American Eared Grebe (*Dytes nigricollis californicus*). Auk 1: 18-20.



WESTERN GREBE

(*Aechmophorus occidentalis*)

[SP: Achichilique]

GENERAL DISTRIBUTION

North America In Canada, Western Grebes breed locally in central interior British Columbia, north-central Alberta, and south-central Manitoba (Godfrey 1966) south to central California, western Nevada, northern Utah, western Wyoming, Montana, and northern North Dakota, and locally in Colorado, Oregon, Nebraska, South Dakota, southwestern Minnesota (AOU 1957), and on the Mexican Plateau (Palmer 1962, Storer 1979b).

Western Grebes winter primarily along coasts from southeastern Alaska to Baja California and Jalisco, and locally inland to western Nevada and Puebla (AOU 1957).

World Distribution As above.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina In North Carolina, as in most of the rest of the eastern United States, the Western Grebe is accidental in occurrence. We have found six records for North Carolina, one from inland waters, and the rest from coastal localities.

1956	29 Dec.	1 seen	offshore Wrightsville Beach	Irvine 1971
1959	30 Mar.	1 seen	North Pond, Pea Island NWR	Parnell et al. 1962
1961	20 Dec.	1 seen	Lake Johnson ca. 3 m S Raleigh (inland)	Parnell et al. 1962
1969	28 Dec.	1 seen	offshore Carolina Beach	Irvine 1971

Taxonomic note: Lawrence (*in* Baird 1858) described two species of grebes, *Podiceps occidentalis* and *P. clarkii*, from western North America. Coues (1862) decided that *clarkii* was a variant of *occidentalis*, but described a new genus *Aechmophorus* for Western Grebes. Until recently, the existence of two morphs has not been widely recognized. Storer (1965) commented on the morphs and described their distributions. Very recently, Ratti (1979) demonstrated that the two phases behave as separate biological species and recommended ressurection of the name *A. clarkii* for the light-phased birds. We treat the complex as a single species.

1971	2 Jan.	1 seen	Inland Waterway at Myrtle Grove Sound	Needham 1971
1976	18 Dec.	2 seen	Wrightsville Beach (1)	LeGrand 1977a

South Carolina There are apparently only four records from this state, all on or near the coast.

1936	22 Jun.	1 spec. (CM 36136)	shot in Inland Waterway, 1 mi N McClellanville	Chamberlain 1936
1957	14 Apr.	2 seen	offshore Ocean Drive Beach	Irvine 1971
1966	23 Nov.	1 seen	offshore Charleston Harbor	Chamberlain 1967
1973	9 Mar.	1 seen	Bulls Island	Teulings 1973b

Florida - Atlantic Coast We are aware of four records:

1950	2 Jan.	1 seen	Indian River	Brookfield 1950
1958	20 Oct.	1 photogr.	St. Lucie River	Sprunt 1963
1958	29 Dec.	1 seen	Cocoa	Stevenson 1959a
1965	30 Mar.-14 Apr.	1 seen	Jacksonville	Cunningham 1965b

Florida - Gulf Coast We know of six records, five from coastal localities and one from further inland. One other record, from Perdido Bay, is on the border between Florida and Alabama and may be counted as a "record" in both state check lists. We have included it with the Alabama records.

1927	12 Nov.	1 seen	near Pensacola	Sprunt 1954
1954	20 Nov.	1 photogr.	Mullet Key (Tampa Bay)	Stevenson 1955b
1957	6,12,14 Jan.	1 seen	Tampa Bay (two localities)	Stevenson 1957a
1973	27 Dec.	1 seen	Holmes Beach	Edscorn 1977

(1) LeGrand indicates that these birds were seen on the Wilmington Christmas Count but the national listing of that count fails to list the species, however, the state list for the count does provide the record.

1974-75	Nov.-17 Mar.	1 seen	Tamiami Canal near Shark Valley, N side of Everglades (inland)	Kale 1975
1975	4 May	1 photogr.	East Lake, Tampa	Kale 1975

Alabama There are three records of the Western Grebe from Alabama, one well inland.

1964	2nd week Feb.	1 seen	Point Clear	Imhof 1976b
1972	15 May	2 seen	Perdido Bay	Imhof 1976b
1975	21-29 Nov.	1 photogr.	Lake Purdy, Birmingham (inland)	Purrington 1976

Mississippi Western Grebes have been recorded four times in Mississippi; all the records are from inland localities.

1965	29 Jan.	1 seen	Grenada Lake	Turcotte 1973
1972	2 Dec.	1 seen	Ross Barnett Reservoir	Turcotte 1972
1976	3,10,24 Jan.	1 seen	Sardis Lake	Hamilton 1976
1976	8 Nov.	1 seen	Sardis Lake	Purrington 1977

Louisiana We are aware of four Louisiana records, three from near the coast and one inland.

1971	3-6 Nov.	1 photogr.	Mississippi River opposite New Orleans	Lowery 1974
1974	3-16 Jan.	1-2 seen	Cross Lake, Shreveport (inland)	Lowery 1974
1974	2 Feb.-26 Mar.	1 seen	Mud Lake, S of Sabine NWR	Lowery 1974
1977	20-21 Feb.	2-3 seen	Holly Beach, Cameron	Hamilton 1977

Texas The Texas coast is the only area in the southeast in which the Western Grebe may be seen with some regularity. More abundant inland, although scarce and local even there, it is a rare to casual winter resident along the coast (Oberholser 1974). An examination of the records in the Changing Seasons sections of American Birds from 1970 through early 1978 reveals 12 records involving at least 24 individuals in the coastal area. The species is apparently least abundant on the central coast (1 record of 1 individual), somewhat more abundant on the northern coast (4 records of 5 individuals), and most frequent on the southern coast (6 records of 18-21 individuals--all of

them at Laguna Atascosa NWR). These records occurred from as early as 4 November to as late as 24 April.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Western Grebe, confined to North America, is rare to accidental throughout the southeastern United States; it occurs infrequently on the Atlantic coast and in the eastern Gulf of Mexico. It is more abundant in the western gulf (and inland in bordering states), and may be considered rare but fairly regular along the Texas coast. The range of dates of occurrence is listed in Table 16.

Table 16. Dates of occurrence for Western Grebes in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence (a)
North Carolina	5	18 December - 30 March
South Carolina	4	23 November - 14 April (22 June)
Georgia	unrecorded	
Florida - Atlantic Coast	3	29 December - 14 April
Florida - Gulf Coast	5	12 November - 4 May
Alabama	3	21 November - 15 May
Mississippi	unrecorded from coast	
Louisiana	3	3 November - 26 March
Texas	15	4 November - 24 April (at least)

(a) Exceptional occurrences are listed in parentheses.

HABITAT

Nesting The Western Grebe is a colonial nester with hundreds or even thousands of pairs at some sites (Palmer 1962). Nests are predominantly found among emergent vegetation such as cattail (*Typha* sp.) or bulrush (*Scirpus* sp.), but may also be found floating in open water or on dry land sites (Nero et al. 1958, Nero 1959, Palmer 1962, Lindvall 1976).

The most detailed report on sites chosen was made by Lindvall (1976), who studied this species at the Bear River Migratory Bird Refuge, Utah, in 1973 and 1974. He found that 54% of the nests (n = 386) were among emergent vegetation and that these were either floating (24%) or built on a snag, or resting on the bottom in shallow water (76%). The average distance from land was

55 m and the grebes apparently made little distinction between stagnant water, where 59% of the nests were located, and moving water (41%). Forty-one percent of the nests nests were built on pondweed (Potamogeton spp.) in open waters and held in place by contact with the bottom. The remaining 5% of the nests were on dry land sites, with the majority among Saltgrass (Distichlis spicata) or bulrush. Nests in both emergent vegetation in water and those on land were near open water, with the average distance in both instances less than 0.5 m. Lindvall (1976) concluded that Western Grebes selected nest sites for nearness to open water more than 20 cm in depth.

Lindvall (1976) also stated that 95% of the grebes were colonial, defining a noncolonial nest as one "over 100 [meters] from the nearest nest." On this basis, he reported that colony size for Western Grebes at the Bear River study area ranged from 5 to 88 nests. He further reported that density of nests was greater in large colonies than in small ones.

Feeding On the breeding grounds at Clear Lake, California, Lawrence (1950) noted that most feeding occurred near tules in water averaging about 6 ft deep. Birds clearly preferred to feed in well-lit, unshaded water.

Winter and Offshore Birds winter primarily on salt or brackish waters where they usually are found in sheltered bays and inlets (Palmer 1962).

FOOD AND FEEDING BEHAVIOR

The Western Grebe may be the most piscivorous of the North American grebes, with fish consumption relatively greater along the coasts than in the interior (Palmer 1962). Wetmore (1924) examined 19 stomachs from California, Oregon, Utah, and British Columbia and found that nearly 100% of the stomach contents consisted of fish. Food items identified included chubs (Mylocheilus, Leuciscus), carp (Cyprinus), and smelt (Atherinopsis). Munro's (1941) examination of 4 stomachs from Tugwell Creek, Vancouver Island, showed that the birds had been feeding predominantly on mysid crustaceans, and to a lesser extent on amphipods. His examination of 13 stomachs from birds collected on lakes in interior British Columbia revealed that food of both adults and young was primarily invertebrates, with nymphs and larvae of aquatic insects the chief food. Amphipods (Gammarus) were evidently also of some importance.

Lawrence (1950) looked at 24 stomachs from birds collected on the breeding grounds at Clear Lake, California, from June to September 1947. He found that insects, again predominantly aquatic forms, constituted an estimated 17% of the total food volume, with fish contributing 81%. The primary food fish was a centrarchid, the Bluegill (Lepomis macrochirus), which by itself made up 71% of the total volume of food. A later analysis by Herman et al. (1969) of 18 stomachs obtained at Clear and Topaz lakes between March and December 1967 again revealed that fish were the primary food source. Fish taken were cyprinids and centrarchids from 3.5 to 20.5 cm in length, the latter averaging 12 g in weight.

Most recently, Lindvall (1976) examined 13 stomachs (8 of which contained food items) from birds collected at Bear River Migratory Bird Refuge, Utah,

mostly in July and August. Fish were the primary food item, with carp (Cyprinus carpio) found most frequently.

Phillips and Carter (1957) reported the stomach contents of seven grebes taken in Puget Sound, Washington, during February and March 1952. All contained fish, with herring (Clupea pallasii) apparently the most important food item. Sea-perch (Cymatogaster sp.) and sculpins (probably Cottidae) were also eaten.

Other food items known to be taken by Western Grebes include salamanders (Ambystoma), crayfish, and other crustaceans (Wetmore 1924, Palmer 1962, Lindvall 1976).

Western Grebes obtain their food by diving from the surface and pursuing their prey underwater, using their feet for propulsion. Lawrence (1950) studied their feeding activities at some length on the breeding grounds at Clear Lake, California. He found that the mean diving time was 30.4 seconds (n = 1,747), with the interval between dives averaging 21.3 seconds. These records are an average of data obtained over 6 months (April-September), at different times of day, and in varying depths of water. Lawrence also pointed out that, unlike some other grebes, there appears to be no correlation between depth of water and duration of dive.

During the day, Lawrence found that there were two peaks of feeding activity, one at 0900 and the other about 1800. His observations suggest that feeding is normally restricted to daylight hours, but this species will also feed at night when artificial illumination is provided (Chatwin 1956).

The Western Grebe feeds solitarily with at least 200 feet of open water normally separating feeding birds (Lawrence 1950), but this species, "at all seasons....probably the most gregarious of the grebes" (Munro 1941), assembles into flocks to rest and preen.

SUSCEPTIBILITY TO OIL POLLUTION

Included in a group of diving birds highly susceptible to oil pollution, the Western Grebe is one of the most vulnerable. There have been reports of hundreds or more killed as a result of a single spill. Following a spill in San Francisco Bay in March 1937, Aldrich (1938) found 94 dead, oiled Western Grebes in five and one half miles of beach. Only murres were found dead in larger numbers. Similarly, 2,055 oiled grebes were brought to treatment stations following the 1971 San Francisco Bay oil spill (Smail et al. 1972), 55.7% of all birds brought in. If, as Smail et al. indicated, as many as 20,000 birds died during this spill, then perhaps as many as 11,000 or more Western Grebes died.

Survival rates observed at cleaning stations following oiling also suggest the high susceptibility of this species. Although quantitative data are few, only about 6% of birds treated following the Santa Barbara oil spill survived, but about 25% of those treated in 1973 that were oiled in San Francisco Bay survived (Holmes and Cronshaw 1977).

BIBLIOGRAPHY

1981

Nuechterlein, G. L. 1981a. Courtship behavior and reproductive isolation between Western Grebe color morphs. Auk 98: 335-349.

Nuechterlein, G. L. 1981b. Variations and multiple functions of the advertising display of Western Grebes. Behaviour 76: 289-317.

1980

Lindevall, M. L. and J. B. Low. 1980. Effects of DDE, TDE, and PCBs on shell thickness of Western Grebe eggs, Bear River Migratory Bird Refuge, Utah--1973-74. Pestic. Monit. J. 14: 108-111.

Neuchterlein, G. L. 1980. Courtship behavior of the Western Grebe. Ph. D. thesis, Univ. Minnesota. 162 pp.

1979

Kaufman, K. 1979. The double identity of the Western Grebe. Continental Birdlife 1: 85-89.

Lindvall, M. and J. B. Low. 1979. Organochlorine pesticide and PCB residues in Western Grebes from Bear River Migratory Bird Refuge, Utah. Bull. Environ. Contam. Toxicol. 22: 754-760.

Ratti, J. T. 1979. Reproductive separation and isolating mechanisms between sympatric dark- and light-phase Western Grebes. Auk 96: 573-586.

1978

Delehanty, C. 1978. Photographs of New York State rarities. 29. Western Grebe. Kingbird 28: 208-209.

1977

Feerer, J. L. 1977. Niche partitioning by Western Grebe polymorphs. M. S. thesis, Humboldt State Univ./Arcata, CA.

Feerer, J. L. and R. L. Garrett. 1977. Potential Western Grebe extinction on California lakes. Cal.-Neva. Wildl. Trans. 1977: 80-89.

Ratti, J. T. 1977. Reproductive separation and isolating mechanisms between sympatric dark- and light-phase Western Grebes. Ph. D. diss., Utah St. Univ. 175 pp.

1976

Lindvall, M. L. 1976. Breeding biology and pesticide-PCB contamination of Western Grebe at Bear River Migratory Bird Refuge. M. S. thesis, Utah St. Univ. 96 pp.

1975

Neuchterstein, G. L. 1975. Nesting ecology of Western Grebes on the Delta Marsh, Manitoba. M. S. thesis, Colo. St. Univ./Ft. Collins, CO.

1974

Herman, S. G. 1974. Cyclic fluctuations in feeding rates and body weight of captive Western Grebes. Ph. D. thesis, Univ. Calif./Davis, CA. 95 pp.

1973

Dickerman, R. W. 1973. Further notes on the Western Grebe in Mexico. Condor 75: 131-132.

Turcotte, W. H. 1973. Correction on first Western Grebe sight record. MOS Newsl. 18: 2.

1972

Nero, R. W. 1972. Western Grebe fatally entangled in fishing line. Blue Jay 30: 41-42.

Turcotte, W. H. 1972. Western Grebe sight record. MOS Newsl. 17: 25.

1971

Burger, J. 1971. The Western Grebe in Minnesota. Loon 43: 4-9.

Irvine, J. M., Jr. 1971. Sight record of Western Grebe at Carolina Beach, N.C., with comments on its occurrence in the southeast. Chat 35: 27-29.

1970

Hitman, B. A. 1970. Western Grebe nest in Kandiyohi County. Loon 42: 119.

Sibley, F. C. 1970. Winter wing molt in the Western Grebe. Condor 72: 373.

1969

Herman, S. G., R. L. Garrett and R. L. Rudd. 1969. Pesticides and the Western Grebe. Pp. 24-53 in M. W. Miller and G. C. Berg (eds.) Chemical Fallout/ Current Research on Persistent Pesticides. Charles C. Thomas, Springfield, IL. 531 pp.

Paul, A. 1969. Survival of Western Grebe in minus fifty degree temperature. Murrelet 50: 36.

1968

Nero, R. W. 1968. Wet waterbirds--a problem at sewage lagoons. Blue Jay 26: 2-7.

1967

Chamberlain, N. A. 1967. A sight record of the Western Grebe at Charleston. Chat 31: 24.

Lee, D. T. 1967. Winter breeding of the Western Grebe. Condor 69: 209.

1966

Bolduc, D. 1966. Western Grebe in Minneapolis. Loon 38: 140.

Haag, K. 1966. Young Western Grebe on Frog Lake in November. Loon 38: 37.

1965

Storer, R. W. 1965. The color phases of the Western Grebe. Living Bird 4: 59-63.

1964

Scott, F. R. 1964. Sight record of a Western Grebe. Raven 35: 46-47.

1963

Dickerman, R. W. 1963. The grebe Aechmophorus occidentalis clarkii as a nesting bird of the Mexican Plateau. Condor 65: 66-67.

1962

Parnell, J. F., T. L. Quay and F. L. Roberts. 1962. Two sight records of the Western Grebe in North Carolina. Chat 26: 17-18.

1961

Davis, D. G. 1961. Western Grebe colonies in northern Colorado. Condor 63: 264-265.

Huber, R. L. 1961. Breeding range extension of Eared and Western grebes. Flicker 33: 93-94.

1960

Nero, R. W. 1960. Mass mortality of Western Grebes. Blue Jay 18: 110-112.

1959

Nero, R. W. 1959. Western Grebe colony. Nat. Hist. 68: 291-295.

Veronee, W. R. 1959. Western Grebe (Aechemophus occidentalis). Fla. Nat. 32: 145.

1958

Nero, R. W., F. W. Lahrman and F. G. Bard. 1958. Dry-land nest-site of a Western Grebe colony. Auk 75: 347-349.

Yocum, C. F., S. W. Harris and H. A. Hansen. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

1957

Phillips, E. and G. D. Carter. 1957. Winter food of Western Grebes. Murrelet 38: 5-6.

1956

Chatwin, S. L. 1956. The Western Grebe taken on hook and line. Condor 58: 73-74.

1954

Munro, D. A. 1954. Notes on Western Grebe in British Columbia. Auk 71: 333.

Sutton, G. M. 1954. Western Grebe in Oklahoma. Condor 56: 229.

1953

Wolf, K. 1953. Grebe-duck nesting parasitism. Auk 70: 84.

1950

Lawrence, G. E. 1950. The diving and feeding activity of the Western Grebe on the breeding grounds. Condor 52: 3-16.

Pearse, T. 1950. Migration of Western Grebe on British Columbia coast. Can. Field Nat. 64: 94.

1949

Chambers, C. 1949. The air sac system in the Western Grebe. M. S. thesis, Univ. Wash.

Lawrence, G. E. 1949. The diving and feeding activity of the Western Grebe on the breeding grounds. M. A. thesis, Univ. Calif./Berkeley, CA.

Packard, F. M. 1949. The validity of east coast records of the Western Grebe. Wood Thrush 4: 159-160.

1947

Taber, W. 1947. Western Grebe in Massachusetts. Auk 64: 144.

1941

Munro, J. A. 1941. Studies of waterfowl in British Columbia. The Grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

1939

Munro, J. A. 1939. Nesting of the Western Grebe in British Columbia. Rept. Prov. Mus. Brit. Columbia 1938: 16-17.

1937

Allen, F. H. 1937. Western Grebe in Massachusetts. Auk 54: 376-379.

1936

Chamberlain, E. B. 1936. Western Grebe in South Carolina. Auk 53: 438.

1926

Wood, N. A. 1926. A new species for Michigan. Auk 43: 555.

1923

Gregory, S. S., Jr. 1923. Western Grebe in Illinois. Auk 40: 526.

1907

Finlay, W. L. 1907. The grebes of southern Oregon. Condor 75: 131-132.

1881

Henshaw, H. W. 1881. On *Podiceps occidentalis* and *P. clarkii*. Bull. Nuttall Ornithol. Club 6: 211-216.

BLACK-BROWED ALBATROSS

(*Diomedea melanophrys*)

[DA: Sortbrynet Albatros, DU: Malimokalbatros, Wenkbraulbatoss, FI: Mustajuova-albatrossi, FR: Albtros a sourcil noir, GE: Mollymauk, IT: Diomedea dalle ciglia nere, NW: Svartbrynt albatross, NZ/SAf: Black-browed Mollymawk, PO: Albatros czarnobrwisty, SP: Albatros ojeroso, SW: Svartbrynad albtross]

GENERAL DISTRIBUTION

North America The Black-browed Albatross is a very rare vagrant in the North Atlantic. It has occurred several times in the northeast and twice in the southeast (McDaniel 1973).

World Distribution This albatross breeds on islands off southern South America (Islas Idlefonso, Evout, Diego Ramirez), in the South Atlantic on South Georgia and the Falkland islands, in the Indian Ocean on Kerguelen and Heard islands, and in the Australian region on the Anitipodes, the Macquarie Islands, Staten Island, and Campbell Island (Watson 1975). It ranges at sea throughout the southern oceans and strays to the North Atlantic, where it is far more common off Europe than off North America (DuMont 1973, Warham et al. 1974).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

We include this albatross on the basis of two sight records, both by reliable observers.

North Carolina

1972	19 Aug.	2 seen	off Morehead City, Carteret Co.	Teulings 1973a

Florida - Atlantic Coast

1974	13 Sept.	1 seen	off Cape Canaveral, Brevard Co.	Edscorn 1975

HABITAT

Nesting Black-browed Albatrosses nest on wide ledges or slopes overlooking the ocean on a few Southern Hemisphere islands. The nesting sites are usually vegetated with tussock grasses (Watson 1975).

Feeding and Offshore Albatrosses are highly pelagic and are usually found well out at sea except when breeding or sick or injured. Cramp et al. (1977) remarked that this species "...often fishes inshore, sometimes near

breakwaters and quays, even among flocks of gulls...". In the southeast they may be expected most frequently around the margin of the Continental Shelf.

FOOD AND FEEDING BEHAVIOR

The Black-browed Albatross feeds primarily by surface seizing (Ashmole 1971) but will also engage in surface plunging (Prince 1980). These albatrosses are ship-followers that readily scavenge offal and that will make shallow dives from the surface to obtain food (Serventy et al. 1971). They eat fish and squid and also eat euphausiid crustaceans and salps (Watson 1975). Prince (1980) recently reported that the diet at Bird Island, South Georgia, was composed of krill (*Euphausia superba* - 41% by weight), squid (37%), and fish (21%). Some of the material regurgitated by the albatrosses were identified as the remains of lantern fishes (Myctophidae). Most of the squid eaten were *Todarodes sagittus* (Ommastrephidae - 76.1% by weight) and *Mesonychoteuthis* sp. (Cranchiidae - 13.2%) but a variety of other species were also taken.

SUSCEPTIBILITY TO OIL POLLUTION

We do not have any records of oiled Black-browed Albatrosses. Albatross oilings are rarely reported and may in fact be rare. These birds normally occur far offshore and rarely appear, dead or alive, on beached bird surveys.

BIBLIOGRAPHY

1981

Slings (Rienk), Q. L. 1981. Waarneming van Wenbraualbatross in Nederland in October 1971. [Observation of Black-browed Albatross in Netherlands in October 1971.] Dutch Birding 2: 122-125.

1980

Clark, A. and P. A. Prince. 1980. Chemical composition and calorific value of food fed to mollymauk chicks *Diomedea melanophris* and *D. chrysostoma* at Bird Island, South Georgia. Ibis 122: 488-500.

Prince, P. A. 1980. The food and feeding ecology of Grey-headed Albatross *Diomedea chrysostoma* and Black-browed Albatross *D. melanophris*. Ibis 122: 476-488.

1979

Pascal, M. 1979. Donnees ecologiques sur l'albatros a sourcils noirs. *Diomedea melanophrys* (Temminck) dans l'archipel des Kerguelen. [Ecological data on the Black-browed Albatross *Diomedea melanophrys* in the Kerguelen Archipelago.] Alauda 47: 167-172. [In French with German and English summaries.]

Robertson, H. A. 1979. An interesting band recovery. Notornis 26: 46.

1978

Cox, J. B. 1978. Albatross killed by Giant-Petrel. Emu 78: 94-95.

1976

Tickell, W. L. N. 1976. The distribution of Black-browed and Grey-headed albatrosses. Emu 76: 64-68.

1975

Tickell, W. L. N. and R. Pinder. 1975. Breeding biology of the Black-browed Albatross Diomedea melanophris and Grey-headed Albatross D. chrysostoma at Bird Island, South Georgia. Ibis 117: 433-451.

1974

Cooper, J. 1974. Albatross displays off the south-west coast of South Africa. Notornis 21: 234-235.

Warham, J. and W. R. P. Bourne. 1974. Additional notes on albatross identification. Am. Birds 28: 598-603.

Warham, J., W. R. P. Bourne and H. F. I. Elliott. 1974. Albatross identification in the North Atlantic. Am. Birds 28: 585-598.

Stiles, E. W. 1974. Black-browed Albatrosses on fresh water. Auk 91: 844-845.

1973

Cox, J. B. 1973. The identification of the smaller Australasian Diomedea, and the status of the Diomedea in South Australia. S. Austr. Ornithol. 26: 67-75.

DuMont, P. G. 1973. Black-browed Albatross sightings off the United States East Coast. Am. Birds 27: 739-740.

McDaniel, J. W. 1973. Vagrant albatrosses in the western North Atlantic and Gulf of Mexico. Am. Birds 27: 563-565.

1970

de Bruijne, J. W. A. 1970. Black-browed Albatross (Diomedea melinophris) in the Caribbean. Ardea 58: 264.

Ross, G. J. B. 1970. South African recoveries of birds ringed abroad. Ostrich 41: 268.

1968

Harris, M. P. 1968. Black-browed Albatross (Diomedea melanophris) and other seabirds near Guayaquil, Ecuador. Ardea 56: 284-285.

Waterston, G. 1968. Blackbrowed Albatross on the Bass Rock. Brit. Birds 61: 22-27.

1967

Escalante, R. 1967. Notas sobre Procellariiformes en el Uruguay. Hornero 10: 440-441. [In Spanish.]

Tickell, W. L. N. 1967. Movements of Black-browed and Grey-headed albatrosses in the South Atlantic. Emu 66: 357-367.

Tickell, W. L. N. and R. Pinder. 1967. Breeding frequencies in the albatrosses Diomedea melanophris and D. chrysostoma. Nature (Lond.) 213: 315-316.

1966

Tickell, W. L. N. and R. Pinder. 1966. Two-egg clutches in albatrosses. Ibis 108: 126-129.

Warham, J., W. R. P. Bourne and H. F. I. Elliott. 1966. Albatross identification in the North Atlantic. Brit. Birds 59: 376-384.

1964

Marr, B. A. E. and J. T. R. Sharrock. 1964. Black-browed Albatross off County Cork. Brit. Birds 57: 179-180.

Tickell, W. L. N. 1964. Feeding preferences of the albatrosses Diomedea melanophris and D. chrysostoma at South Georgia. Pp. 383-387 in R. Carrick (ed.) Biologie Antarctique, Hermann, Paris. 651 pp.

1956

Bednall, D. K. 1956. Black-browed Albatross at Mombasa. Ibis 98: 138.

1953

MacDonald, J. D. 1953. Black-browed Albatross in Derbyshire. Brit. Birds 46: 110-111.

1952

Hagen, Y. 1952. Diomedea melanophris (Temminck). Pp. 48-51 in Norweg. Sci. Exped. to Tristan de Cunha, 1937-38. Results No. 20. 248 pp.

1897

Butler, E. A. 1897. [Letter on] The capture of a Black-browed Albatross in Cambridgeshire. Ibis 7th Ser., Vol. 3: 625-627.

1895

Anderson, K. 1895. Diomedea melanophrys in the Faeroe Islands. Proc. R. Soc. Edinburgh 13: 91-114.

YELLOW-NOSED ALBATROSS

(*Diomedea chlororhynchos*)

[DA: Gulnaebbet Albatros, DU: Geelsnauelalbatros, FI: Keltanokka-albatrossi, FR: Albatros a bec jaune, GE: Gelbnasenalbatros, IC: Gymir, IT: Albatressa dal becco verde, NZ/SAf: Yellow-nosed Mollymawk, SP: Albatros clororrinco, SW: Sotmantlad albatross]

GENERAL DISTRIBUTION

North America The Yellow-nosed Albatross is a casual vagrant along the Atlantic and Gulf coasts from Canada to Texas. Records are more frequent north of Chesapeake Bay than to the south (McDaniel 1973).

World Distribution This albatross breeds in the South Atlantic on Tristan da Cunha and Gough islands and in the south Indian Ocean on Prince Edward, St. Paul, and Amsterdam islands (Palmer 1962, C. J. R. Robertson 1975b, Watson 1975). It ranges at sea from Patagonia and Tierra del Fuego east through the South Atlantic and southern Indian oceans to New Zealand and straggles to the North Atlantic (McDaniel 1973, Watson 1975).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

We have records from only three states.

Florida - Atlantic Coast We have one record from Florida:

1958	13 Jul.	1 seen	20 mi off New Smyrna Beach, Volusia Co.	Stevenson 1958d

Louisiana A single sight record seems referable to this species on the basis of photographs and a description furnished by the observers.

1970	9 May	1 seen	Holly Beach, Cameron Par.	Imhof 1970

Texas There are but two records, both from the south coast.

1972	14 May	1 seen	S. Padre Island, Cameron Co.	Webster 1972d
1976	late Oct.	1 found	S. Padre Island, Cameron Co.	Webster 1977a

HABITAT

Nesting Yellow-nosed Albatrosses nest on cliff ledges, slopes, and flat areas and in valleys of several subantarctic islands. Nests may be in the

open or sheltered by tussock grass or even small trees (Watson 1975).

Feeding and Offshore Albatrosses are highly oceanic and rarely come to land. Yellow-nosed Albatrosses occur primarily between 30° and 50° S but range north to 15° S during the southern winter (Palmer 1962). Within the southeastern United States, they are most likely to occur along the margin of the Continental Shelf, and rarely inshore.

FOOD AND FEEDING BEHAVIOR

The Yellow-nosed Albatross feeds largely on cephalopods but also takes fish and large shrimp (Palmer 1962, Watson 1975). It follows fishing vessels less commonly than the Black-browed Albatross (Serventy et al. 1971) and obtains most of its food by surface-seizing. It will also dive from the surface and may scavenge food (Ashmole 1971).

SUSCEPTIBILITY TO OIL POLLUTION

We have found no records of oiling in Yellow-nosed Albatrosses. These and other albatrosses usually occur far offshore, consequently the lack of records is not indicative of lack of vulnerability.

BIBLIOGRAPHY

1980

Latham, P. C. M. 1980. Yellow-nosed Mollymawks in the Bay of Plenty. Notornis 27: 393-394.

1979

Barton, D. 1979. Albatrosses in the western Tasman Sea. Emu 79: 31-35.

1978

Pascal, M. 1978. Note sur *Phoebetria fusca*, *Diomedea chlororhynchos* et *Diomedea chrysostoma* aux Iles Kerguelen (49°S, 69°E). [Note on *Phoebetria fusca*, *Diomedea chlororhynchos* and *Diomedea chrysostoma* on the Kerguelen Islands (49°S, 69°E).] Oiseau R. F. O. 48: 69-71. [In French.]

1976

Howe, W. and B. Weissman. 1976. Yellow-nosed Albatross at Croton Point, Westchester County [New York]. Kingbird 26: 200-201.

1975

Robertson, C. J. R. 1975a. Yellow-nosed Mollymawk *Diomedea chlororhynchos* recorded in the Chatham Islands. N. Zeal. Dept. Intern. Affairs Wildl. Publ. 173.

Robertson, C. J. R. 1975b. Yellow-nosed Mollymawk (Diomedea chlororhynchus) [sic] recorded in the Chatham Islands. Notornis 22: 342-344.

Rowlett, R. A. 1975. First records of Atlantic Puffin and Yellow-nosed Albatross off Maryland. Md. Birdlife 31: 51-56.

1974

Cooper, J. 1974. Albatross displays off the south-west coast of South Africa. Notornis 21: 234-238.

Warham, J. and W. R. P. Bourne. 1974. Additional notes on albatross identification. Am. Birds 28: 598-603.

Warham, J., W. R. P. Bourne and H. F. I. Elliott. 1974. Albatross identification in the North Atlantic. Am. Birds 28: 585-598.

1973

Cox, J. B. 1973. The identification of the smaller Australasian Diomedea, and the status of the Diomedea in South Australia. S. Austr. Ornithol. 26: 67-75.

McDaniel, J. W. 1973. Vagrant albatrosses in the western North Atlantic and Gulf of Mexico. Am. Birds 27: 563-565.

Wall, L. E. 1973. Yellow-nosed Albatross Diomedea chlororhynchos in Tasmanian waters. Tasmanian Nat. 32: 7.

1970

Anon. 1970. A Yellow-nosed Albatross in Louisiana. La. Ornithol. Soc. News 55: 6.

1968

Post, P. W. 1968. Photographs of New York state rarities. 13. Yellow-nosed Albatross. Kingbird 18: 66-68.

1966

Warham, J., W. R. P. Bourne and H. F. I. Elliott. 1966. Albatross identification in the North Atlantic. Brit. Birds 59: 376-384.

1961

Bull, J. L. 1961. Yellow-nosed Albatross off the coast of Long Island, New York. Auk 78: 425-426.

1960

Bell, B. D. 1960. Yellow-nosed Mollymawk in northern New Zealand waters. Notornis 9: 109.

1958

Johnson, J. B., Jr. 1958. Yellow-nosed Albatross off Florida. Aud. Field Notes 12: 406.

1952

Hagen, Y. 1952. Diomedea chlororhynchos (Gmelin). Pp. 51-73 in Norweg. Sci. Exped. to Tristan de Cunha, 1937-38. Results No. 20. 248 pp.

1951

Rowan, M. K. 1951. The Yellow-nosed Albatross at its breeding grounds in the Tristan da Cunha group. Ostrich 22: 139-155.

1950

Nichols, D. G. 1950. Albatross feather from Jones Beach, Long Island, New York. Auk 67: 379-380.

1934

Norton, A. H. 1934. Second occurrence of the Yellow-nosed Albatross (Thalassogeron chlororhynchos) in Maine. Auk 51: 507-508.

1922

Murphy, R. C. 1922. Notes on tubinares, including records which affect the AOU Check-list. Auk 39: 58-65.

1886

Emerson, N. O. 1886. Egg of the Yellow-nosed Albatross. Ornithol. & Oolog. 11: 21.

NORTHERN FULMAR

(*Fulmarus glacialis*)

[DA: Mallemuk, DU: Noordse Stormvogel, EN: Fulmar, Fulmar Petrel; IC: Fyll, IT: Fulmaro, FI: Myrskylintu FR: Petrel glacial, GE: Eissturmvogel, JA: Furuma kamome, NW: Havhest, PO: Petrel traniasty, SP: Fulmaro, SW: Stormfagel]

GENERAL DISTRIBUTION

North America Northern Fulmars frequent the colder waters of the North Atlantic, south regularly to New England, irregularly to New Jersey (AOU 1957, Palmer 1962), and casually to Virginia (Sykes 1964), North Carolina (Lee and Rowlett 1979), and South Carolina (Teulings 1978a).

World Distribution Northern Fulmars breed abundantly in arctic and subarctic areas of the North Atlantic and North Pacific, in the Atlantic south to Brittany and Newfoundland (Fisher 1966, Nettleship and Montgomerie 1974, Cramp et al. 1977, Montevecchi et al. 1978), and in the Pacific to southern Alaska (Fisher 1952a). The nonbreeding range in the Pacific extends south regularly to southern California (Small 1974) and casually to the Hawaiian Islands (Berger 1972). Formerly a bird of the north polar convergence between arctic and warmer waters, it has been extending its range southward apparently as a result of the development of commercial fishing (Palmer 1962).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The Northern Fulmar is a bird of arctic and subarctic waters that occasionally wanders south to the Carolinas. We have no records from farther south along the Atlantic coast, nor from any of the states bordering the Gulf of Mexico.

North Carolina There are eight records, including four specimens, all since 1970.

1973	spring	1 captured	Pea Island NWR, Dare Co.	Lee and Rowlett 1979
1976	14 Oct.	1 seen	35 mi SE of Oregon Inlet	Lee and Rowlett 1979
1978	17 May	1 seen	8 mi S of Diamond Shoals Light	Lee and Rowlett 1979
1978	18 May	1 coll. (NCSM 6457)	47 mi E of Oregon Inlet	Lee and Rowlett 1979

1978	1 Oct.	2 coll. (NCSM 6864, 6880)	40 mi E of Oregon Inlet	Lee and Rowlett 1979
1978	14 Nov.	2 seen	30 and 40 mi SSE Oregon Inlet	Lee and Rowlett 1979
1979	22 Apr.	6 seen	off Oregon Inlet	Lee and Booth 1979
1979	23 Apr.	9 seen (1 coll.)	off Oregon Inlet	Lee and Booth 1979

South Carolina There is a single sight record for this state.

1978	5 Mar.	1 seen	Mt. Pleasant Causeway, Charleston Co.	Teulings 1978a

HABITAT

Nesting Northern Fulmars breed on cliff ledges overlooking the ocean. In Britain, they have begun breeding on a few coastal buildings as well. Fulmars generally breed in large colonies, but colony size is limited by the availability of suitable ledges (Fisher 1952a, Palmer 1962, Cramp et al. 1977).

Feeding and Offshore Northern Fulmars range widely over oceanic and Continental Shelf waters and are found mostly between 40-42°N and around 50°N latitude (Cramp et al. 1977). In the North Pacific, Hoffman has observed them regularly in winter within a few kilometers of shore but the species only rarely occurs on brackish or fresh waters (Cramp et al. 1977). Fulmars are essentially cool-water inhabitants, so the waters of the Carolinas inshore of the Gulf Stream are the only places they might be expected in the southeast. Storm-driven birds might show up almost anywhere as accidentals.

FOOD AND FEEDING BEHAVIOR

According to Fisher (1952a), Northern Fulmars eat "mainly crustaceans, cephalopods, fish, fish offal and carrion (especially whale, walrus and seal), mostly by surface-seizing whilst floating or swimming". Fulmars also feed, but infrequently, by pursuit-plunging (Cramp et al. 1977). Hoffman (this report) has observed that Pacific jellyfish (including *Cyanea*) are regularly eaten in the North Pacific. Bradstreet (1978) analyzed the stomachs of 180 Fulmars collected in Canada from late July through early September. He found that fish (*Boreogadus saida* - 63% by dry weight) made up most of the diet. Amphipods (mostly *Parathemisto* spp., *Onisimus* spp., and *Apherusa glacialis*) comprised another 31%. Amphipods occurred much more frequently in Fulmar stomachs than did fish which led Bradstreet (1978) to conclude that Fulmars preferred to feed on amphipods and took fish only opportunistically.

SUSCEPTIBILITY TO OIL POLLUTION

Northern Fulmars are apparently fairly adept at avoiding oil. For the Pacific Northwest, King and Sanger (1979) give an Oil Vulnerability Index of 57 to this species. This figure indicates a species at least moderately vulnerable to oiling in that area. Some records of oiling are available, usually of small numbers of birds (Table 17).

Table 17. Number of dead birds and number and percentage of dead Northern Fulmars found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Northern Fulmars	Percentage of Northern Fulmars	Source
North Sea coast, Denmark	1957-1958	92 (a)	2	2.17	Joensen 1972a
North-central Kattegat, Denmark	Jan.-Feb. 1962	1,723 (a,b)	9	0.52	Joensen 1972a
Southeast Kent, England	winters of 1963-1964 to 1965-1966	509 (a)	4	0.79	Gibson 1966
North Sea coast, Denmark	1965-1966	803 (a)	38	4.73	Joensen 1972a
Northeast England	Jan. 1966	805	4	0.50	Parrack 1967
Northeast Britain	Jan.-Feb. 1970	10,992 (a,c)	20	0.18	Greenwood et al. 1971
Off Eastern Canada	Feb.-Apr. 1970	1,276 (a,d)	72	5.64	Brown et al. 1973
Northern Scotland	May-Jun. 1971	1,101 (a)	16	1.45	Bourne 1971
Waddensea, Denmark	Dec. 1972	9,151 (a)	4	0.04	Joensen and Hansen 1977

(a) Total includes only those birds identified to species.
(b) These birds were not oiled when found dead, but are included in the total.
(c) Total includes some birds that were not oiled.
(d) Total includes both live and dead oiled birds.

BIBLIOGRAPHY

1980

Anderson, A. 1980. Band wear in the Fulmar. J. Field Ornithol. 51: 101-109.

Hutchinson, L. V. and B. M. Wenzel. 1980. Olfactory structures in the Northern Fulmar. (Abstract only). Pac. Seabird Group Bull 7: 58.

Macdonald, M. A. 1980. The winter attendance of Fulmars at land in NE Scotland. Ornis Scand. 11: 23-29.

Ollason, J. C. and G. M. Dunnet. 1980. Nest failures in the Fulmar: the effect of observers. J. Field Ornithol. 51: 39-54.

Rosler, S. 1980. Zum verhalten des Eissturmvogels, Fulmarus glacialis, auf offener See. [On the behavior of the Fulmar, Fulmarus glacialis, on the open sea.] Vogelwarte 30: 268-270. [In German with English summary.]

Tanaka, Y. and T. Kajihara. 1980. [The distribution of Fulmarus glacialis and Puffinus tenuirostris in the North Pacific and the Okhotsk Sea during the summer.] J. Yamashina Inst. Ornithol. 11: 79-86.

1979

Dunnet, G. M., J. C. Ollason and A. Anderson. 1979. A 28-year study of breeding Fulmars Fulmarus glacialis in Orkney. Ibis 121: 293-300.

1978

Bradstreet, M. S. W. 1978. The pelagic, summer, feeding ecology of Northern Fulmars in Lancaster Sound. Ibis 120: 124.

Dunnet, G. M. and J. C. Ollason. 1978a. Survival and longevity in the Fulmar. Ibis 120: 124-125.

Dunnet, G. M. and J. C. Ollason. 1978b. The estimation of survival rate in the Fulmar, Fulmarus glacialis. J. Anim. Ecol. 47: 507-520.

Mathiasson, S. 1978. Stormfageln--en bildserie. Var Fagelvarld 37: 354-362. [In Swedish.]

Montevecchi, W. A., E. Blundon, G. Coombes, J. Porter and P. Rice. 1978. Northern Fulmar breeding range extended to Baccalieu Island, Newfoundland. Can. Field Nat. 92: 80-82.

Ollason, J. C. and G. M. Dunnet. 1978. Age, experience and other factors affecting the breeding success of the Fulmar, Fulmarus glacialis, in Orkney. J. Anim. Ecol. 47: 961-976.

Osborn, D. 1978. A naturally occurring cadmium and zinc binding protein from the liver and kidney of Fulmarus glacialis, a pelagic North Atlantic seabird. Biochem. Pharmacol. 27: 822-824.

Zonfrillo, B. 1978. The Fulmar's diet. Glasgow Nat. 19: 425.

1977

Clarke, A. 1977. Contamination of Peregrine Falcons (Falco peregrinus) with Fulmar stomach oil. J. Zool. 181: 11-20.

MacDonald, M. A. 1977a. Adult mortality and fidelity to mate and nest site in a group of marked Fulmars. Bird Study 24: 165-168.

MacDonald, M. A. 1977b. An analysis of the recoveries of British-ringed Fulmars. Bird Study 24: 208-214.

MacDonald, M. A. 1977c. The pre-laying exodus of the Fulmar Fulmarus glacialis (L.). Ornis Scand. 8: 33-37.

Puleston, D. 1977. Northern Fulmar grounded on Long Island. Kingbird 27: 25-26.

1976

Booth, C. J. 1976. Peregrine and Raven possibly contaminated by Fulmar oil. Brit. Birds 69: 61.

Hatch, S. A. 1976 ms. Population ecology and breeding biology of Fulmars at Semidi Islands, Alaska. A progress report. U.S. Fish & Wildl. Serv., Off. Biol. Serv., Coastal Ecosystems, Anchorage, Alaska. Field Rept. 76-024.1. 3 pp.

Willis, D. P. 1976. Fulmars entangled in barbed wire and Gorse. Scott. Birds 9: 118.

1975

Birkhead, T. R. and R. E. Ashcroft. 1975. Auk numbers on Skomer Island. Nat. Wales 14: 222-233.

Dott, H. E. M. 1975. Fulmars at colonies: time of day and weather. Bird Study 22: 255-259.

Hawker, D. M. 1975. Golden Eagle (Aquila chrysaetos) eating Fulmars. Brit. Birds 68: 293.

Hepburn, I. R. and R. E. Randall. 1975. Nest site distribution of the Fulmar (Fulmarus glacialis) within the Monach Isles National Nature Reserve, Outer Hebrides, U.K. J. Biogeogr. 2: 223-228.

Hume, R. A. 1975. Fulmar sitting on egg and two dead passerine nestlings. Brit. Birds 68: 116.

MacDonald, M. A. 1975. The biology of the Fulmar Fulmarus glacialis (L.) in N.E. Scotland with special reference to the pre-laying period. Ph. D. thesis, Univ. Aberdeen.

Manikowski, S. 1975. The effect of weather on the distribution of Kittiwakes and Fulmars in the North Atlantic. Acta Zool. Cracov. 20: 489-497.

Prevatt, J. P. 1975. Fulmar from southern James Bay in December. Can. Field Nat. 89: 462-463.

Robertson, I. S. 1975a. Fulmar occupying Raven's nest. Brit. Birds 68: 115.

Robertson, I. S. 1975b. Sheep contaminated by Fulmar oil. Brit. Birds 68: 115-116.

Warham, J. 1975. Fulmar behaviour. Scott. Birds 8: 319-321.

1974

Broad, R. A. 1974. Contamination of birds with Fulmar oil. Brit. Birds 67: 297-301.

Chappuis, C., A. Guillemont and Y. Le Maho. 1974. Nidification du Fulmar *Fulmarus glacialis* en Normandie. Oiseau R. F. O. 44: 85-87. [In French.]

Nettleship, D. N. 1974. Northern Fulmar colonies on the south coast of Devon Island, N.W.T., Canada. Auk 91: 412.

Nettleship, D. N. and R. D. Montgomerie. 1974. The Northern Fulmar, *Fulmarus glacialis*, breeding in Newfoundland. Am. Birds 28: 16.

Newby, T. C. and R. O. Larson. 1974. Aggression in the Pacific Fulmar, *Fulmarus glacialis*. Murrelet 55: 10.

Swennen, C. 1974. Observations on the effect of ejection of stomach oil by the Fulmar, *Fulmarus glacialis* on other birds. Ardea 62: 111-117.

1973

Brown, R. G. B. 1973. Transatlantic migration of dark-phase Fulmars from the European Arctic. Can. Field Nat. 87: 312-313.

Hepburn, I. R. 1973. Aspects of the breeding biology of the Fulmar (*Fulmarus glacialis*) on the Monach Islands or Heisker, in 1973, with particular reference to behaviour. B. Sc. thesis, Univ. Ulster.

Monnat, J. Y. 1973. Statut actuel des eiseauy nicheurs en Bretagne IX. Procellariiformes. Ar Vran 6: 1-10. [In French.]

Nettleship, D. N. and A. R. Lock. 1973. Observations of Fulmars on ledges in Labrador. Can. Field Nat. 87: 314.

1972

Coulson, J. C. and J. M. Horobin. 1972. The annual re-occupation of breeding sites by the Fulmar. Ibis 114: 30-42.

Sanson, R. 1972. Fine structure and location of basal cells in the salt gland of the Fulmar Fulmarus glacialis (Aves, Procellariiformes). Norw. J. Zool. 20: 105-109.

1971

Clausen, G., R. Sanson and A. Storlsund. 1971. The HbO_2 dissociation of the Fulmar and the Herring Gull. Respir. Physiol. 12: 66-70.

Harper, R. A. 1971. Premature departure from the nest by young Fulmars in Cornwall in 1971. Seabird Rept. 1970: 42-43.

1970

Brown, R. G. B. 1970. Fulmar distribution: a Canadian perspective. Ibis 112: 44-51.

1969

Pashby, B. S. and J. Cudworth. 1969. The Fulmar "wreck" of 1962. Brit. Birds 62: 97-109.

1967

Boylan, P. J. 1967. Western Atlantic Fulmars on the East Yorkshire coast. Nat. Hull 903: 109-113.

Doran, G. 1967. Possible effect of kittiwake and guillemot colonies on Fulmar colony. Irish Nat. J. 15: 337-339.

Dott, H. E. M. 1967. Three Fulmars apparently sharing parental duties. Brit. Birds 60: 521-522.

MacDonald, J. W., D. A. McMartin, K. G. Walker, M. Carins and R. H. Dennis. 1967. Puffinosis in Fulmars in Orkney and Shetland. Brit. Birds 60: 356-360.

Mougin, J. L. 1967. Etude ecologique des deux especes de Fulmars, le Fulmar Atlantique (Fulmarus glacialis) et le Fulmar Antarctique (Fulmarus glacialoides. [Ecological study of two species of Fulmars--the Atlantic Fulmar (Fulmarus glacialis) and the Antarctic Fulmar (Fulmarus glacialoides).] Oiseau R. F. O. 37: 57-103. [In French.]

Walker, K. G. 1967. The plumage of Fulmars. Bird Study 14: 247.

1966

Bourne, W. R. P. 1966. The plumage of the Fulmars of St. Kilda in July. Bird Study 13: 209-213.

Fisher, J. 1966. The Fulmar population of Britain and Ireland, 1959. Bird Study 13: 5-76.

Ozawa, K. 1966. Summer distribution of Laysan and Black-footed albatrosses and Pacific Fulmar in the eastern North Pacific. (Abstract) Proc. XIth Pac. Sci. Congr. 5-7: 214.

1965

Dunnet, G. M. and A. Anderson. 1965. A study of the Fulmars on Eynhallow Orkney. Scott. Birds 3: 233-235.

Moss, R. 1965. Diurnal rhythms of Fulmars Fulmarus glacialis in the Arctic autumn. Ibis 107: 533-535.

Rees, E. I. S. 1965. The Fulmar in the western North Atlantic. Ibis 107: 428-429.

Rogers, A. E. F. 1965. The changing status of the Fulmar in Northern Ireland. Bird Study 12: 34-35.

Salomonsen, F. 1965. The geographical variation of the Fulmar (Fulmarus glacialis) and the zones of marine environment in the North Atlantic. Auk 82: 327-355.

1964

Richards, G. A. 1964. Fulmar incubating eggs of Herring Gull with its own. Brit. Birds 57: 31.

Sykes, P. W., Jr. 1964. Fulmar taken in Virginia. Auk 81: 437.

1963

Doran, G. 1963. Behaviour of the Fulmar (Fulmarus glacialis) at the nest site. Irish Nat. J. 14: 172-174.

Dunnet, G. M., A. Anderson and R. M. Cormack. 1963. A study of survival of adult Fulmars with observations on the pre-laying exodus. Brit. Birds 56: 2-18.

Mathiason, S. 1963. Stormfagler (Fulmarus glacialis) i Svenska vatten en Biometrisk morfologisk studie med syfte att Klarlagga deras ursprung. [Fulmars (Fulmarus glacialis) in Swedish waters, a biometrical-morphological study in order to establish their geographical origin.] Var - Fagelvarld 22: 271-289. [In Swedish with English summary.]

Waters, W. E. 1963. Observations on the Fulmar at St. Kilda. Scott. Birds 2: 459-468.

Yakhontov, V. D. 1963. [Occurrences of Fulmarus glacialis and Ardea purpurea in the Soviet Far East.] Ornitologia 6: 486. [In Russian.]

1962

Taylor, L. S. 1962. Fulmar laying egg in Northamptonshire garden. Brit. Birds 55: 134.

Warnecke, G. 1962. Beobachtungen an Eissturmvogeln (Fulmarus glacialis) und anderen Seevogeln auf dem Nordatlantik im August und September 1956. [Observations on the Fulmar (Fulmarus glacialis) and other sea birds on the North Atlantic during August and September 1956.] Ornithol. Mitt. 14: 30-32. [In German.]

1961

Dunnet, G. M. and A. Anderson. 1961. A method for sexing living Fulmars in the hand. Bird Study 8: 119-126.

Joensen, A. H. 1961. Massedod af Mallemuk (Fulmarus glacialis (L.)) og Ride (Rissa tridactyla (L.)) i danske farvande 1959. [Disaster among Fulmars (Fulmarus glacialis) and Kittiwakes (Rissa tridactyla) in Danish waters 1959.] Dan. Ornithol. Foren. Tidsskr. 55: 212-218. [In Danish with English summary.]

Rees, E. I. S. 1961. Notes on the distribution of the Fulmar in the northwest Atlantic. Sea Swallow 14: 51-53.

1960

Brown, P. B. 1960. Fulmar incubating eggs of Herring Gull. Brit. Birds 53: 127.

1959

Drury, W. H. and M. Drury. 1959. Fulmars in the North Atlantic in the summers of 1956 and 1958. Brit. Birds 52: 377-383.

Pennycuick, C. J. and D. Webbe. 1959. Observations on the Fulmar in Spitsbergen. Brit. Birds 52: 321-332.

1956

Wynne-Edwards, V. C. 1956. Records of short-billed Fulmars in the North Sea. Ibis 98: 534.

1954

Carrick, R. and G. M. Dunnet. 1954. Breeding of the Fulmar Fulmarus glacialis. Ibis 96: 356-369.

Cullen, J. M. 1954. The diurnal rhythm of birds in the Arctic summer. Ibis 96: 31-46.

Williamson, K. 1954. The fledging of a group of young Fulmars. Scott. Nat. 66: 1-12.

1953

Broun, M. 1953. Fulmar in Delaware. Cassinia 39: 24.

Kay, G. T. 1953. The Fulmar's bill. Scott. Nat. 65: 125-127.

Prevost, J. 1953. Notes sur la reproduction du Fulmar Antarctique (Fulmarus glacialoides). Alauda 21: 157-164. [In French.]

1952

Allison, F. R. 1952. Reactions of Fulmars to skuas. Brit. Birds 45: 35.

Fisher, J. 1952a. The Fulmar. Collins, London. xv and 496 pp.

Fisher, J. 1952b. A history of the Fulmar Fulmarus and its population problems. Ibis 94: 334-354.

Gudmundsson, F. 1952. Islenzkir fuglar IV. Fyll (Fulmarus glacialis (L.)). [Icelandic Birds IV. The Fulmar (Fulmarus glacialis (L.)).] Natturufraedingurrin 22: 177-180. [In Icelandic with English summary.]

Williamson, K. 1952. The incubation rhythm of the Fulmar. Scott. Nat. 64: 138-147.

Wynne-Edwards, V. C. 1952a. Geographical variation in the bill of the Fulmar (Fulmarus glacialis). Scott. Nat. 64: 84-101.

Wynne-Edwards, V. C. 1952b. The Fulmars of Cape Searle. Arctic 5: 105-117.

1951

Armstrong, E. 1951. Discharge of oily fluid by young Fulmars. Ibis 93: 245-251.

Duffey, E. 1951. Field studies on the Fulmar Fulmarus glacialis. Ibis 93: 237-242.

Miles, J. A. R. and J. B. Shrivastav. 1951. Ornithosis in certain sea-birds. J. Anim. Ecol. 20: 195-200.

1950

Duffey, E. 1950. Non-breeding in the Fulmar Fulmarus glacialis. Scott. Nat. 62: 111-121.

Grey, F. G. 1950. Non-breeding Fulmars. Brit. Birds 42: 305.

Lees, J. 1950. Stomach oil in Fulmars. Ibis 92: 152-153.

Mason, A. G. 1950. Sun-bathing of Fulmar Petrel. Brit. Birds 42: 160.

Orr, R. T. and A. E. Breed. 1950. Fulmar at Ross, California. Condor 52: 164.

1949

Jespersen, P. 1949. Notes on Fulmars and other birds in the southern North Sea in the month of May. Brit. Birds 42: 257-259.

Voous, K. H. 1949. The morphological, anatomical and distributional relationship of the Arctic and Antarctic fulmars (Aves, Procellariidae). Ardea 37: 113-122.

1948

Hazelwood, A. 1948. Fulmar ejecting oil in deliberate attack. Brit. Birds 41: 248.

Kritzler, H. 1948. Observations on behavior in captive Fulmars. Condor 50: 5-15.

Roberts, E. L. 1948. Fulmar Petrel appropriating Herring-Gull's nest. Brit. Birds 41: 26-27.

1947

Fisher, J. 1947. The colour-phases of the Fulmar. Brit. Birds 40: 338-339.

1946

Fisher, J., R. G. Newton, A. R. Sumerfield and J. E. S. Dallas. 1946. First breeding of Fulmar Petrels in South Wales. Brit. Birds 39: 28-29.

1943

Baxter, E. V. and L. J. Rintoul. 1943. Breeding of Fulmars in Fife. Brit. Birds 37: 98-99.

Fisher, J. 1943. Spread of the Fulmar in Britain. Field 182: 60-62.

Zielke, O. 1943. Des *Fulmarus g. glacialis* (L.) trouves en ete dans le Golfe de Gascogne. Oiseau R. F. O. 13: 95. [In French.]

1942

Clementson, G. 1942. On the appearance, nesting and breeding of *Fulmarus g. glacialis* (L.) in the Isle of Man. North West. Nat. 17: 247-248.

1941

Cowin, W. S., B. R. S. Cowin and E. M. Megaw. 1941. First successful breeding of the Fulmar in Isle of Man. Brit. Birds 35: 159.

Fisher, J. and G. Waterston. 1941. The breeding distribution, history and population of the Fulmar (Fulmarus glacialis) in the British Isles. J. Anim. Ecol. 10: 204-272.

Junge, G. C. A. 1941. Maaginhoud van Fulmarus glacialis (L.). Ardea 30: 266. [In Dutch.]

Robertson, I. 1941. First breeding of Fulmars on Ayrshire mainland. Brit. Birds 35: 159.

Stirling, J. F. and J. K. Robinson. 1941. Breeding of the Fulmar Petrel in Cumberland. Brit. Birds 35: 61.

1940

Fisher, J. 1940. The status of the Fulmar in the British Isles. Bull. Br. Ornithol. Club 60: 87-89.

1939

Fisher, J. 1939. Distribution of the colour phases of the Fulmar (Fulmarus glacialis). Nature 144: 941.

Wynne-Edwards, V. C. 1939. Intermittent breeding of the Fulmar (Fulmarus glacialis (L.)), with some general observations on non-breeding in sea birds. Proc. Zool. Soc. Lond. (Ser. A.) 109: 127-132.

1937

Beamer, L. H. 1937. Fulmar at Meaford, Georgian Bay, Ontario. Auk 54: 200.

Richter, R. 1937. Einiges uber die Lebensweise des Eissturmvogels (Fulmarus glacialis L.). J. Ornithol. 85: 187-200. [In German.]

Robinson, H. W. 1937a. First Fulmar Petrel to hatch on the Bass Rock. Scott. Nat. 1937: 172.

Robinson, H. W. 1937b. Nesting of the Fulmar Petrel on the Bass Rock and incubation period. Brit. Birds 31: 154.

1936

Norton, A. H. 1936. The Fulmar (Fulmarus glacialis glacialis) in Maine. Auk 53: 74.

Robinson, H. W. 1936. Incubation and nesting period of the Fulmar Petrel. Brit. Birds 30: 194.

1935

Levett, Ms. M. J. 1935. Fulmar Petrels ejecting oil when undisturbed. Brit. Birds 28: 312.

1933

Daukes, A. H. 1933. Unusual nesting-sites of Fulmar Petrel in Orkney. Brit. Birds 27: 110-111.

1931

Harrisson, T. H. 1931. Fulmar Petrel calling in flight. Brit. Birds 25: 166.

1929

Oldham, C. 1929. Fulmar standing on its toes. Brit. Birds 23: 70.

Rollin, C. N. 1929. The walking of the Fulmar Petrel. Brit. Birds 23: 31-33.

Snyder, L. L. 1929. Second Ontario record for Fulmarus glacialis glacialis. Auk 46: 376.

1927

Verwey, J. 1927. A specimen of Fulmarus glacialis (L.) with feathered legs. Ardea 16: 11-19.

1924

Gormley, A. L. 1924. First Ontario record for Fulmarus g. glacialis. Auk 41: 470-471.

Michel, J. and O. Reiser. 1924. Zwei Falle des Vorkommens des Eissturmvogels, Fulmarus glacialis, im Innern des europaischen Festlandes. [Two cases of occurrence of Fulmarus glacialis in the interior of the European continent.] J. Ornithol. 72: 99-100. [In German.]

1895

Anthony, A. W. 1895. The Fulmars of southern California. Auk 12: 100.

TRINDADE PETREL

(*Pterodroma arminjoniana*)

[EN/US: Trinidad Petrel, South Trinidad Petrel, Herald Petrel (1)]

GENERAL DISTRIBUTION

North America The Trindade Petrel is an extremely rare vagrant in North America, where there are only two reliable records. The first bird was found inland after a hurricane at Ithaca, New York, 24 August 1933 (Allen 1934). The other was recently collected off North Carolina (Lee 1979).

World Distribution Two races of this petrel occur and breed in the Southern Hemisphere. The nominate race, usually referred to as the Trindade or South Trinidad Petrel, breeds on Trindade Island and Martin Vas Rocks in the South Atlantic Ocean and on Round Island off Mauritius in the southern Indian Ocean (Jouanin and Mougin 1979). The Pacific form, most frequently referred to as the Herald Petrel (*P. a. herladica*), has been recorded breeding off northeastern Australia, in the Chesterfield, Tonga, Cook, Marquesas, Tuamotu, Gambier, and Pitcairn islands, and on Easter Island (Jouanin and Mougin 1979), although its current status at many of these stations is unknown.

Bourne (*in* Palmer 1962) suggested that this species might disperse northward across the equator. He remarked that few specimens were available and that sight records were unreliable; this is still true today. Both the single record from North Carolina and some recent specimens from the Central Pacific (Gould and King 1967, Amerson 1971) indicate at least occasional dispersal into these waters. There is also a specimen from pelagic waters of the North Atlantic. Lowe (1911 *in* Murphy 1936) reported that one struck the rigging of a yacht 31 December 1905 at 21°51' N, 43°35' W, a point nearly equidistant from the Lesser Antilles and the Cape Verde Islands but somewhat to the north of either.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

There is only one record for the southeastern United States.

North Carolina

1978	20 Aug.	1 female coll. (NCSM 6651)	74 km ESE Oregon Inlet, Dare Co.	Lee 1979

(1) Also known as the "Drinking Man's" Petrel, since this bird was described by Warham (1959) as "mostly silent, it occasionally used a sharp monosyllabic 'hik' and at times also broke into song."

HABITAT

Nesting The Trindade Petrel is a colonial, surface-nesting petrel that breeds on oceanic islands in a zone between about 15° and 30° S (Bourne in Palmer 1962). On Round Island, nests usually had some cover, either from succulent plants or tufts of grass or, more frequently, provided by overhanging ledges or large boulders (Gill et al. 1970, Vinson 1976).

Feeding Presumably in pelagic waters.

Offshore This pelagic petrel usually disperses into tropical waters on the warm side of the Subtropical Convergence (Bourne in Palmer 1962).

FOOD AND FEEDING BEHAVIOR

Exceedingly little is known of the food and feeding behavior of the Trindade Petrel. Vinson (1976) reported that birds at the Round Island colony fed almost solely on squid, with fish being taken far less commonly. The stomach of the bird collected by Lee (1979) off North Carolina contained beak fragments of many squid and the partial skeleton of one fish.

SUSCEPTIBILITY TO OIL POLLUTION

This is unknown. The pelagic distribution and rarity of occurrence in the southeastern United States make it of little concern in this regard.

BIBLIOGRAPHY

1980

Izzard, J. and W. D. Watson. 1980. A sight record of the Herald Petrel off Northern New South Wales. Aust. Bird 15: 5-6.

1979

Lee, D. S. 1979. Second record of the South Trinidad Petrel (*Pterodroma arminjoniana*) for North America. Am. Birds 33: 138-139.

1976

Vinson, J.-M. 1976. Notes sur les Procellariens de l'ile Ronde. [Notes on the Procellariiformes of Round Island.] Oiseau R. F. O. 46: 1-24. [In French with English summary.]

1974

Clapp, R. B. 1974 [1975]. Specimens of three species of *Pterodroma* from the Pacific Ocean. Ardea 62: 246-247.

1972

Vernon, D. P. and J. L. McKean. 1972. A specimen of the Herald Petrel from Queensland. Emu 72: 115.

1970

Gill, F. B., C. Jouanin and R. W. Storer. 1970. Notes on the seabirds of Round Island, Mauritius. Auk 87: 514-521.

1967

Gould, P. J. and W. B. King. 1967. Records of four species of Pterodroma from the central Pacific Ocean. Auk 84: 591-594.

1959

Warham. J. 1959. The Trinidad Petrel, Pterodroma arminjoniana, a new bird for Australia. Emu 59: 153-158.

1934

Allen, A. A. 1934. A new bird for North America. St. Univ. N.Y. Bull. to Schools 20: 134-135.

CAHOW

(*Pterodroma cahow*)

[US: Bermuda Petrel]

INTRODUCTION

An abundant bird in Bermuda in the early 1600's, populations of the Cahow were soon depleted to the point of extinction by man and introduced animals (Murphy and Mowbray 1951, Zimmerman 1975b). Unrecorded for many years, the Cahow was found nesting on Bermuda in 1951. The population was thought to consist of only about 100 adults and was seriously threatened by introduced rats (Murphy and Mowbray 1951). Later menaces to the population included pesticides and the usurpation of nesting holes and destruction of chicks by White-tailed Tropicbirds. These competitors were controlled by putting baffles over the entrances to the nest-sites. These baffles allowed the smaller Cahow to enter the nest-holes but prevented the larger tropicbirds from entering. Nonetheless, the breeding population was only 26 pairs in 1977 (Wingate 1978).

Although the Cahow has never been recorded within the study area, we have included a brief account because the species is critically endangered and probably wanders to the offshore waters of the Southern Atlantic States.

GENERAL DISTRIBUTION

Historically known only from Bermuda, its range in the Atlantic is very poorly known.

HABITAT

Nesting Cahows formerly nested in burrows on the main islands of Bermuda. The remnant population present uses crevices in rocky islets as well as artificial burrows provided by Wingate (1978).

Offshore The offshore habitat of the Cahow is essentially unknown. The Cahow has never been convincingly identified at sea away from Bermuda.

FOOD AND FEEDING BEHAVIOR

Wingate (1972) stated that the Cahow's food "consists primarily of small squid with lesser amounts of shrimp and probably also small fish".

SUSCEPTIBILITY TO OIL POLLUTION

The waters around Bermuda are heavily burdened with tar balls. Despite regular examination of many of the surviving birds, however, no sign of oiling has been detected (D. Wingate, pers. comm.). Other *Pterodroma* sometimes become oiled. A specimen of the Cahow's close relative, the Black-capped Petrel (*Pterodroma hasitata*) was found heavily oiled with "feul oil" on a Connecticut beach (Holman 1952). The *Pterodroma* may be much more susceptible to fresh spills than to the tar balls so abundant around Bermuda and elsewhere.

BIBLIOGRAPHY

1978

Wingate, D. B. 1978. Excluding competitors from Bermuda Petrel nesting burrows. Pp. 93-102 *in* S. A. Temple (ed.) Endangered Birds. Management Techniques for Preserving Endangered Species. Intern. Symp. on Management Techniques for Preserving Birds. Univ. Wisc. Press/Madison. 466 pp.

1975

Zimmerman, D. R. 1975a. The Bermuda Petrel returns from oblivion. Natl. Parks Conserv. Mag. 49: 10-13.

Zimmerman, D. R. 1975b. To Save a Bird in Peril. Coward, McCann & Geoghagan, Inc., N.Y. 286 pp.

1973

Zimmerman, D. R. 1973. 'No longer extinct' N.Y. Times Mag., 2 Dec. 1973.

1972

Wingate, D. B. 1972. First successful hand-rearing of an abandoned Bermuda Petrel chick. Ibis 114: 97-101.

1969

Gochfeld, M. 1969. Marine contamination by pesticides. N. Engl. J. Med. 280: 899-900.

1968

Anon. 1968. DDT threatens the Cahow. Oryx 9: 386.

McLean, L. A. 1968. DDT residues and Bermuda Petrels. Science 161: 397.

Milne, L. and M. Milne. 1968. The Cahow--10 years to doom? Audubon 70: 46-50.

Rogin, G. 1968. There are problems when man plays God. Sports Illustrated 29 (4 Nov.) 1968: 78-90.

Wurster, C. F., Jr. and D. B. Wingate. 1968a. [Reply to MacLean's letter.] Science 161: 397.

Wurster, C. F., Jr. and D. B. Wingate. 1968b. DDT residues and declining reproduction in the Bermuda Petrel. Science 159: 979-981.

1960

Wingate, D. B. 1960. Cahow, living legend of Bermuda. Can. Aud. 22: 145-149.

1952

Holman, J. P. 1952. West Indian Black-capped Petrel, Pterodroma hasitata, picked up on Fairfield beach, Connecticut. Auk 69: 459-460.

Shepard, P., Jr. 1952. Can the Cahow survive? Nat. Hist. 61: 302-305.

1951

Moltoni, E. 1951. La riscoperta del Procellariiforme Pterodroma cahow (Nichols e Mowbray) alle Isole Bermude. Riv. Ital. Ornitol. 21: 99-103. [In Italian.]

Murphy, R. C. 1951. Rediscovery of the Cahow. Bull. Br. Ornithol. Club 71: 9-10.

Murphy, R. C. and L. S. Mowbray. 1951. New light on the Cahow, Pterodroma cahow. Auk 68: 266-280.

1938

Wetmore, A. 1938. Bird remains from the West Indies. Auk 55: 51-55.

1935

Beebe, W. 1935. Rediscovery of the Bermuda Cahow. Bull. N.Y. Zool. Soc. 38: 187-190.

1923

Wood, C. A. 1923. The fossil eggs of Bermudan birds. Ibis 11th Ser., Vol. 5: 193-207.

1922

Schufeldt, R. W. 1922. A comparative study of some subfossil remains of birds from Bermuda, including the 'Cahow'. Ann. Carnegie Mus. 13 (1918-1922): 333-418.

1916

Nichols, J. T. and L. L. Mowbray. 1916. Two new forms of petrels from the Bermudas. Auk 33: 194-195.

Shufeldt, R. W. 1916. The bird-caves of the Bermudas and their former inhabitants. Ibis 10th Ser., Vol. 4: 623-635.

1902

Tristram, H. B. 1902. The "cahows" of the Bermudas. Ann. Mag. Nat. Hist. 9: 447- 448.

Verrill, A. E. 1902. The "Cahow" of the Bermudas, an extinct bird. Ann. Mag. Nat. Hist. 9: 26-31.

BLACK-CAPPED PETREL

(*Pterodroma hasitata*)

[DA: Karaibisk Skrape, Atlantisk Petrel; DU: Zwartkapstormvogel, FR: Petrel diablotin, GE: Teufelssturmschwalbe, IT: Uccello delle tempeste col cappuccio, SP: Petrel diablotin, SW: Vastindisk stormfagel, US: Diablotin]

GENERAL DISTRIBUTION

North America Black-capped Petrels are rare but regular migrants well off the Atlantic coast of North America from Florida to southern Canada. They have also appeared inland on occasion as storm-driven waifs (Murphy 1936). They seem to be most common in the Gulf Stream off the Middle Atlantic States and North Carolina (Lee and Rowlett 1979).

World Distribution Black-capped Petrels breed on inland forested cliffs on Santo Domingo (Wingate 1964). All known colonies on Hispaniola were found in Haiti, but they may also breed in the Dominican Republic (Wetmore and Swales 1931). They formerly bred on Dominica, Guadeloupe, and Martinique in the Lesser Antilles, and may possibly still do so on one or more of them (Noble 1916, Murphy 1936). A dark race (possibly a separate species) formerly bred on Jamaica (Murphy 1936).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The waters of the Gulf Stream off the southeastern United States apparently constitute the primary non-breeding range of the Black-capped Petrel. Birds normally remain well out to sea, occurring inshore or on land only when sick or storm-driven.

North Carolina Lee and Rowlett (1979) summarized the occurrence of this bird in North Carolina. It is apparently uncommon but quite regular, usually along the western boundary of the Gulf Stream, most frequently in summer and early autumn. Lee and Rowlett have seen 70-100 Black-capped Petrels since the first sighting for the state in 1972, and have collected one specimen. These petrels have been recorded in all months except January, March, and December.

South Carolina and Georgia Morzer Bruyns (1967a) reported at least 12 Black-capped Petrels in the Gulf Stream 70-100 mi off Georgia and South Carolina, 6 September 1966. This is the only record for these two states, although the Florida and North Carolina records suggest that they are probably regular along the whole southeastern Atlantic coast.

Florida Several specimens exist, and there are also several recent sight records. The first specimen was from near Indian River Inlet, in the winter of 1846-47 (Howell 1932, Murphy 1936). The second specimen was obtained when a bird hit the WCTV tower in Leon County in the fall of 1964 (Stoddard and Norris 1967), and the third was found "sick" in Melbourne Beach, Brevard

County, in June 1972. Paul Sykes collected one (USNM #527749) of 13 seen on 21 May 1977 off Ponce Inlet, Volusia County (Kale 1977). One was seen on 16 July 1974 off Cape Canaveral, Brevard County (Ogden 1974) and in 1978, seven were seen on 29 April and three on 27 May (Kale 1978). In early 1979, 3 were seen off Ponce Inlet on 14 April, and 38 on 3 May (Kale 1979).

The Leon County TV tower casualty is the only record for the Gulf coast of Florida, and indeed, the only record for the Gulf of Mexico.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Wingate (1964) estimated the breeding population of Haitian colonies as at least 4,000 birds, and suggested that the actual total might be much higher. Off the Atlantic coast, the Black-capped Petrel apparently migrates regularly to Gulf Stream waters.

HABITAT

Nesting Black-capped Petrels nest in burrows in soil on steep forested cliffs of Caribbean islands. They may now be restricted to Haiti and the Dominican Republic. The dark Jamaican form apparently used solution cavities in the limestone as well as burrows in soil.

Feeding, Winter and Offshore Black-capped Petrels use warm oceanic waters, generally off the continental shelves. The waters of the Gulf Stream off the southeastern United States are apparently a major foraging area during the non-breeding season. These petrels have also been seen in this area during the breeding season in November and February. These birds are probably nonbreeders, perhaps subadults, although it is conceivable that breeding birds could range the 800 miles from Haiti between incubation shifts.

FOOS AND FEEDING BEHAVIOR

The stomach of one specimen contained cephalopod beaks and lenses (Wingate 1964). Black-capped Petrels apparently are not adapted for diving, so they probably feed at the surface. Perhaps much of their foraging is crepuscular or nocturnal.

SUSCEPTILIBITY TO OIL POLLUTION

A Black-capped Petrel found on a Connecticut beach in October 1938 was described as "smeared with fuel oil" (Holman 1952). In general, *Pterodroma* seem relatively invulnerable to spilled oil.

BIBLIOGRAPHY

1979

Lee, D. S. and R. A. Rowlett. 1979. Additions to the seabird fauna of North Carolina. Chat 43: 1-9.

1977

Lambert, K. 1977. Black-capped Petrel in the George's Bank area. Am. Birds 31: 1056.

Lee, D. S. 1977. Occurrence of the Black-capped Petrel in North Carolina waters. Chat 41: 1-2.

Rowlett, R. A. 1977. A sight record of the Black-capped Petrel off Virginia. Raven 48: 26-27.

1976

Reed, S. M. 1976. Correction to shore note on the Black-capped Petrel in the Waikoto. Notornis 23: 355.

1974

Woolfenden, G. E. and H. W. Kale, II. 1974. A Black-capped Petrel specimen from Florida. Fla. Field Nat. 2: 17-19.

1973

Brown, R. G. B. 1973. A Black-capped Petrel north of Bermuda. Am. Birds 27: 742.

1970

Jenkins, J. 1970. Black-capped and other petrels near the Kermadics. Notornis 15: 214-215.

1967

Morzer Bruyns, W. F. J. 1967a. Black-capped Petrels (Pterodroma hasitata) in the Atlantic Ocean. Ardea 55: 270.

Morzer Bruyns, W. F. J. 1967b. Black-capped Petrels (Pterodroma hasitata) in the Caribbean. Ardea 55: 144-145.

1966

Nieboer, E. 1966. Probable sight record of Pterodroma hasitata in the Western Sargasso Sea. Ardea 54: 88.

1964

Wingate, D. B. 1964. Discovery of breeding Black-capped Petrels on Hispaniola. Auk 81: 147-159.

1952

Holman, J. P. 1952. West Indian Black-capped Petrel, Pterodroma hasitata, picked up on Fairfield Beach, Connecticut. Auk 69: 459-460.

Wetmore, A. 1952. A record for the Black-capped Petrel, Pterodroma hasitata, in Martinque. Auk 69: 460.

1940

Sutton, G. M. 1940. Black-capped Petrel in New York. Auk 57: 244.

Wetmore, A. 1940. A specimen of the Black-capped Petrel. Auk 57: 105.

1939

Wetmore, A. 1939. A record of the Black-capped Petrel from Haiti. Auk 56: 73.

1932

Wetmore, A. 1932. The Diablotin in Dominica. Auk 49: 456-457.

1904

Allen, J. A. 1904. Black-capped Petrel in New Hampshire. Auk 21: 383.

BULWER'S PETREL

(*Bulweria bulwerii*)

[DA: Bulwers Skrape, DU: Bulwer's Stormvogel, FR: Petrel de Bulwer, GE: Bulwersturmschwalbe, Weichfedersturmvogel; IT: Berta del Bulwer, Uccello delle tempeste di Bulwer; JA: Anadori, PR: Anjinho, SP: Petrel de Bulwer, SW: Spets-sjartad stormfagel]

GENERAL DISTRIBUTION

North America Bulwer's Petrel is accidental in North America. There is one old and discredited record for Greenland (AOU 1957), and one sight record off Key West (Taylor 1972).

World Distribution This petrel breeds on tropical and subtropical oceanic islands in the eastern Atlantic north of the equator (the Selvages, Porto Santo group, Desertas, Canary Islands, Cape Verde Islands, and formerly on Santa Maria, the southernmost of the Azores)(Cramp et al. 1977). It is also found in the tropical and subtropical North Pacific, Taiwan, off southeastern China, in the Hawaiian group, and in the Phoenix, Marquesas, Bonin, and Volcano islands (King 1967, Jouanin and Mougin 1979). The at-sea distribution of Bulwer's Petrel is not well known. According to King (1967), they range at least 1,000 mi from the breeding colonies.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Florida - Keys The only record for our area is a sight record in Rebecca Passage between the Marquesas Keys and the Dry Tortugas, Monroe County, 14 May 1969 (Taylor 1972).

HABITAT

Nesting Bulwer's Petrels nest in the eastern Atlantic in rock crevices, holes in stone walls, and similar sites, but apparently not in burrows (Lockley 1952). In the Pacific they use crevices and burrows, particularly under coral blocks, boards, and other solid objects, and may even nest under heavy vegetation (Ely and Clapp 1973).

Feeding, Winter and Offshore These petrels are oceanic and range far out from their nesting islands. They seem to prefer subtropical and tropical-waters, mostly north of the equator. The islands they nest on are all oceanic, therefore Bulwer's Petrels may spend their whole lives away from the waters of the continental shelves.

FOOD AND FEEDING BEHAVIOR

Cramp et al. (1977) report that Bulwer's Petrel is almost entirely a nocturnal feeder. Bulwer's Petrels feed on planktonic organisms including ctenophores, fish eggs, and polychaetes (King 1967, Bent 1922 in Cramp et al. 1977). C. Harrison (pers. comm.) believes that they feed nocturnally to a considerable extent. They feed mostly on fish, most commonly lanternfish (Myctophidae) and hatchetfish (Sternoptychidae) in the Northwestern Hawaiian Islands. They also eat squid (Ommastrephidae) and, to a much lesser extent, small crustaceans and other surface-dwelling organisms (C. Harrison, pers. comm).

SUSCEPTIBILITY TO OIL POLLUTION

Unknown.

BIBLIOGRAPHY

1981

Gauntlett, F. M. 1981. Tail shape of Bulwer's Petrel. Brit. Birds 74: 188.

1980

Alibone, M. R. 1980. Bulwer's Petrel in Co. Cork. Brit. Birds 73: 217-218.

1979

Jouanin, C., J.-L. Mougin, F. Roux and A. Zino. 1979. Le Petrel Bulweria bulwerii dans l'archipel de Madere et aux iles Selvagens. Oiseau R. F. O. 49: 165-184. [In French with English summary.]

1978

Thibault, J.-C. and D. T. Holyoak. 1978. Vocal and olfactory displays in the Petrel genera Bulweria and Pterodroma. Ardea 66: 53-56.

1975

Bourne, W. R. P. 1975. The lachrymal bone in the genus Bulweria. Ibis 117: 535.

Olson, S. L. 1975. Remarks on the generic characters of Bulweria. Ibis 117: 111-113.

Wink, M. 1975. Eifund der Bulwersturmschwalbe (Bulweria bulwerii) auf Teneriffa. J. Ornithol. 116: 489-490. [In German.]

1972

Taylor, J. W. 1972. Probable Bulwer's Petrel off Key West, FLorida. Wilson Bull 84: 198.

1968

Sharrock, J. T. R. 1968. The Irish record of Bulwer's Petrel. Brit. Birds 61: 423-425.

1963

ffrench, R. 1963. Bulwer's Petrel (*Bulweria bulwerii*) in Trinidad, West Indies. Auk 80: 379.

1959

Phillips, W. W. A. 1959. Note on the occurrence of Bulwer's Petrel (*Bulweria bulwerii*) in the Indian Ocean. Bull. Br. Ornithol. Club. 79: 100-101.

1946

Baldwin, P. H. 1946. Bulwer Petrel breeding on eastern Hawaiian Islands. Condor 48: 42-43.

1941

Munro, G. C. 1941. Birds of Hawaii and adventures in bird study. Bulwer's Petrel. Elepaio 2: 1-3.

CORY'S SHEARWATER

(*Calonectris diomedea*)

[DA: Kuhls Skrape, DU: Cory's Pijlstormvogel, Kuhls Pijlstormvogel; EN/US: North Atlantic Shearwater, Meditterranean Shearwater; FI: Keltanokkaliira, FR: Puffin cendre, GE: Gelbschnabel-Sturmtaucher, IC: Urdaskrofa, IT: Berta maggiore, NW: Gulnebblire, PO: Burzyk zoltodzioby, Nurzec zoltodzioby; PR: Cagarra, Pardela-de-bico branco; SP: Pardela cenicienta, SW: Kuhls lira, Gulnabbad lira]

GENERAL DISTRIBUTION

North America In North America, Cory's Shearwater occurs as an offshore visitor in Atlantic waters north to about Nova Scotia (Godfrey 1966). Formerly considered casual to accidental in most of the Atlantic states, recent observations off some states have shown that it is common and often abundant in migration (Lee and Booth 1979). Too few observations have been made in the Gulf of Mexico for an adequate appraisal of the status of Cory's Shearwater there, but it is probably considerably more common than formerly thought; Kale (1979 ms b) goes so far as to suggest that it is probably relatively abundant.

World Distribution Cory's Shearwater is a bird of temperate to subtropical waters that breeds in the Atlantic on islands off Portugal and Madeira, the Desertas, Porto Santo, Salvage, Canary, Azore, and Cape Verde islands. In the Mediterranean, these shearwaters breed primarily in the northern portion from the Balearic Islands off Spain east to Turkey. They are largely unknown as breeders in the southern portion except on Zembra Island off Tunisia (Jouanin and Mougin 1979).

Birds from the Mediterranean islands (*Calonectris d. diomedea*) and the North Atlantic islands (*C. d. borealis*) are migratory (Jouanin and Mougin 1979); the latter race is believed to supply most of the birds that occur offshore from North America. The nominate race migrates through the Straits of Gibralter to spend the nonbreeding period off the coasts of western and southern Africa. The population in the Cape Verde Islands (*C. d. edwardsii*) is not thought to be migratory (Jouanin and Mougin 1979). Like other petrels, Cory's Shearwater may straggle well outside its normal range. It has wandered to a number of European countries as well as Israel, Egypt, and even as far (once) as New Zealand (Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Cory's Shearwaters have been recorded from all the states along the Atlantic coast where they occur in some abundance. They are considerably less

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Taxonomic note: This species also appears in recent literature as *Puffinus diomedea* and *Procellaria diomedia*.

common in the Gulf of Mexico and are as yet unrecorded from Mississippi and Louisiana waters.

North Carolina This species was previously known from North Carolina on the basis of very few records. There are now 46 records, all but a few obtained in the last 10 years. Cory's Shearwater is now regarded as a common resident offshore, one that is often abundant in migration (Lee and Booth 1979). They have been recorded from as early as 3 March to as late as 14 November.

1940	6 Jul.	1 found dead, coll. (NCSM)	Pea Island	Pearson et al. 1942
1940	20 Aug.	1 found dead, coll. (NCSM)	Pea Island	Pearson et al. 1942
1955	13 Aug.	1 found dead, coll.	beach, Shackleford Bank, Beaufort	Chamberlain 1956a
1966	9 Apr.	2 seen	ca. 19 mi S Beaufort	Parnell 1966b
1966	4 Sep.	1 seen	off Hatteras	Parnell 1967a
1968	25-26 Jun.	ca. 25 seen	Gulf Stream off Cape Hatteras	Parnell 1968c
1972	26 Jun.	2 seen	offshore betw. Morehead City and Cape Hatteras	Teulings 1972d
1972	27 Jun.	1 seen	offshore betw. Morehead City and Cape Hatteras	Teulings 1972d
1972	12 Aug.	30 seen	off Hatteras	Teulings 1973a
1972	19 Aug.	74-123 seen	off Morehead City	Teulings 1972d, Teulings 1973a
1972	27 Aug.	30 seen	off Morehead City	Teulings 1973a
1972	29 Aug.	3 seen	off Morehead City	Teulings 1973a
1973	19 May	1 seen	off Hatteras	Teulings 1973c
1973	26 May	1 seen	off Morehead City	Teulings 1973c
1973	30 May	20 seen	from Hatteras Inlet	Buckley 1973
1973	31 May	3,600+ seen	from 4 mi NE Hatteras Inlet	Buckley 1973
1973	1 Jun.	1,400+ seen	from Hatteras Village	Buckley 1973

1973	3 Jun.	9 seen	off Morehead City	Teulings 1973c
1973	25 Jun.	10+ seen	from beach, Cape Hatteras	Teulings 1973d
1973	28 Jul.	69 seen	off Morehead City	Teulings 1973d
1973	29 Jul.	20 seen	off Hatteras	Teulings 1973d
1973	Aug.-Oct.	"in considerable abundance"	offshore coast	Teulings 1974a
1974	17 Jul.	92 seen	Gulf Stream, 35-40 mi SE Oregon Inlet	Teulings 1974d
1974	3 Aug.	9 seen	off Hatteras	Teulings 1975a
1974	4 Aug.	4 seen	off Hatteras	Teulings 1975a
1974	9 Aug.	56 seen	off Hatteras	Teulings 1975a
1974	18 Aug.	11 seen	off Morehead City	Teulings 1975a
1974	1 Sep.	9 seen	off Hatteras	Teulings 1975a
1974	13 Sep.	49 seen	off Morehead City	Teulings 1975a
1974	14 Sep.	15 seen	off Wrightsville Beach	Teulings 1975a
1974	28 Oct.	8,850+ seen	in 7 hours from Cape Point, Hatteras Island	Rowlett 1978
1975	5 Jul.	15 seen	24 mi. off Cape Hatteras	Teulings 1975d
1975	late Aug-early Oct.	"good numbers"	Gulf Stream waters off coast	Teulings 1976a
1976	1 Aug.	94 seen	off Hatteras (peak count Jul.-Aug.)	LeGrand 1976
1976	11 Aug.	8 seen	off Oregon Inlet	Teulings 1977a
1976	5 Sep.	13 seen	off Oregon Inlet	Teulings 1977a
1976	6 Sep.	48 seen	off Hatteras	Teulings 1977a
1976	10 Oct.	12 seen	off Hatteras	Teulings 1977a
1977	30 Jun.	60+ seen	off Oregon Inlet (peak count Jun.)	LeGrand 1977b
1978	4 Apr.	seen	off North Carolina	Lee and Booth 1979

1978	17 Apr.	seen	off North Carolina	Lee and Booth 1979
1978	8 Oct.	152 seen	off Hatteras	LeGrand 1979a
1978	14 Nov.	6 seen	off Oregon Inlet	LeGrand 1979a
1979	8 Mar.	1 seen	resting on water, Oregon Inlet	LeGrand 1979c
1979	23 Apr.	4 seen	off Oregon Inlet	LeGrand 1979c
1979	16 May	3 seen	off Oregon Inlet	LeGrand 1979c

South Carolina Sprunt and Chamberlain (1949) considered this species a rare summer visitor off the coast, and even now we are aware of only eight records for the state (see below). Cory's Shearwater is common to abundant both to the north and south of South Carolina, however, and the apparent rarity of this pelagic species probably only results from the infrequency of observations off the coast.

1940	13 Jul.	at least 1,000 seen	several 100 mi off coast	Pearson et al. 1942
1940	11 Aug.	1 found (1) dead, coll.	Isle of Palms	von Dingle and Chamberlain 1941
1968	25 Aug.	1 seen	ca. 40 mi off Charleston	Parnell 1968c
1970	8 Aug.	18 seen	10-50 mi off Murrell's Inlet	Teulings 1970b
1973	20 Jun.	5 seen	off Charleston	Teulings 1973d
1973	25 Jul.	20 seen	off Charleston	Teulings 1973d
1973	28 Jul.	2 seen, 1 coll. (CM-CB-2) (2)	15 km off Charleston	Forsythe 1980
1975	18 Jul.	2 seen	off Myrtle Beach	Teulings 1975d

Georgia Denton et al. (1977) regarded this species as accidental in Georgia, listing only one record. As suggested for South Carolina, Cory's Shearwater is undoubtedly more common than the single record indicates.

1973	2 Sep.	1 coll.	Cumberland Island	Denton et al. 1977

(1) Identified as the Atlantic *C. d. borealis*.
(2) Identified as the Mediterranean *C. d. diomedea*.

Florida - Atlantic Coast Unknown from Florida through the last state bird book (Sprunt 1954), there are now at least 33 records from the Atlantic coast. Cory's Shearwater is considered to be the most abundant shearwater offshore from May to December, with peak numbers seen from September to November (Kale 1979 ms a).

1958	14 Nov.	1 found dead, (part coll./ USNM)	Palm Beach	Stevenson 1959a, Langridge 1959
1961	25 May	1 seen	25 mi E Miami Beach	Abramson 1961
1961	7 Oct.	several coll. (1)	4 mi E Tavernier	Stevenson 1962
1962	5 Nov.	1 found dead	near Ormond Beach	Stevenson 1963a
1963	26 Sep.	1 found dead	New Smyrna Beach	Cunningham 1964a
1965	14 Aug.	500 seen	25 mi ENE St. Augustine, 200 in one flock	Stevenson 1965a, Lesser and Williams 1967
1965	21 Aug.	200+ seen (2) (1 coll., FSM 11215)	at once ca. 7 mi E St. Augustine Light	Lesser and Williams 1967
1968	22 Dec.	1 seen	off Miami Beach	Stevenson 1969
1967	1 Sep.	5 seen	18 mi E Melbourne Beach	Robertson and Ogden 1968
1967	12 Sep.	2 seen	20 mi E Cocoa Beach	Robertson and Ogden 1968
1970	22 Aug.	2 seen	8 mi E Mayport	Ogden 1970
1971	18 Jun.	2 seen	ca. 20 mi E Cocoa	Ogden 1971
1971	8 Oct.	3 seen	off Cocoa Beach	Robertson 1972
1972	17 Sep.	27 seen	off Boynton Inlet	Stevenson 1973
1973	11 Aug.	1 seen	off Mayport	Edscorn 1974

(1) Sources vary as to the number collected. Taylor (1976) remarked that three were collected, but Lesser and Williams (1967) stated that at least five were collected, two of which went to the University of Miami, and one each to the Peabody Museum at Yale University, Florida State University, and the Miami Museum of Science. At least three were the Mediterranean *C. d. diomedea* (Taylor 1976).

(2) Identified as the Atlantic *C. d. borealis*.

1973	9 Sep.	8 seen	off Mayport	Edscorn 1974
1973	23 Sep.	2 seen	20 mi off Cape Canaveral	Edscorn 1974
1974	15 Jul.	49 seen, 1 female coll. (1) (FTU 1941)	20 mi off Cocoa, Brevard Co.	Ogden 1974, Taylor 1976
1974	10 Aug.	22 seen	off Mayport	Edscorn 1975
1974	11 Aug.	2 seen	off Mayport	Edscorn 1975
1974	9 Oct.	27 seen	off Canaveral	Edscorn 1975
1974	15 Nov.	300 seen	off Canaveral	Edscorn 1975
1975	22 Apr.	1 seen	from shore, Deerfield Beach	Kale 1975
1975	1 Jul.	52 seen	off Cape Canaveral (high count)	Ogden 1975
1975	4 Sep.	300 seen	off St. Augustine	Edscorn 1976
1976	30 May	2 seen	18 mi E Cape Canaveral	Kale 1976
1976	9 Dec.	1 found dead, coll. (USF)	Vero Beach	Stevenson 1977
1977	21 May	4 seen	E of Ponce de Leon Inlet	Kale 1977
1977	19 Oct.	700 seen	off Canaveral	Edscorn 1978
1977	20 Dec.	1 seen	off Canaveral	Stevenson 1978
1977	21 Dec.	1 seen	near land at Lake Worth	Stevenson 1978
1978	24 Jun.	1 seen	off Ponce de Leon Inlet	Ogden 1978
1978	30 Jul.	1 seen	off Ponce de Leon Inlet	Ogden 1978

Florida - Gulf Coast Cory's Shearwater was formerly unknown from the Gulf of Mexico, but recent observations suggest that it may occur there regularly. Too few pelagic observations have been made for any certain statements as to its status in the Gulf of Mexico, but this species is more frequent during late summer and fall. The eight records from the Gulf Coast of Florida fall between 13 May and 29 October.

(1) These birds were referred to as the race *C. d. diomedea*.

1976	25 Sep.	1 seen	off Clearwater	Edscorn 1977
1977	31 Jul.	4 seen	off Clearwater	Edscorn 1978
1977	17 Sep.	1 seen	off Clearwater	Edscorn 1978
1978	13 May	1 seen	Cape San Blas	Imhof 1978
1978	23 May	2 seen	in Gulf, 20+ mi NW Dry Tortugas	Kale 1978
1978	6 Aug.	1 seen	off Clearwater	Edscorn 1979
1978	29 Oct.	1 seen	off Hudson	Edscorn 1979
1979	6 Aug.	1 seen	on aerial survey off Naples	Hoffman, this paper

Alabama Cory's Shearwater has only twice been recorded in Alabama.

1973	10 Sep.	1 seen	Mississippi Sound	Imhof 1976b
1979	Sep.	15-20 seen	during Hurricane Frederic	Duncan, *in litt*.

Texas Although specimens have not been obtained in recent years, Cory's Shearwater has been reported 11 times during late summer and fall. Too little work has been done in areas off the Texas coast to draw any conclusions about its abundance in these waters.

1975	27 Sep.	3-4 seen	ca. 40 mi off Port Aransas	Webster 1976a
1976	2 Oct.	45+ seen	off Port Aransas	Webster 1977a
1977	27 Aug.	3 seen	off Port Aransas	Webster 1978a
1977	2 Oct.	1 seen	off Port Aransas	Webster 1978a
1978	during Aug.-Oct.	"a few" seen	ca. 45 mi off Port Aransas	Webster 1979a
1979	20 Aug.	75-100 seen	in two groups, during aerial survey off Brownsville	Hoffman, this paper
1979	21 Aug.	50 seen	in one group, off Brownsville	Hoffman, this paper
1979	22 Aug.	5 seen	as individuals, off Brownsville	Hoffman, this paper

1979	23 Aug.	1 seen	off Corpus Christi during aerial survey	Hoffman, this paper
1979	24 Aug.	1 seen	off Corpus Christi during aerial survey	Hoffman, this paper
1979	25 Aug.	3 seen	off Corpus Christi during aerial survey	Hoffman, this paper

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Cory's Shearwater is a bird of warm temperate to subtropical marine waters (Cramp et al. 1977) that is restricted in its breeding distribution to islands of the western Atlantic and Mediterranean. Although the total world population is unknown, Cramp et al. (1977) reported that until recently there were at least 22,000 pairs in the Selvagens, several thousands present in the Cape Verdes, and that some 10,000 were seen at dusk at a station in Tunisia. It was formerly the most abundant shearwater in the Canaries, Azores, and Madeira. Populations in the Selvagens, Desertas, and Porto Santo groups are apparently rapidly declining, largely as a result of the harvesting of the species.

Winter and Migration Tables 18 and 19 summarize the occurrence of Cory's Shearwater in southeastern waters. Off the Atlantic coast the species is often abundant, particularly as a migrant, but its status in many areas is still imperfectly known. The numbers reported from the Atlantic coastal states almost directly reflect the degree to which observations have been made, and it should not be assumed that this species is uncommon off Georgia and South Carolina where little work has been done.

Cory's Shearwater also occurs in the Gulf of Mexico but is less common there than off the Atlantic coast. So few offshore observations have been made in this area that further comment on its occurrence there would be speculation.

Birds recorded from southeastern waters are from both northeastern Atlantic (*C. d. borealis*) and Mediterranean (*C. d. diomedea*) breeding populations, but the majority of these birds are probably *C. d. borealis* (Palmer 1962, Cramp et al. 1977).

HABITAT

Nesting Cory's Shearwaters nest primarily on uninhabited islands or in mountainous terrain up to 30 km from the coast (Cramp et al. 1977). On volcanic Selvagem Grande, most nest in holes and caves in the rocks, but others nest out in the open under scrub (Zino 1971). Similar sites were noted on Dragonada Island in the Dionisiades Islands, where Round and Swann (1977) found this species nesting under large boulders or slabs of stone or in deep crevices in the rocks. Nest sites in the Azores consisted of tunnels excavated in soft lava dust under grassy slopes, natural tunnels in lava, and spaces be-

Table 18. Approximate number of Cory's Shearwaters recorded by month for the coastal southeastern United States (a).

State/region	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	1	8	3625	1508	196	321	135	9014	6	-
South Carolina	-	-	-	5	1024	20	-	-	-	-
Georgia	-	-	-	-	-	-	1	-	-	-
Florida-Atlantic Coast	-	1	7	3	102	727	345	736	302	3
Subtotal-ATLANTIC COAST	1	9	3632	1516	1322	1068	481	9750	308	3
Florida-Gulf Coast	-	-	3	-	4	2	2	1	-	-
Alabama	-	-	-	-	-	-	16	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-	-
Louisiana	-	-	-	-	-	-	-	-	-	-
Texas	-	-	-	-	-	138	3	46	-	-
Subtotal-GULF COAST	-	-	3	-	4	140	21	47	-	-
Total-ALL AREAS	1	9	3635	1516	1326	1208	502	9797	308	3

(a) Birds found dead within the first 10 days of a month are arbitrarily assigned to the preceding month. If the source did make it clear whether one or more was seen, we have assumed only one was seen. If the source indicated more than one was seen (i.e., "several", "a few"), we have assumed two were seen. There were no records for January or February.

Table 19. Dates of occurrence for Cory's Shearwaters in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence
North Carolina	46	3 March - 14 November
South Carolina	8	20 June - 25 August
Georgia	1	2 September
Florida-Atlantic Coast	33	22 April - 22 December
Florida-Gulf Coast	8	13 May - 29 October
Alabama	2	10 September
Mississippi	unrecorded	
Louisiana	unrecorded	
Texas	ca. 11	20 August - 2 October

tween old lava boulders (Mallet and Coghlan 1964). On islets in the French Mediterranean, nests may be on the surface of the ground under thick shrub. Artificial sites consisting of crude walls and piles of stones constructed by humans (who harvest the birds) have been used readily (Roux and Jouanin 1968). Cramp et al. (1977) added rabbit burrows and burrows excavated in sand or hard earth to this list of nest sites.

Feeding, Nonbreeding, and Offshore Migrant and wintering Cory's Shearwaters usually occur well offshore, but occasionally may be seen from shore in considerable numbers. Cramp et al. (1977) indicated that they avoid colder waters but show no preferences among pelagic, offshore, and inshore waters. Off North Carolina this species regularly occurs inshore (5-20 miles), but it is more abundant in the waters of the Gulf Stream and along the edge of the continental slope (Lee and Booth 1979).

Cory's Shearwaters show no reluctance to alight on the water, and in pelagic areas they may form immense rafts of roosting birds. Bourne (in Palmer 1962) noted that such dense flocks were once seen off Portuguese Guinea that they were mistaken for land.

FOOD AND FEEDING BEHAVIOR

According to Palmer (1962) and Cramp et al. (1977), food is chiefly fish, fish spawn, cephalopods, and crustaceans. Offal from fishing vessels is also taken. Nocturnal feeding is apparently largely on squid at the surface of the water, but these birds also feed on small fish driven to the surface by predaceous fish (Watson 1966). These shearwaters also follow cetaceans to glean food coming to the surface (Palmer 1962). Almost nothing is known of specific food items eaten, either in the Old World or off the North Atlantic coast. They have been seen feeding on herring (*Clupea vulgaris*) off Massachusetts (Baird 1887).

There is little or no quantitative information on the feeding habits of this species, but Cramp et al. (1977) stated that "...most food [is] obtained naturally by plunging, often in association with other Procellariiformes or gulls *Larus*." They also stated that Cory's Shearwater "feeds mainly at night, chiefly by skimming over surface and surface feeding." Brown et al. (1978) indicated that Cory's Shearwater will dive for food, but apparently not as frequently nor as deeply as most of the shearwaters of the genus *Puffinus*. Bourne (in Brown et al. 1978) noted that birds feeding off Spain and Portugal made brief plunges to retrieve fish falling off sardine boats but did not dive deeply. Beven (1946) observed a small flock of Cory's Shearwaters near the Azores that was fluttering and hovering above the surface and then plunging to seize fish, some of which were taken in the air as they jumped out of the water. Rafts have also been seen swimming about and apparently picking up food near the surface (Bierman and Voous 1950 in Palmer 1962).

This species may sometimes follow ships. According to Cramp et al. (1977), Cory's Shearwater "attends fishing boats (even following them close to land)...", but "although scavenging, does not turn aside to follow ships."

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Zino (1971) reported that egg laying took place from late May to early June on Selvagem Grande in 1969.

Mean Clutch Size Cory's Shearwater lays one egg.

Incubation Period For 24 clutches in 1969, Zino (1971) recorded periods of 52-55 days, with a mean of 53.8 days.

Hatching Success In a study on the Salvage Islands in 1969, Zino (1971) found that 30 of 42 eggs (71%) hatched. Seven other eggs failed to hatch, but were excluded from the analysis because they had been disturbed by the investigators.

Fledging Success No precise data are available. On the Salvage Islands, 29 of 30 chicks hatched in late August were still alive in mid-September (Zino 1971).

Age at Fledging Age at fledging is not precisely known. For a colony in Crete, Round and Swann (1977) found that about two-thirds of the young fledged between 89 and 94 days of age. In the Salvage Islands, birds hatched in late July were still visited by their parents in mid-September (Zino 1971).

Age at First Breeding Age at first breeding is not adequately known, but Jouanin et al. (1977) suggested that breeding may occur as early as the fifth year and may regularly occur in the sixth year.

Mortality of Eggs and Young In a study conducted on Selvegem Grande, Salvage Islands, Zino (1971) found that the primary source of egg loss was predation by Herring Gulls (*Larus argentatus*).

Historically, a major source of mortality to young birds has been exploitation by humans. According to Zino (1971), young Cory's Shearwaters on the Salvage Islands were collected for food through 1967. Roux and Jouanin (1968) remarked that for more than a century 18 to 24 thousand young were taken yearly on Selvagem Grande. Their flesh was sold commercially, their down used for making eiderdowns, and their oil used for maintaining brass fittings on boats. Chicks too small for human consumption were chopped up for fish bait; Madeiran fishermen thought highly of them in this regard (Zino 1971).

Known predators include Black Rats (*Rattus rattus*), which caused high mortality in chicks on the Ile de Riou, off Marseille, France (Fernandez 1979).

Renesting No information is available.

Maximum Natural Longevity No data are available.

Weight (in grams) Weights of 26 breeding males in the Salvage Islands ranged from 940 to 1,130, and averaged 1,014; values for 26 breeding females were 700-1,000, with a mean of 877 (Zino 1971). A sample of chicks about 2 months old weighed an average of 1,092, some 140 g more than the average adult

weights in May (Zino 1971). Weights of adults from the Azores, Malta, Crete, and Tunisia were considerably lower than those in the Salvage Islands, with averages of various samples ranging from 535 to 731 (data in Cramp et al. 1977, Round and Swann 1977).

Weights of 13-day-old chicks from the Salvage Islands averaged 77 (range = 65-89) (Zino 1971); 9 from Crete averaged 70 (range = 53-82) (Round and Swann 1977). Weights of 46 fresh eggs from the Salvage Islands averaged 104.3 (range = 95-115) (Zino 1971); 19 eggs from Tunisia weighed 70-90 (mean = 79.8). The eggs from Tunisia were laid by the smaller nominate race, those from the Salvage Islands by the larger C. d. borealis.

SUSCEPTIBILITY TO OIL POLLUTION

A bird found dead and oiled at Ormond Beach, Florida, 5 November 1962 (Hudson 1963) is the only instance of oiling in Cory's Shearwater that we have found; 18 of a closely related species, the Streaked Shearwater (Calonectris leucomelas), were found in 1962-1965 on the beaches of Niigata Prefecture, Japan, and at least some were oiled. The Streaked Shearwater is an offshore migrant in Japan (Kazama 1968), as is Cory's Shearwater in the southeastern United States.

Procellariiforms in general seem to be less affected by oil than many other groups, possibly because they are largely pelagic and occur in areas where mortality due to oiling might go unnoticed. Cory's Shearwater is known to sit on the sea in large rafts when both roosting and feeding, thus it may be more vulnerable to the effects of oil than others of the group, particularly when drifting oil might encounter a rafting flock.

BIBLIOGRAPHY

1981

Ristow, D., C. Wink and M. Wink. 1981. Telemetrie der Korpertemperatur des Gelbschnabelsturmtauchers Calonectris diomedea. [Telemetry of the body temperature of Cory's Shearwater Calonectris diomedea.] Vogelwelt 102: 57-60. [In German with English summary.]

1980

da Juana, E., J. Varela and H.-H. Witt. 1980. Le Puffin cendre Calonectris diomedea nicheur aux Iles Chaffarines. [Cory's Shearwater Calonectris diomedea breeding in the Chaffarine Islands.] Alauda 48: 27-31. [In French with Spanish and English summaries.]

Forsythe, D. M. 1980. Cory's Shearwater off the South Carolina coast. Wilson Bull. 92: 265-266.

Jouanin, C, G. Hemery, J.-L. Mougin and F. Roux. 1980. Sur l'acquisiton de l'aptitude a la reproduction chez le Puffin cendre. [Progressive breeding capacity in the Cory's Shearwater.] C.R. Hebd. Seances Acad. Sci. Ser. D Sci. Nat. 290: 995-998.

Telleria, L. J. 1980. Autumn migration of Cory's Shearwater through the Straits of Gibraltar. Bird Study 27: 21-26.

1979

Fernandez, O. 1979. Observations sur le Puffin cendre Calonectris diomedea nicheur sur les Iles Marseillaises. [Observations of Cory's Shearwater Calonectris diomedea--breeding bird of the islands off Marseilles.] Alauda 47: 65-72. [In French with German and English summaries.]

Wink, M., C. Wink and D. Ristow. 1979. Parasitenbefall juveniler und adulter Gelbschnabelsturmtaucher (Calonectris diomedea). Bonn. Zool. Beitr. 30: 217-219.

Wink, M. and D. Ristow. 1979. Zur biometries des sexualdimorphismus beim Gelbschnabelsturmtaucher (Calonectris diomedea). [Biometrics of sexual dimorphism in Cory's Shearwater, Calonectris diomedea.] Vogelwarte 30: 135-138. [In German with English summary.]

1978

Brown, R. G. B., W. R. P. Bourne and T. R. Wahl. 1978. Diving by shearwaters. Condor 80: 123-125.

Harrison, P. 1978. Cory's Shearwaters in the Indian Ocean. Cormorant No. 5: 19-20.

Rowlett, R. A. 1978. A massive flight of Cory's Shearwaters at Cape Hatteras. Chat 42: 45-46.

1977

Araujo, J., J. Munoz-Cobo and F. J. Purroy. 1977. Las rapaces y aves marinas del archipelago de Cabrera. Instituto Nacional para la Conservacion de le Naturaleza: Madrid. Naturalia Hispanica 12. 94 pp. [In Spanish.]

Jouanin, C., F. Roux and A. Zino. 1977. Sur les premiers resultats du baguage des Puffins cendres aux Iles Selvagens. Oiseau R.F.O. 47: 351-358. [In French with English summary.]

Round, P. D. and R. L. Swann. 1977. Aspects of the breeding of Cory's Shearwater Calonectris diomedea in Crete. Ibis 119: 350-353.

1976

Anon. 1976. Great and Cory's shearwaters. Sea Swallow 25: 47.

Jouanin, C. 1976. Note sur la biometrie des Puffins cendres de Tunisie. Oiseau R.F.O. 46: 97-102. [In French with English summary.]

Taylor, W. K. 1976. Another Cory's Shearwater specimen from Florida. Fla. Field Nat. 4: 19.

1975

Stanley, G. 1975. Cory's Shearwater off Hilbre. Cheshire Bird Rept. 1975: 36.

1974

Zino, P. A. 1974. [The breeding of Cory's Shearwater Calonectris diomedea on the Salvage Islands.] Cyanopica 1: 5-18. [In Portuguese.]

1973

McCrimmon, D. A., Jr. 1973. Leach's Storm Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47-48.

Meiklejohn, M. F. M. 1973. Cory's Shearwater in Orkney. Scott. Birds 6: 330.

Ross, G. J. B. 1973. Mediterranean Shearwater in Natal waters. Ostrich 44: 85.

1972

Kumerloeve, H. 1972. Le statut du Puffin cendre Procellaria diomedea Scopoli dans le Golfe Saronique (Grece). Alauda 40: 102-104. [In French.]

1971

Narosky, S. 1971. Dos hallazgos interesantes para la avifauna Argentina (Puffinus diomedea y Chlidonias niger). Hornero 11: 129-130. [In Spanish.]

Zino, P. A. 1971. The breeding of Cory's Shearwater Calonectris diomedea on the Salvage Islands. Ibis 113: 212-217.

1970

Besson, J. 1970. Le Puffin cendre (Puffinus diomedea) nicheur aux iles d'Hyeres (Var.). Alauda 38: 157-159. [In French.]

1969

Collins, C. T. 1969. A review of the shearwater records for Trinidad and Tobago, West Indies. Ibis 111: 251-253.

Schwarze, E. 1969. Erstbeobachtung des Gelsnabel-Sturmtauchers (Calonectris diomedea) an der bulgarischen Kuste. J. Ornithol. 110: 110. [In German.]

1968

Marshall, R. V. A. 1968. Cory's Shearwater in Outer Hebrides. Scott. Birds 5: 209.

Roux, F. and C. Jouanin. 1968. Studies of less familar birds. 147. Cory's Shearwater. Brit. Birds 61: 163-169.

Sharrock, J. T. R. 1968. The flight of Great and Cory's shearwaters. Brit. Birds 61: 571-572.

1967

Lesser, F. H. and L. E. Williams, Jr. 1967. Cory's Shearwaters (Puffinus diomedea borealis) off eastern Florida. Auk 84: 278-279.

Thiollay, J. M. 1967. Important deplacement du Puffins cendres en Mediterranee occidentale. Oiseau R.F.O. 37: 240. [In French.]

Vande Weghe, J. P. 1967. Premiere observation pour la Belgique du Puffin cendre Puffinus diomedea (Scopoli) et du Puffin des Baleares Puffinus puffinus mauretanicus Lowe. Gerfaut 57: 125-138. [In French with Flemish summary.]

1966

Jouanin, C. and F. Roux. 1966. La colonie du Puffins cendres Calonectris diomedea borealis (Cory) de Selvagem Grande. Bol. Mus. Munic. Funchal 20: 14-28. [In French with English summary.]

1965

Clancey, P. A. 1965. Cory's Shearwater Procellaria diomedea borealis (Cory) in Natal. Ostrich 36: 36.

Garrido, O. H. and F. G. Montana. 1965. Aves nueva para Cuba. Poeyana Instit. Biol. Ser. A, 10: 1-6. [In Spanish.]

1964

Mallet, G. E. and L. J. Coghlan. 1964. Cory's Shearwater Procellaria diomedea breeding in the Azores. Ibis 106: 123-125.

Mason, C. R. 1964. Cory's Shearwater (Puffinus diomedea). Fla. Nat. 37: 24.

1963

Dobinson, H. M. and J. T. R. Sharrock. 1963. Exceptional passage of Cory's Shearwaters off Co. Cork. Brit. Birds 56: 189-190.

Hudson, R. D. 1963. Cory's Shearwater at Ormond Beach. Fla. Nat. 36: 27.

1960

Bauer, K. 1960. Puffinus kuhlii kuhlii in Pommern. J. Ornithol. 101: 361-362. [In German.]

1959

Langridge, H. P. 1959. Cory's Shearwater at Palm Beach, Florida. Auk 76: 241.

Pickering, C. H. C. 1959. Notes sur le Puffin cendre (Puffinus diomedea borealis) aux Iles Salvages. Oiseau R.F.O. 29: 1-3. [In French.]

1955

Bourne, W. R. P. 1955. On the status and appearance of the races of Cory's Shearwater Procellaria diomedea. Ibis 97: 145-149.

1952

Nicholson, E. M. 1952. Shearwaters in the English Channel. Brit. Birds 45: 41-55.

1950

Cabanne, F. and C. Ferry. 1950. Le Puffin cendre nicheur sur les iles Riou et Plane. Oiseau R.F.O. 20: 84-85. [In French.]

1947

Bos, G. 1947. Puffinus kuhlii borealis Cory, een nieuwe vogel voor Nederland. Ardea 35: 240-241. [In Dutch.]

1946

Beven, G. 1946. Feeding behaviour of North American shearwater. Brit. Birds 39: 122-123.

Glegg, W. E. 1946. Earliest known British occurrence of North Atlantic shearwater. Brit. Birds 39: 56-57.

1941

von Dingle, E. S. and E. B. Chamberlain. 1941. Cory's Shearwater in South Carolina. Auk 58: 251.

1934

Oliver, W. R. B. 1934. The occurrence of the Mediterranean Shearwater in New Zealand. Emu 34: 23-24.

1933

Laubmann, A. 1933. Puffinus kuhlii borealis Cory erstmals in Deutschland erbeutet. Ornithol. Monatsber. 41: 139-141. [In German.]

1922

Griscom, L. and E. R. P. Janvrin. 1922. Cory's Shearwater off Newfoundland, with remarks on its identification in life. Auk 39: 103-104.

Murphy, R. C. 1922. Notes on tubinares, including records which affect the AOU Checklist. Auk 39: 58-65.

1887

Baird, S. F. 1887. Occurrence of Cory's Shearwater (Puffinus borealis) and several species of jaegers in large numbers in the vicinity of Gayhead, Mass., during the autumn of 1886. Auk 4: 71-72.

GREATER SHEARWATER

(*Puffinus gravis*)

[DA: Storskrape, DU: Grote Pijlstormvogel, EN: Great Shearwater, FI: Iso myrskysukeltaja, FR: Puffin majeur, GE: Grosser Sturmtaucher, IC: Hettuskrofa, IT: Berta dell'Atlantico, NW: Storlire, PR: Cagarra de fora, Pardela-de-bico-preto; SP: Pardela capirotada, SW: Storre lira]

GENERAL DISTRIBUTION

North America In North America, Greater Shearwaters occur pelagically both as migrants and as summer visitors (during the southern winter) in the colder waters of the Atlantic. They occur during the same seasons but in less abundance in the Gulf of Mexico, where their status is very poorly known. These shearwaters have been recorded north as far as northern Labrador and eastern Hudson Strait (Godfrey 1966) and Greenland (AOU 1957), and to the south in the West Indies and Bermuda (Watson 1966). Birds occasionally wander inland along watercourses, or may be blown inland by storm winds.

World Distribution Greater Shearwaters breed only in the South Atlantic on Nightingale and Inaccessible islands of the Tristan da Cunha group, on Gough Island, and on Kidney Island in the Falkland Islands (Cramp et al. 1977).

Greater Shearwaters migrate north from their breeding grounds during the northern spring through the western Atlantic to New England and Greenland, and spreading eastward to European waters and to those of the western Mediterranean (AOU 1957). Most winter north of 45° N latitude (Stresemann and Stresemann 1970), but small numbers also winter off South Africa and in the extreme southwestern Indian Ocean. Birds reported from the southwestern Pacific may have been misidentified as *Pterodroma externa cervicalis* (Watson 1971).

The return route is poorly understood and may be concentrated in the western Atlantic or on a broad front across the entire ocean (Cramp et al. 1977). Newell (1968), citing earlier authors, stated that "it is believed that the main movements take place in mid-Atlantic with large numbers also on the west side and...only a small minority in the east...". These shearwaters are largely absent from the North Atlantic from December to April (Cramp et al. 1977) and reach peak numbers off the south Atlantic coast of the United States from May through June and early July (Table 20), when maximum numbers of migrants occur offshore.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The Greater Shearwater has been recorded from all of the coastal south-

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Taxonomic note: Also appears in recent literature as *Procellaria gravis*.

Table 20. Approximate number of Greater Shearwaters recorded by month for the coastal southeastern United States (a).

State/region	JAN	FEB	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	-	5	1929	809	103	73	8	52	16	2
South Carolina	-	-	-	-	34	5	9	-	-	-	2
Georgia	-	4	-	3	4	1	-	-	-	-	-
Florida-Atlantic Coast	2	1	-	14	10	311	14	5	46	11	1
Subtotal-ATLANTIC COAST	2	5	5	1946	857	420	96	13	98	27	5
Florida-Keys	-	-	-	-	-	-	1	-	-	-	-
Florida-Gulf Coast	1	-	1	6	-	3	9	18	4	-	-
Mississippi	-	-	-	-	-	-	-	-	-	-	-
Alabama	-	-	-	-	-	16	25	8	-	-	2
Louisiana	-	-	-	1	-	2	1	3	-	-	-
Texas Coast	-	-	-	-	-	-	1	-	-	1	-
Subtotal-GULF COAST	1	-	1	7	-	21	36	29	4	1	2
Total-ALL AREAS	3	5	6	1953	857	441	133	42	102	28	7

(a) Birds found dead within the first 10 days of the months are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. If the source indicated more than one was seen (i.e., "several", "a few") but did not specify how many, we have assumed two were seen. There are no records for March.

eastern states except Mississippi. Systematic pelagic observations have only been made in a few areas, and even for these there is a considerable seasonal bias. As a result, the status of this shearwater is poorly known, particularly in the Gulf of Mexico. One consequence of the paucity of information is that although the species may be considered fairly common in one state, it may be one of the rarest birds known to occur in an adjacent state.

North Carolina In the 74 years from 1897 through 1970 there were only about 20 to 22 records for the state. With the advent of reasonably regular pelagic observations in the early 1970's, more than 30 observations were made in the next 9 years (see below). Lee and Booth (1979) now consider it a regular summer visitor off the coast. Extreme dates of occurrence are 17 April 1978 and 30 December 1970; mid-May to mid-November is the normal period of occurrence (Lee and Booth 1979). Examination of the records below suggests a very pronounced peak in numbers from mid-May through about mid-July.

1897	4 Jul.	"a number" seen	ca. 50 mi off Cape Hatteras	Pearson et al. 1919

1936	24 Jul.	1 seen	Cape Hatteras Point	Pearson et al. 1942
1936	1 Aug.	2 seen	Cape Hatteras Point	Pearson et al. 1942
1936	12 Aug.	1 seen	Cape Hatteras Point	Pearson et al. 1942
1938	25 Jun.	1 coll. (NCSM)	New River Inlet, Onslow Co.	Pearson et al. 1942
1939	22 Jun.	1 found dead	beach near Poyner's Hill, Currituck Co.	Pearson et al. 1942
1939	26 Jun.	1 found	Bodie Island	Pearson et al. 1942
1946	28 Dec.	1 seen	Wrightsville Beach	Wray and Davis 1959
1953	4 Aug.	1(?) seen	Fort Macon	Wray and Davis 1959
1960	12 Jun.	1 found semi-mummified, photogr.	at foot of Hatteras lighthouse	Parkes 1962
1965	17 Jun.	"common"	off Cape Lookout	Parnell 1965c
1966	3 Jul.	1 seen	close inshore Cape Hatteras	Parnell 1966c
1967	5 Aug.	ca. 60 seen	15 mi off Morehead City	Parnell 1968a
1968	25-26 Jun.	1 seen	Gulf Stream off Cape Hatteras	Parnell 1968c
1969	27 Apr.	2 seen	65 mi offshore, SE Cape Lookout	Enders 1972
1969	17 May	4 seen	off Cape Lookout	Parnell 1969a
1969	3 Nov.	1 found freshly dead	Hatteras Island, near Avon	Parnell 1970
1970	30 May	10 seen	off Hatteras Inlet	Buckley 1973
1970	31 May	1800+ seen	off Hatteras Inlet	Buckley 1973
1970	1 Jun.	700+ seen	off Hatteras Village	Buckley 1973

1970	14 Oct.	1 seen	in surf off Nag's Head	Teulings 1971a
1972	26 Jun.	1 seen	25 mi offshore between Morehead City and Cape Hatteras	McCrimmon 1973
1972	27 Jun.	3 seen	30 mi offshore between Morehead City and Cape Hatteras	McCrimmon 1973
1972	19 Aug.	5-9 seen	off Morehead City	Teulings 1972d, 1973a
1973	19 May	31 seen	off Hatteras	Teulings 1973c
1973	26 May	2 seen	off Morehead City	Teulings 1973c
1973	3 Jun.	34 seen	off Morehead City	Teulings 1973c
1973	25 Jun.	30+ seen	from beach, Cape Hatteras	Teulings 1973d
1973	14 Jul.	75+ seen	off Wrightsville Beach	Teulings 1973d
1973	25 Jul.	4 seen	off Hatteras	Teulings 1973d
1973	28 Jul.	2 seen	off Morehead City	Teulings 1973d
1973	29 Jul.	4 seen	off Hatteras	Teulings 1973d
1973	through Oct.	seen	off coast	Teulings 1974a
1974	late Jun., Jul.	"seen in small numbers"	off coast	Teulings 1974d
1974	9 Aug.	2 seen	off Hatteras	Teulings 1975a
1974	1 Sep.	3 seen	off Hatteras	Teulings 1975a
1974	14 Sep.	2 seen	off Wrightsville Beach	Teulings 1975a
1974	28 Oct.	6 seen	from Cape Point, Hatteras Island	Teulings 1975a
1975	11 Jun.	8 seen	off Frisco, Cape Hatteras National Seashore	Lynch and Marsh 1977
1975	Jun.-early Oct.	"small numbers seen"	off coast	Teulings 1975d, 1976a
1976	23 Jun.	18 seen	off Cape Lookout	LeGrand 1976

1976	1 Jul.	present in large numbers, at least one coll. (NCSM)	offshore	Lee and Booth 1979
1976	10 Jul.	15-20 seen	off Carolina Beach	LeGrand 1976
1976	6 Sep.	3 seen	off Hatteras	Teulings 1977a
1977	22 Jun.	seen, coll. (NCSM)	offshore, first sighting of year	Lee and Booth 1979
1977	Jun.	3 seen	off Oregon Inlet (peak count)	LeGrand 1977b
1978	17 Apr.	reported	offshore (?)	Lee and Booth 1979
1978	8 Oct.	42 seen	off Hatteras	LeGrand 1979a
1978	14 Nov.	16 seen, at least one coll. (NCSM)	off Oregon Inlet	LeGrand 1979a, Lee and Booth 1979
1979	13 Apr.	2 seen	off Oregon Inlet	LeGrand 1979c
1979	10 May	40 seen	off Oregon Inlet	LeGrand 1979c
1979	16 May	42 seen	off Oregon Inlet	LeGrand 1979c

South Carolina Burton (1970) regarded Greater Shearwaters as probably fairly common offshore during summer. We know of only 10 records for the state. These document occurrence between 19 June and 16 December and suggest a pattern of occurrence similar to that found in North Carolina. More information is needed to determine whether there are any differences between the periods of occurrence in the two states and to document accurately the primary areas of occurrence offshore.

1893	ca. late Aug.	many found dead	Long Island (Isle of Palms) following storm	Wayne 1910, Sprunt and Chamberlain 1949
1911	4 Sep.	1 found dead	Sullivan's Island, following storm	Sprunt and Chamberlain 1949
1958	19 Jun.	1 found dead, head coll.	Hilton Head Island, Beaufort Co.	Tomkins 1959
1961	23 Jun.	ca. 30 seen	off coast	Voous and Wattel 1963
1964	16 Dec.	2 seen	50-60 mi off Charleston	Parnell 1965a

1966	10 Jul.	1 found dead, coll. (CM 68.48)	mouth of N. Edisto River	Burton 1970
1966	4 Aug.	1 seen	20 mi off Murrell's Inlet	Parnell 1966c
1970	8 Aug.	3 seen	10-50 mi off Murrell's Inlet	Teulings 1970b
1973	20 Jun.	2 seen	off Charleston	Teulings 1973d
1973	25 Jul.	5 seen	off Charleston	Teulings 1973d

Georgia Denton et al. (1977) recently regarded Greater Shearwaters as uncommon summer visitors offshore. We have found only six records for the state, but suspect that these shearwaters are probably considerably more common offshore than these few records suggest. Perhaps the best summary of the status of the Greater Shearwater off Georgia is simply "unknown".

1911	11 Jun.	1 found decomposed, head coll.	Tybee Island beach	Hoxie 1911
1949	25 Feb.	4-5 seen	end of St. Marys Jetties	Burleigh 1958
1962	23,29 Jun.	2 mummies found, coll. (UG 2091, 2092)	Sapelo Island	Kale 1962, Tomkins 1963
1972	1 Jul.	1 (?)	Little Cumberland Island	Denton et al. 1977
1973	27 May	3 seen	Jekyll Island	Teulings 1973c
1973	10 Jun.	1 (?)	Little Cumberland Island	Denton et al. 1977

Florida - Atlantic Coast Knowledge of offshore occurrence of pelagic seabirds off the east coast of Florida has increased considerably during the last decade because there has been a considerable increase in offshore observation. Known from only three well-documented records through 1954 (Sprunt 1954), Greater Shearwaters have now been recorded at least 27 times (see below) on or off the Atlantic coast, in all months except March and April, when the species is generally least abundant in the southeast. Kale (1979 ms a) now considers them relatively uncommon rather than rare. Kale also suggests that peak numbers usually occur in fall, but examination of the data below suggests that this conclusion may be premature.

1913	Dec.	1 found, coll. (FSM 14230)	10 mi N West Palm Beach	Howell 1932

1947	20 Sep.	2 found dead after storm	beach near Jupiter Inlet	Sprunt 1954
1959	7 Feb.	1(?) seen	off Miami Beach	Stevenson 1959a
1962	19 Jun.	1 coll. (FSU)	off Hillsborough Inlet	Robertson 1962
1963	10 Sep.	1 seen	off Miami	Cunningham 1964a
1965	14 Aug.	1 seen	25 mi ENE St. Augustine	Stevenson 1965b
1967	30 Aug.-15 Sep.	several seen	moving south E of Cocoa	Robertson and Ogden 1968
1968	12 Oct.	1 found dying	beach, Anastasia St. Park, St. Johns Co.	Robertson and Ogden 1969
1969	late May-Jun.	several found dead or dying	near Fort Pierce	Ogden 1969
1971	14 Aug.	9 seen	off Cocoa	Ogden 1971
1971	2 Nov.	2 seen	off Cocoa Beach	Robertson 1972
1972	22 Jan.	1 seen	off Jacksonville	Stevenson 1972
1972	17 Jun.	2 found dead, coll. (USF)	Cocoa Beach	Ogden 1972
1972	17 Jun.	1 found dead, coll. (FTU)	Satellite Beach	Ogden 1972
1972	13 Aug.	2 seen	off Mayport	Ogden 1972
1973	21 May	1 seen	20 mi E Cape Canaveral	Kale 1973
1973	10 Jun.	1 seen	from shore, 2 mi S Melbourne Beach	Ogden 1973
1973	7 Nov.	8 seen	off Canaveral	Edscorn 1974
1974	1 Jul.	11 seen	ca. 20 mi offshore Cocoa	Ogden 1974
1974	10 Dec.	1 found dead, coll. (USF)	Indiatlantic beach	Stevenson 1975
1975	1 Jul.	200 seen	off Cape Canaveral	Ogden 1975
1975	early Jul.	ca. 100 found dead or dying	beaches, S. Brevard Co.	Ogden 1975

1975	27 Oct.	24 seen	off Canaveral	Edscorn 1976
1976	23 May	8 seen	50 mi off Cape Canaveral	Kale 1976
1977	19 Oct.	11 seen	off Canaveral	Edscorn 1978
1978	28 May-24 Jun.	7 found dead or dying	beaches between Nassau Sound and Stuart	Ogden 1978
1978	28 May-24 Jun.	1 found, coll. (FSM)	Vero Beach	Ogden 1978

Florida - Keys We have one record from the Keys:

1975	19 Aug.	1 seen	over Florida Bay	Edscorn 1976

Florida - Gulf Coast Pelagic observations off the Gulf Coast of Florida are considerably more recent than those off the Atlantic coast and have been made less frequently. Consequently, only the most limited comparisons may be made between the two areas. Until very recently Greater Shearwaters were virtually unknown from the Gulf of Mexico, but observations now available indicate that this species is at least of regular occurrence there. We now have about 15 records for Greater Shearwaters from the Florida Gulf Coast (below). They have been recorded there from 6 April through 10 October, with an exceptional record on 29 January (of a bird found dead). Records from summer and fall predominate, and the distribution of records seems somewhat later than on the Atlantic coast (Table 20). This later distribution may be the result of a bias in the observations, however, and we believe it would be unwise to speculate on the validity of this possible difference without further information.

1950	29 Jan.	1 found dead, coll. (FSU)	Dog Island, St. Marks NWR, Franklin Co.	Sprunt 1954, Palmer 1962
1958	10 May	1 seen (1)	ca. 20 mi E Dry Tortugas	Palmer 1962
1963	6 Apr.	1 seen	off Alligator Point, Franklin Co.	Stevenson 1963c
1970	7 May	2 seen	off Santa Rosa Island	Imhof 1970
1970	21, 23 May	3 seen	1.5 mi off Panama City	Imhof 1970
1972	16 Jul.	1 seen	off Horseshoe Beach, Dixie Co.	Ogden 1972

(1) This may be the same bird reported seen 11 May by Stevenson (1958c).

1973	3 Aug.	8 seen	1 mi off St. Marks Light	Edscorn 1974
1975	12 Sep.	ca. 10 seen	off Panama City	Purrington 1976
1976	15 Jul.	1 found, coll. (USF)	Ozona	Edscorn 1977
1976	25 Sep.	5 seen	35 mi off Clearwater	Buhrman and Hopkins 1978
1977	17 Jul.	1 seen	off mouth of Pensacola Bay	Jackson and Cooley 1978b
1977	16 Sep.	1 seen	off Sarasota	Edscorn 1978
1977	17 Sep.	2 seen	19 mi off Clearwater	Buhrman and Hopkins 1978
1977	10 Oct.	4 seen	36-49 mi off Clearwater	Buhrman and Hopkins 1978
1978	6 Aug.	1 seen	off Clearwater	Edscorn 1979

Alabama Although Imhof (1976b) considered this species a rare summer visitor off the Alabama coast, enough have been seen offshore recently that Duncan and Havard (1979 ms) now consider it regular in the eastern Gulf of Mexico. All but 1 of the 15 records known to us have been made between 4 July and 29 September.

1958	1 Aug.	1 caught, coll. (U. Ala.)	came aboard pilot boat 7 mi S entrance Mobile Bay (seen nearby all through July)	Newman 1959, Imhof 1976b
1966	29 Sep.	1 found moribund	Dauphin Island	Imhof 1976b
1973	25 Jul.	8 photogr.	5-8 mi off Dauphin Island	Kennedy 1973
1973	11 Aug.	1 seen	5-8 mi off Dauphin Island	Kennedy 1973
1973	14 Aug.	16 seen	9 mi S Dauphin Island	Imhof 1976b
1973	10 Sep.	5 seen	off Dauphin Island	Imhof 1976b
1974	4 Jul.	1 seen	5 mi S Fort Morgan	Imhof 1976b
1977	26 Jul.	1 seen	offshore in Gulf	C. Duncan, pers. comm.

1977	27 Jul.	1 seen	offshore in Gulf	C. Duncan, pers. comm.
1977	29 Jul.	3 seen	offshore in Gulf	C. Duncan, pers. comm.
1977	6 Aug.	6 seen	offshore in Gulf	C. Duncan, pers. comm.
1977	7 Sep.	2 seen	offshore in Gulf	C. Duncan, pers. comm.
1977	6 Dec.	2 seen	offshore in Gulf	C. Duncan, pers. comm.
1978	25 Jul.	1 seen	offshore in Gulf	C. Duncan, pers. comm.
1978	24 Aug.	2 seen	offshore in Gulf	C. Duncan, pers. comm.

Louisiana We have found considerably fewer records for Greater Shearwaters in Louisiana offshore waters than in Alabama, but this may reflect nothing more than a difference in the amount of offshore observation in the two states. Four of the five records fall in the same period (July-September) within which the species has been recorded off Alabama.

1964	16 Jul.	2 seen	Chandeleur Sound, ca. mi W North Island	Lowery 1974
1970	4 Sep.	2 seen	ca. 35 mi off South Pass	Lowery 1974
1970	5 Sep.	1 seen	ca. 35 mi off South Pass	Lowery 1974
1971	11 Aug.	1 seen	ca. 35 mi off South Pass	Lowery 1974
1972	3 May	1 seen	ca. 20 mi off South Pass	Lowery 1974

Texas We have found only two records of the Greater Shearwater for Texas. We do not know whether this indicates a lower abundance in waters offshore that state or simply a lack of observation.

1973	4 Nov.	1 moribund bird coll. (Texas A&M)	near south jetty Galveston Beach	Arnold 1975
1975	18 Aug.	1 seen	ca. 40 mi off Port Aransas	Webster 1976a

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Greater Shearwaters breed primarily on three small islands in the South Atlantic between 37° and 40° S latitude (Stresemann and Stresemann 1970) where they nest in dense colonies. The breeding population of Nightingale Island has been estimated at 2 million pairs (Rowan 1952), and at least 150,000 pairs (Elliott *in* Rowan 1952) and 600,000 (Elliott 1971) pairs have been thought to breed on Inaccessible and Gough islands, respectively.

Winter Greater Shearwaters winter (during the northern summer) in the North Atlantic largely north of 45° N latitude.

Migration Primary periods of transequatorial migration are May-June and August-October (Blake 1977). Greater Shearwaters are most abundant off the Atlantic coast during the spring migration, whereas the peak of occurrence in the Gulf of Mexico is apparently several months later (Table 20). These shearwaters are evidently considerably less common in the gulf, and the birds there may mainly be individuals that were diverted from their normal migration routes.

HABITAT

Nesting Greater Shearwaters breed colonially, most digging burrows about 3 feet long (Rowan 1952). On Nightingale Island, where immense numbers breed, Hagen (1952) reported that huge areas were completely undermined by petrel burrows and that burrows were found over the entire island from shore cliffs to the peak. Rowan (1952) added that burrows could be found in nearly all habitats, in meadows, woods, and tussock slopes, but remarked that nests were most numerous in open tussock grassland and least numerous in woodland. She noted that the only areas not densely populated were those too wet to support excavation, the rocky foreshore and low seaward cliffs, and the penguin rookeries.

On Inaccessible Island, where there is a much smaller breeding population, burrows were still widely distributed and were found close to the beach, on slopes to about 400 m elevation, and to some degree on the lower parts of the high plateau. Although the species predominantly digs burrows, other nests were found in cavities and crevices in lava rocks, in a niche in the wall of a deep cave, and in a large chamber under a tussock root.

Feeding These shearwaters feed out in the open ocean during both breeding and nonbreeding periods.

Nonbreeding and Offshore Greater Shearwaters migrate north and south rapidly. They spend little time in tropical and subtropical waters, and instead move directly to the cool to fairly cold pelagic waters they prefer. They are found at moderate distances offshore, usually avoiding both mid-ocean and inshore areas (Cramp et al. 1977). Greater Shearwaters are occasionally seen on passage in large numbers close inshore (Buckley 1973).

During migration these birds are often found in large flocks which readily alight on the water to feed and rest (Cramp et al. 1977), but are generally

less frequent inshore than are Cory's Shearwaters (Lee and Booth 1979). Greater Shearwaters tend to prefer cooler waters than Cory's Shearwater (Watson 1966).

FOOD AND FEEDING BEHAVIOR

The food of the Greater Shearwater consists primarily of fish and squid, and (apparently) to a lesser extent, crustaceans. Like Cory's Shearwater, this species will come to fishing vessels to scavenge offal.

There are a few reports of food habits based on the examination of stomach contents, two from the breeding grounds near Tristan da Cunha, the other from wintering birds on the Newfoundland Grand Banks. In the former area Hagen (1952) examined the contents of 10 stomachs, 3 from adults and 7 from immatures. Seven contained soft marine organisms, 5 had cephalopod beaks, and 1 held the remains of a small fish. The only material more specifically identified was a few amphipods (Themisto gaudichaudi) and a decapod thought to be a young Palinurus. Rowan (1952) found that the stomach contents of 20 chicks were largely the remains of squid, but crustaceans were found occasionally. On the Grand Banks, Rees (1961) examined the stomach contents of 38 shearwaters. These birds had been captured on trailing hooks 26 June 1961 as they scavenged near fishing vessels. The only food found that the shearwaters evidently had caught for themselves was squid, and all that could be identified were Illex illecebrosus, the most common species in the area. Food scavenged from near the fishing vessels consisted of fish livers and stomach contents. Capelin (Mallotus villosus) and euphausiids (Thysanoessa inermis) were identified from the stomach contents. On other occasions these shearwaters have been seen diving for cod (Gadus callarias) and haddock (Oadus aeglefinus) refuse as well as for dead capelin (Baganel 1951).

As a result of recent studies conducted off Nova Scotia, Brown et al. (1981) concluded that Great Shearwaters were opportunistic feeders that choose food items varying in size from euphausiids to smaller fish and squid and that feed on those foods that are found in local concentrations. In 1974 the principal food of Great Shearwaters off Brier Island was a euphausiid (Meganyctiphanes norvegica). During the following year, when Meganyctiphanes was not abundant, the principal food was squid. Squid eaten were from several different families. The only one identified to species was Illex illecebrosus (Ommastrephidae).

Great Shearwaters, like Sooty Shearwaters, will plunge for food either from the surface or from the air, but may do so somewhat less and may have a tendency toward more shallow dives (Brown et al. 1978). Brown et al. also report "belly-flop" plunging by these shearwaters in which flying birds dive to the surface, strike it with breast and feet, and immediately lower the head and dive. Brown et al. (1981) noted that Greater Shearwaters diving off Brier Island, Nova Scotia, never submerged for over 12 sec.

These shearwaters readily flock in areas where food is abundant around the breeding grounds and on migration. During migration in northern waters such flocks are particularly common when the birds arrive and just before they depart (Palmer 1962).

Cramp et al. (1977) noted that Greaters Shearwaters typically feed by day, but they evidently feed nocturnally as well (Watson 1966).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Quantitative data on egg laying do not exist, but a considerable amount of anecdotal data indicate that Greater Shearwaters on Nightingale Island have a strongly synchronized, brief laying period early in November (Rowan 1952). An informant told Rowan that laying seldom began before 9 November, but occasionally started as late as 12 or 13 November.

Mean Clutch Size Greater Shearwaters lay only one egg.

Incubation Period According to Elliott (1957), the incubation period is apparently 55 ± 2 days. He based his remark on an assumed average laying date of 11 November, and on his observation that no eggs examined on 3 January had hatched, but that all had hatched or were hatching on the following day. Rowan's (1952) comment, based on the same data, that the incubation period is 7 to 8 weeks, is perhaps more useful.

Hatching Success Unknown.

Fledging Success Unknown.

Age at Fledging Recent sources (Palmer 1962, Watson 1975) indicate the age at fledging at about 105 days. This is apparently based on Elliott's (1957) estimate of a fledging period of 105 ± 10 days. It seems clear from examining Elliott's account that he based his figure on an average hatching date of 4 January and an "average date of departure...about the 20th" of May. The latter date is, however, the 140th day of the year, which would indicate a fledging period of about 136 days, not 105. This figure may be somewhat too large, because some of Rowan's (1952) observations suggest birds may fledge well before 20 May. This is consistent with Elliott's (1971) comment that he would add another 2 weeks (= ca. 119 days total) for young fledging at Gough Island.

Age at First Breeding Unknown.

Mortality of Eggs and Young The inhabitants of Tristan da Cunha regularly harvested eggs, young, and adults for food and fat, according to Hagen (1952) who estimated that about 30,000 eggs were collected yearly around 1938. Skuas are important predators of young birds when they begin to fledge (Rowan 1952) and on Gough Island have been thought to take as many as 5% of the fledging chicks (Elliott 1971). Elliott (1971) suggested that mortality of young within the burrows (to unknown causes) might be as much as 6% or more.

Renesting Data are not available on renesting.

Maximum Natural Longevity The oldest Greater Shearwater marked by Old World banding organizations is a bird recovered at an estimated minimum age of 5 years, 11 months (Rydzewski 1978). The oldest banded under the United

States banding program is a bird with an estimated minimum age of 5 years, 2 months (Clapp et al. 1979 ms). Judging from ages known to have been reached by other procellariids, both these life spans are considerably less than the maximum that may be expected for the Greater Shearwater.

Weight (in grams) Hagen (1952) reported the weights of 14 adults collected on the breeding grounds from 17 December to 1 March. Five males averaged 870 (range = 850-912), three females averaged 875 (range = 834-950), and six unsexed birds averaged 784 (range = 715-830). Fifty Great Shearwaters collected off Brier Island, Nova Scotia in late summer 1974 averaged 833 g (s.d. = 77.6); 8 collected there in August 1975 averaged 946 g (s.d. = 68.9) (Brown et al. 1981). The maximum weight recorded for a chick at Gough Island (n = 523) was 1,300 (Elliott 1971), and that of an emaciated immature from Surinam was 390 (Mees 1976).

SUSCEPTIBILITY TO OIL POLLUTION

We are not aware of any reports of oiling for this species and we cannot adequately estimate the effect of development of oil resources on this species. Along the Atlantic coast Greater Shearwaters may be enormously abundant for short periods, and it seems likely that a fairly large proportion of the species population migrates through this area. The species also feeds gregariously and dives for its food, suggesting that it might be quite vulnerable to offshore spills during spring and summer.

BIBLIOGRAPHY

1981

Brown, R. G. B., S. P. Barker, D. E. Gaskin and M. R. Sandeman. 1981. The foods of Great and Sooty shearwaters *Puffinus gravis* and *P. griseus* in eastern Canadian waters. Ibis 123: 19-30.

1980

Ash, J. J. and G. E. Watson. 1980. Greater Shearwater *Puffinus gravis* new to Mexico. Bull. Br. Ornithol. Club 100: 194-195.

1979

Bourgeois, C. E. and W. Threlfall. 1979. Parasites of the Greater Shearwater (*Puffinus gravis*) from Newfoundland, Canada. Can. J. Zool. 57: 1355-1357.

Carr, G. S. 1979. Greater Shearwater in Costa Rica. Condor 81: 323.

Powers, K. D. and J. A. Van Os. 1979. A concentration of Greater Shearwaters in the western North Atlantic. Am. Birds 33: 253

1978

Brown, R. G. B., W. R. P. Bourne and T. R. Wahl. 1978. Diving by shearwaters. Condor 80: 123-125.

Gaskin, D. E., M. Holdrinet and R. Frank. 1978. Organochlorine residues in shearwaters from the approaches to the Bay of Fundy, Canada. Arch. Environ. Contam. Toxicol. 7: 505-513.

1977

Imhof, T. A. 1977. The Greater Shearwater in the northern Gulf of Mexico. Auk 94: 163-164.

1976

Anon. 1976. Great and Cory's shearwaters. Sea Swallow 25: 47.

Anon. 1976. Greater Shearwater. High Peaks Audubon Newsl. 4: 50.

Barker, S. P. 1976. Comparative feeding ecology of Puffinus (Order Procellariiformes) in the Bay of Fundy. M. S. thesis, Univ. Guelph/Ontario, Canada.

Mees, G. F. 1976. Mass mortality of Puffinus gravis (O'Reilly) on the coast of Surinam (Aves, Procellariidae). Zool. Meded. R. Mus. Nat. Hist. Leiden 49: 269-271.

Peterson, J. M. C. 1976. Greater Shearwater flies up Hudson River to Lake Champlain [New York]. Kingbird 26: 148-149.

1975

Arnold, K. A. 1975. First record of the Greater Shearwater from the Gulf of Mexico. Auk 92: 394-395.

1974

Collins, C. T. and E. S. Tikasingh. 1974. Status of the Great Shearwater in Trinidad, West Indies. Bull. Br. Ornithol. Club 94: 96-99.

1973

Bourne, W. R. P. 1973. Influx of Great Shearwaters in autumn 1973. Brit. Birds 66: 540.

Grafe, F. 1973. Verbreitung des Grosser Sturmtauchers Puffinus gravis vor der SE-Kuste Gronlands im August 1966. Vogelwelt 94: 175-182. [In German with English summary.]

McCrimmon, D. A., Jr. 1973. Leach's Storm Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47-48.

1972

Grubb, T. C., Jr. 1972. Smell and foraging in shearwaters and petrels. Nature 237: 404-405.

1971

Elliott, C. C. H. 1971. Ecological considerations and the possible significance of weight variations in the chicks of the Great Shearwater on Gough Island. Ostrich Suppl. 8: 385-396.

Watson, G. E. 1971. Molting Greater Shearwaters (Puffinus gravis) off Tierra del Fuego. Auk 88: 440-442.

1970

Bourne, W. R. P. 1970. Movements of Great Shearwaters and Wilson's Petrels in the western North Atlantic from the records of Radio Officer Lars-Erik Lofgren. Sea Swallow 20 [1968]: 40.

Haverschmidt, F. 1970. Zum zug von Puffinus gravis im nordlichen Atlantik. J. Ornithol. 112: 459-460. [In German.]

Stresemann, E. and V. Stresemann. 1970. Uber Mauser und Zug von Puffinus gravis. J. Ornithol. 111: 378-393. [In German with English summary.]

Voous, K. H. 1970. Moulting Greater Shearwater (Puffinus gravis) in Bay of Biscay. Ardea 58: 265-266.

Watson, G. E. 1970. A shearwater mortality on the Atlantic coast. Atl. Nat. 25: 75-80.

Woods, R. W. 1970. Greater [illegible] ater Puffinus gravis breeding in the Falkland Islands. Ibis 112 [illegible] 60.

1969

Anon. 1969. Shearwaters killed along coast. Raven 40: 82-83.

Bridge, D., M. S. Hundt, W. T. Van Velzen and A. C. Van Velzen. 1969. The Greater Shearwater in Maryland. Md. Birdlife 25: 111-115.

Gobeil, R. E. 1969. Arteries in the heart region of the Greater Shearwater. Auk 86: 343-345.

Collins, C. T. 1969. A review of the shearwater records for Trinidad and Tobago, West Indies. Ibis 111: 251-253.

1968

Jenkins, J. 1968. Does the Greater Shearwater reach the southwest Pacific? Notornis 15: 214-215.

Newell, R. G. 1968. Influx of Greater Shearwaters in autumn 1965. Brit. Birds 61: 145-159.

1967

Newell, R. G. and R. N. Rankin. 1967. The 1965 invasion of Great Shearwaters as observed at Cape Clear Island. Cape Clear Bird Observ. Rept. 7: 39-41.

Reinsch, H. H. 1967. Zum Vorkommen des Kappensturmtauchers, Puffinus gravis, im Bereich des Nordatlantik. Beitr. Vogelkd. 13: 191-197. [In German.]

1966

Dennis, R. H. 1966. Great and Cory's Shearwaters at Fair Isle. Scott. Birds 4: 218-222.

Flynn, J. E. 1966. Great Shearwaters in Cape Clear waters. Cape Clear Bird Observ. Bull. 16: 11-13.

Metcalf, W. G. 1966. Observations of migrating Greater Shearwaters Puffinus gravis off the Brazilian Coast. Ibis 108: 138-140.

1965

Brown, R. G. B. and D. E. Baird. 1965. Social factors as possible regulators of Puffinus gravis numbers. Ibis 107: 249-251.

Holmes, R. P., III. 1965. Shearwaters and petrels off of Morehead City, North Carolina. Chat 29: 106.

1964

Hawkins, R. S. 1964. Northward passage of Great Shearwaters in the North Atlantic in May, 1963. Sea Swallow 16: 64-65.

1963

Kale, H. W., II. 1963. Occurrence of the Greater Shearwater along the southern Atlantic and Gulf coasts of the U.S. Oriole 18: 1-4.

Voous, K. H. and J. Wattel. 1963. Distribution and migration of the Greater Shearwater. Ardea 51: 143-157.

1962

Kale, H. W., II 1962. Greater Shearwaters washed ashore on Sapelo Island, Georgia. Oriole 27: 53-54.

Parkes, K. C. 1962. A record of the Greater Shearwater in 1960 at Hatteras. Chat 26: 18.

1961

Rees, E. I. S. 1961. Notes on the food of the Greater Shearwater. Sea Swallow 14: 54-55.

1960

Bergstrom, U. 1960. First record for Sweden of the Great Shearwater (*Puffinus gravis* O'Reilly). Var Fagelvarld 19: 30-35. [In Swedish with English summary.]

1959

Tomkins, I. R. 1959. A specimen of the Greater Shearwater from South Carolina. Chat 23: 19.

1958

Smith, N. G. 1958. Common Tern attacking Greater Shearwater. Proc. Linn. Soc. N.Y. 66-70: 89-90.

1953

Elliott, H. F. I. 1953. Field identification of the Great Shearwater. Brit. Birds 46: 312.

1952

Nicholson, E. M. 1952. Shearwaters in the English Channel. Brit. Birds 45: 41-55.

Rowan, M. K. 1952. The Greater Shearwater *Puffinus gravis* at its breeding grounds. Ibis 94: 97-121.

1949

Gullick, T. M. 1949. Great Shearwaters in Skagerak in early June. Brit. Birds 42: 250.

1948

Broekhuysen, G. J. 1948. Observations on the Great Shearwater in the breeding season. Brit. Birds 41: 338-341.

1946

Alexander, H. G. 1946. Great Shearwaters in the English Channel. Brit. Birds 39: 55-56.

Williamson, K. 1946. Great and Sooty shearwaters north of Orkney. North West. Nat. 21: 247.

1940

Alexander, H. G. 1940. Great Shearwaters in the English Channel. Brit. Birds 33: 284.

Witherby, H. G. 1940. The species of Great Shearwaters in the English Channel. Brit. Birds 33: 248-249.

1939

Joy, N. H. 1939. Great Shearwater in Kent. Brit. Birds 32: 276.

1937

MacFarlane, D. and A. MacRae. 1937. Great and Sooty Shearwaters off the Hebrides. Brit. Birds 30: 324.

1936

Allen, F. N. 1936. Shearwaters and ships. Auk 53: 320-321.

1934

Bartsch, P. 1934. *Puffinus gravis* in Virginia. Auk 51: 507.

1911

Hoxie, W. J. 1911. The Greater Shearwater on the coast of Georgia. Auk 28: 481-482.

1860

Andrews, W. 1860. Notes on the birds of the south-west coast, and on the occurrence of the Greater Shearwater (*Puffinus major*). Proc. Nat. Hist. Soc. Dublin 1: 80-85.

SOOTY SHEARWATER

(*Puffinus griseus*)

[DA: Sodfarvet Skrape, DU: Grauwe Pijlstormvogel, FI: Harmaaliira, FR: Puffin fuligineux, GE: Dunkler Sturmtaucher, IC: Graskrofa, IT: Berta grigia, JA: Hai-iro mizunagadori, NW: Gralire, PR: Pardela-preta, RU: (Gray Shearwater), SP: Fardela gris, Pardela sombria; SW: Gra lira]

GENERAL DISTRIBUTION

North America Sooty Shearwaters occur in North America as offshore migrants that winter (May-August) in the temperate waters of the North Atlantic and North Pacific oceans (Cramp et al. 1977). Birds are occasionally blown inland by storms, but the great majority are found and remain in offshore pelagic waters. On the Pacific side of the continent they range north to Alaska and the Aleutian Islands; on the Atlantic side they have been recorded north to northern Labrador, Greenland, and Iceland. This species is frequently seen and is abundant in migration along the Pacific coast, but has been recorded much less frequently from the Atlantic coast or the east coast of Central America (Blake 1977, Jouanin and Mougin 1979).

World Distribution Sooty Shearwaters breed on islands and exposed headlands in subantarctic waters (Watson 1975), where breeding populations are primarily found in two areas. One is the southwest Pacific, where the birds are immensely abundant and breed in southeastern Australia and New Zealand. In Australia they breed on islands off New South Wales and Tasmania as well as on Macquarie Island, the southernmost known breeding station (Watson 1975). In New Zealand, their breeding stations include the Campbell, Auckland, Antipode, Chatham, and Snares islands (Serventy et al. 1971).

The other breeding area is off southern South America where these shearwaters breed abundantly in the Cape Horn Archipelago, on Staten Island off Argentina, and in the Falkland Islands (Blake 1977).

Outside the breeding season (i.e., during summer in the Northern Hemisphere), Sooty Shearwaters move north in both the Atlantic and Pacific oceans, but are far more abundant in the the latter. Their movements are not well understood, but are apparently clockwise in both oceans following prevailing winds (Cramp et al. 1977), and there is also a regular migration through the Central Pacific (Jouanin and Mougin 1979). Birds from Australia and New Zealand may reach the Pacific coast of North America, as shown by recoveries of banded birds north of the Coronado Islands, Mexico (Richdale 1957 *in* Palmer 1962), and off California (Warham 1964). Most birds from the Cape Horn Archipelago are thought to migrate north along the Pacific coast of South America, but those from the Falkland Islands are thought to be the source of most of the birds wintering in the North Atlantic (Cramp et al. 1977).

Taxonomic note: Also appears in recent literature as *Procellaria grisea*.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Although its status was formerly poorly known, the Sooty Shearwater has now been recorded more frequently in North Carolina waters than anywhere else in the southeastern United States. It is now known to be an abundant spring migrant offshore, with peak numbers present in late May and early June (Lee and Booth 1979). There are a few records from late summer and fall, and one winter and one early spring record as well.

1870	21 May	1 male coll. (USNM 61126)	near Fort Macon	Pearson et al. 1942
1892	8 Jun.	1 shot, coll.	near Fort Macon	Pearson et al. 1942
1897	summer	2 shot, coll. (NCSM)	near Cape Lookout	Pearson et al. 1942
1917	29 May	1 coll. (USNM 413624)	Portsmouth	this paper
1924	26 May	2 found alive after storm	Cape Lookout beach	Coles 1925
1930	3 Jun.	1 found dead, 1 seen	ca. 1 mi S Shackleford Banks	Gutsell 1931
1932	28 May	1 male found injured, (USNM 339050)	Atlantic Beach	Pearson et al. 1942
1935	8 Jun.	1 seen	near Brown's Inlet, Onslow Co.	Pearson et al. 1942
1936	22 May	1 coll. (NCSM)	New River Inlet	Pearson et al. 1942
1939	Aug.	1 found	Twin Oaks, 300 mi inland	Ball 1948
1940	15 Sep.	1 seen	Ocrocoke Inlet, Hyde Co.	Pearson et al. 1942
1947	31 May	1(?) seen	Wrightsville Beach	Wray and Davis 1959
1947	4 Jun.	1(?) seen	Baldhead Island	Wray and Davis 1959
1947	10 Jun.	1 seen	off Baldhead Island	McCulloch 1948
1965	6 Jun.	1 seen	on beach, Bogue Banks	Holmes 1965a

1965	17 Jun.	"common"	off Cape Lookout	Parnell 1965c
1967	28 May	1 seen	near Morehead City	Williams and Williams 1968
1967	11 Jun.	several seen	between Cape Lookout and Morehead City	Williams and Williams 1968
1969	17 May	2 seen	off Cape Lookout	Parnell 1969a
1969	26,27 May	1 seen	off Cape Hatteras	Parnell 1969a
1970	16 May	4 seen	Pea Island	Teulings 1970a
1970	30 May	10 seen	off Hatteras Inlet	Buckley 1973
1970	31 May	1800+ seen	off Hatteras Inlet	Buckley 1973
1970	1 Jun.	700+ seen	off Hatteras Village	Buckley 1973
1970	2 Jun.	100± seen	off Hatteras Village	Buckley 1973
1971	22 May	3 seen	just off Pea Island	Teulings 1971c
1971	23-25 Oct.	3 seen	near Kill Devil Hills	Teulings 1972e
1972	8 Jan	1 seen	Pea Island	Teulings 1972b
1972	27 May	ca. 8,000 seen	moving north at Bodie	Teulings 1972c
1972	13 May-4 Jun.	"seen singly or in small numbers"	off Cape Hatteras, Cape Lookout, Atlantic Beach, Carolina Beach	Teulings 1972c
1972	15 Jun.	1 seen	off Cape Lookout lighthouse	Teulings 1972e
1973	11 Mar.	1 seen	Pea Island	Teulings 1973b
1973	19 May	6 seen	off Hatteras	Teulings 1973c
1973	26 May	12 seen	off Morehead City	Teulings 1973c
1973	3 Jun.	2 seen	off Morehead City	Teulings 1973c
1974	21 May	ca. 50 seen	moving north offshore, Hatteras Island	Teulings 1974c
1974	28 Oct.	1 seen	from Cape Point, Hatteras Island	Teulings 1975a
1974	13 Sep.	2 seen	off Morehead City	Teulings 1975a

1975	11 Jun.	1 seen	off Hatteras Island	Lynch and Marsh 1977
1975	21 Jun.	1 found alive	Cape Lookout	Teulings 1975d
1976	5 Jun.	100+ seen	Bodie Island	LeGrand 1976
1976	23 Jun.	2 seen	4 mi off Cape Hatteras	LeGrand 1977c
1977	Jun.	3-4 seen	off Oregon Inlet (peak count)	LeGrand 1977b
1977	6 Aug.	1 seen	27 mi E Oregon Inlet	Lee and Booth 1979
1978	21 May	55 seen	Cape Point, Hatteras Island	Teulings 1978a

South Carolina We have found only nine records for the Sooty Shearwater from South Carolina, about a fifth as many as from North Carolina. Presumably, as in North Carolina, these shearwaters are abundant migrants offshore during May and June, but more pelagic observations are clearly needed.

1915	7 Jun.	1 female coll. (USNM 258855)	Bird Island, Bull's Bay	this paper
1916	May	1 found dead	Bull's Island beach	Sprunt and Chamberlain 1949
1946	10 May	1 seen	off Cape Island	Sprunt and Chamberlain 1949
1950	29 May	1 found dead (CM 150.80)	6 mi S Windy Hill Beach, Horry Co.	Burton 1970
1964	30 May	1 seen	40 mi SE Murrell's Inlet sea buoy	Chamberlain 1964
1969	mid-Jun.	1 found, caught after storm	Pawley's Island	Probst 1972
1972	13 May-4 Jun.	"seen singly or in small numbers"	off Charleston	Teulings 1972c
1972	10 Nov.	3 seen	off Charleston	Teulings 1973a
1975	3 Jul.	to 10 seen	off Charleston	Teulings 1975d

Georgia Denton et al. (1977) regarded the Sooty Shearwater as accidental in Georgia on the basis of a single female collected in McIntosh County (GOS 1977). It is surprising that there are so few records considering how frequently the species has been recorded both to the north and south. The status of

the Sooty Shearwater in Georgia waters perhaps should best be regarded as unknown.

1970	31 May	1 coll.	Altamaha Sound, 5 mi ESE Darien	GOS 1977

Florida - Atlantic Coast Kale (1979 ms a) considers the Sooty Shearwater a relatively rare bird off the Florida Atlantic coast. Of the 30 records we have found, more than a third are in May and June, and suggest peak occurrence then. Whether the species is actually less numerous off the Florida Atlantic coast than off North Carolina cannot be adequately determined from the data available to us.

1899	5 Jun.	1 spec. (AMNH)	New Smyrna	Howell 1932
1930	5 Jun.	1 found dead	Daytona Beach	Longstreet 1930
1933	17 Sep.	1 seen	Mosquito Inlet	Longstreet 1953-55
1942	10 May	1 seen	outside Matanzas Inlet	Sprunt 1954
1944	24 Sep.	1 seen	Mosquito Inlet	Longstreet 1953-55
1952	25 Nov.	12 seen	ca. 10 mi E Miami	Castenholz 1954
1952	4 Dec.	2 seen	10-25 mi E Miami	Castenholz 1954
1956	24 Oct.	(1?) seen	15 mi off Canaveral	Stevenson 1956a
1959	7 Feb.	(1?) seen	off Miami Beach	Stevenson 1959a
1960	9 Sep.	3 seen	Port Everglades Inlet, Broward Co.	Robertson and Paulson 1961
1966	16 Aug.	1 seen	20 mi off Melbourne	Stevenson 1967a
1967	28 May	1 seen	off Jacksonville Beach	Stevenson 1967b
1967	3 Nov.	2 seen	14 mi off Fort Lauderdale	Robertson and Ogden 1968
1969	30 May	1 found, coll. (USF)	Vero Beach	Pantelidis and Stevenson 1969
1971	14 Aug.	1 seen	off Cocoa	Ogden 1971
1972	13 May	1 seen	off Port Canaveral	Kale 1972
1972	28 May	1 found dead	Palm Beach	Ogden 1972

1972	23 Jul.	1 seen	off Cocoa	Ogden 1972
1972	13 Aug.	3 seen	off Mayport	Ogden 1972
1973	20 May	1 seen	27 mi E Mayport	Kale 1973
1974	20 May	1 seen	E of Cape Canaveral	Kale 1974
1974	18 Sep.	1 seen	off Canaveral?	Edscorn 1975
1974	15 Nov.	2 seen	off Canaveral?	Edscorn 1975
1975	1 Jul.	1 seen	off Cape Canaveral	Ogden 1975
1975	9 Aug.	2 seen	off Canaveral	Edscorn 1976
1975	7 Sep.	2 seen	off Mayport	Edscorn 1976
1975	27 Oct.	2 seen	off Canaveral	Edscorn 1976
1977	5 Jun.	1 seen	off Cape Canaveral	Ogden 1977
1977	12 Jun.	1 seen	off Cape Canaveral	Ogden 1977
1978	27 May	2 seen	10 mi E Ponce de Leon Inlet	Kale 1978

Florida - Keys We have four records from the Florida Keys.

1940	29 Dec.	1 seen	near Key West	Sprunt 1954
1951	30 Mar.	2 seen	between Key West and Dry Tortugas	Hundley and Hames 1960-62
1958	11 May	(1?) seen	near Key West	Stevenson 1958c
1975	21 May	1 found sick	off Windley Key	Kale 1975

Florida - Gulf Coast Kale (1979 ms b) commented that this species had been reported more frequently in the Gulf of Mexico in the past than other shearwaters, but he thought that Sooty Shearwaters was actually the least common. That assessment agrees well with our data for the Gulf Coast states in that recent observations of shearwaters are largely of other species.

1926	18 Jul.	2 seen	Pensacola	Howell 1932
1935	3 Jan.	1 decomposed bird found	near Pensacola	Sxrunt 1954
1950	8 Jan.	1 seen	near Pensacola	Sprunt 1954

1951	22 Apr.	1 seen	Pensacola	Lowery and Newman 1951b, Sprunt 1954
1951	25 May	1 found	Pavilion Key	Sprunt 1954
1953	27 Jun.	1 seen	Mullet Key	Stevenson 1953b
1953	27 Sep.	1 seen	Duck Rock	Stevenson 1954a
1973	Jul.	1 seen	off Boca Grande Pass	Kale 1979 ms b
1978	May	1 seen	in Gulf near Dry Tortugas	Kale 1979 ms b

Alabama There are only four records of Sooty Shearwaters from Alabama; three of them are very recent and full details have not yet been published. Their status off Alabama, as well as elsewhere in the Gulf of Mexico, is still not adequately known.

1898	4 May	1 found inland	after storm at Attalla	Howell 1928, Imhof 1976b
1978	23 Dec.	1 seen	from shore off Fort Morgan	Gade and Mattis 1979
1979	May	1 seen	offshore	Duncan and Havard 1979 ms
1979	Sep.	3 seen	during Hurricane Frederic	C. Duncan *in litt*.

Louisiana The Sooty Shearwater has been recorded only once from Louisiana.

1976	Aug.	4 seen	110 km offshore	Duncan and Havard 1979 ms

Texas Blacklock (1978 ms) considered the Sooty Shearwater a casual summer visitor to the Texas coast. We know of six records for the state.

1937	12-20 Jun.	1 seen	Rockport Harbor	Oberholser 1974
1947	16 Jun.	1 caught, photogr.	Rockport	Blacklock 1978 ms
1951	26 Apr.	"birds" seen	Padre Island	Oberholser 1974
1952	19 Jun.	1 found dead (Texas A&M 9081)	Port Aransas, South Pier	Oberholser 1974

1961	14 Jul.	2 seen	2 mi off Port Aransas	Blacklock 1978 ms
1976	23 Jul.	1 decomposing bird coll. (SFAU)	on beach 1.5 mi from Gilchrist, Galveston Co.	Webster 1976d

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Sooty Shearwaters breed colonially in subantarctic waters between about 40° and 55° S latitude (BOU 1971). There they nest primarily in two areas--in the Southwest Pacific and off southern South America.

Total world populations are unknown, but in some areas this species is enormously abundant. Richdale (1963) remarked that this shearwater is one of the most numerous New Zealand seabirds, and he thought that there might be as many as several million birds.

Winter Sooty Shearwaters winter in the waters of the North Pacific Ocean, with only a small proportion in the North Atlantic. Most of the Atlantic birds are thought to come from the Falkland Islands (Cramp et al. 1977).

Migration Some northward migration begins in March but most takes place in April and May. In the Atlantic, migration largely occurs along the east coasts of the Americas. These birds are mostly off New England and Newfoundland by May and June, and then spread eastward across the temperate North Atlantic. In August the birds migrate back to the nesting grounds, mainly in the eastern Atlantic but cross the ocean to migrate south along the South American coast (Cramp et al. 1977).

Sooty Shearwaters have been recorded from all the coastal southeastern United States except Mississippi. They are evidently abundant off the Atlantic coast but have been recorded much more frequently from some states than others. Most birds occur in southeastern waters during late May and early June (Tables 21, 22) as these shearwaters near the end of their northward journey. If the data we have compiled are adequately representative, almost 99% of all Sooty Shearwaters in the southeastern United States are present between 21 May and 10 June.

The status of this species in the Gulf of Mexico is poorly understood, but it seems likely that Sooty Shearwaters are more common there than was formerly thought.

HABITAT

Nesting Sooty Shearwaters nest colonially on islands and headlands in the Southern Hemisphere. Most of these colonies are near the sea (Cramp et al. 1977), but some have been found nearly 5 km inland and at elevations of 1,500 m (Murphy 1936). Serventy et al. (1971) reported that all Australian colonies were at higher elevations, often on ridges above the sea.

Table 21. Approximate number of Sooty Shearwaters recorded by month for the coastal southeastern United States (a)

State/region	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	1	-	1	-	9953	921	-	2	3	4	-	-
South Carolina	-	-	-	-	4	3	10	-	-	-	3	-
Georgia	-	-	-	-	1	-	-	-	-	-	-	-
Florida-Atlantic Coast	-	1	-	-	9	4	2	7	8	3	16	2
Subtotal-ATLANTIC COAST	1	1	1	-	9967	928	12	9	11	7	19	2
Florida-Keys	-	-	2	-	3	-	-	-	-	-	-	1
Florida-Gulf Coast	1	-	-	1	2	1	3	-	1	-	-	1
Alabama	-	-	-	-	2	-	-	-	3	-	-	1
Mississippi	-	-	-	-	-	-	-	-	-	-	-	-
Louisiana	-	-	-	-	-	-	-	4	-	-	-	-
Texas Coast	-	-	-	2	-	3	3	-	-	-	-	-
Subtotal-GULF COAST	1	-	-	3	4	4	6	4	4	-	-	2
Total-ALL AREAS	2	1	3	3	9974	932	18	13	15	7	19	5

(a) Birds found dead within the first 10 days of the month are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. If the source indicated more than one was seen (i.e., "several", "a few") but did not specify how many, we have assumed two were seen.

Burrows on Whero Island, New Zealand, were dug in soft peaty soil and varied from 1 to about 4 feet in length. Those in Australian colonies are often dug in tussock-covered hillsides and may be 3 to 9 feet deep (Richdale 1963, Serventy et al. 1971). The burrows are often in areas densely vegetated with shrubs (Murphy 1936). An apparently exceptional nest-site was a cave in the Chatham Islands where these shearwaters laid their eggs directly on the sandy floor (Archey and Lindsay 1924 in Murphy 1936).

At the Whero Island colony, burrow density was one to 1.72 square yards (Richdale 1963). Richdale knew the population size, however, and reported that each square yard held 1.1 birds, a clear indication that a sizable proportion of the burrows were not in use.

Feeding During the breeding season, at least at Whero Island, these shearwaters evidently feed far out at sea. Richdale (1944a) stated that he had only once seen Sooty Shearwaters feeding close inshore. This is corroborated by the span of days between feedings reported by Richdale (1945). For eight chicks, 52% of 56 feedings occurred at intervals of 3 to 10 days.

Nonbreeding and Offshore These shearwaters are transequatorial migrants

Table 22. Dates of occurrence for Sooty Shearwaters in the coastal southeastern United States.

State/region	Approximate number of occurrences	Dates of occurrence (a)
North Carolina	ca. 45	13 May - 28 October (8 January, 11 March)
South Carolina	9	10 May - 10 November
Georgia	1	31 May
Florida-Atlantic Coast	30	10 May - 25 November (7 February, 4 December)
Florida-Keys	4	11 May - 21 May (30 March, 29 December)
Florida-Gulf Coast	9	22 April - 27 September (8 January)
Alabama	4	4 May - ?? September (23 December)
Mississippi	unrecorded	
Louisiana	1	?? August
Texas	6	26 April - 23 July

(a) Exceptional occurrences are listed in parentheses. The decomposed bird found 3 January 1935 on the Florida Gulf Coast is not included.

that move rapidly from the cold waters of the Southern Hemisphere to winter in the cold temperate waters of the North Atlantic and North Pacific. Sooty Shearwaters also prefer colder waters during migration, and tend to avoid the Gulf Stream (Cramp et al. 1977). They occur widely at sea both as individuals and in flocks, some of which may be very large, and they are common near coasts (Palmer 1962, Watson 1975). Most usually occur offshore but they are occasionally encountered inshore, sometimes in surprisingly large numbers.

FOOD AND FEEDING BEHAVIOR

Little specific or quantitative information on the diet of the Sooty Shearwater is available, but it is known to feed primarily on cephalopods, fish, and crustaceans (Cramp et al. 1977). Palmer (1962) indicated that the main food in the North Atlantic is squid (*Loligo*), and noted that they also eat small fish [Capelin (*Mallotus villosus*) and sand launce (*Ammodytes*)]. They are also fond of oily livers of cod (*Gadus morhua*) and hake (*Merluccius*) (Collins 1884 *in* Cramp et al. 1977).

Ainley and Sanger (1979) briefly summarized what little is known of the diet of the Sooty Shearwater in the Pacific. Cephalopods and anchovies (*Engraulis*) have been reported as major prey in most areas, and euphausiid crustaceans have been considered important in the diet in the Aleutian Islands, British Columbia, and the Southwest Pacific. Other food sources include deca-

pod crustaceans, myctophid fish, and Ammodytes.

Sanger et al. (1978) presented some more specific information on Sooty Shearwater food habits in the northeastern Pacific. They examined the contents of 35 stomachs collected in the Kodiak Island, Alaska, area and found that fish, largely capelin and unidentified osmerids, made up 76% (by volume) of the diet. The rest of the diet consisted almost entirely of squid. Sanger et al. also reported a seasonal change in food habits. In June most of the food (55%) was squid, but by September more than 85% fish. Measurable capelin in Sooty Shearwater stomachs varied from 55 to 140 mm in length, with a mode of about 85 mm.

Brown et al. (1981) recently reported the foods eaten by Sooty Shearwaters off eastern Canada. Sooty Shearwaters, like Great Shearwaters in that area, apparently fed opportunistically on the most available prey. The diet of the two species overlapped but the Sooty Shearwaters fed to a greater extent on crustaceans. The euphausiid crustacean Meganyctiphanes norvegica was a particulary important food item. It was found in 80% of the proventiculi (n = 29) examined in 1974. Other foods eaten included a variety of squid, fish (Atlantic mackerel [Scomber scombrus], herring [Clupea harengus], and capelin [Mallotus villosus]), and fish offal. Clupea and Mallotus were apparently more important in the diet than was Scombrus.

Sooty Shearwaters feed largely by pursuit-plunging (Ainley 1977) and dive readily, either from the surface of the water or by plunge-diving from heights of 3-5 m. Observations off Nova Scotia indicated that this species dives more readily in any situation than does the Greater Shearwater (Brown et al. 1978). Anecdotal information suggests that Sooty Shearwaters may dive to as much as 5 m and may stay under for 15 seconds. A bird caught in a net set ca. 10 m below the surface suggests that even deeper dives may be made (Brown et al. 1981). Most propulsion underwater is apparently supplied by the webbed feet, but the wings may also be used for additional speed.

These shearwaters do not follow ships (Watson 1975), but will congregate and scavenge behind fishing vessels. At the edge of the Grand Banks, Newfoundland, Rees (1964) saw up to 150 behind one ship as it moved into an area where immense shoals of capelin were within 5-10 m of the surface.

These shearwaters are said to follow small whales in the Far East and feed on items in their vomit and feces (Dement'ev and Gladkov 1951b).

Martin (1942) described a feeding behavior by flocks of these birds that is strikingly similar to that known for some species of geese in terrestrial situations. Where there are large concentrations of a food resource (such as Ammodytes), the foremost of a feeding flock dive in pursuit. The following rank passes over these birds and dives, followed by succeeding ranks. When the last birds enter the water, the first to dive take flight and pass over the entire group to dive once more. Martin stated that such a feeding flock had "...the appearance of a small cloud progressing along the ocean with a peculiar rolling motion." Murphy (1936) described this feeding behavior as appearing like a flattened hoop rolling across the water.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying According to Richdale (1963), Sooty Shearwaters have a restricted laying period; almost all eggs are laid from the last 2 weeks of November through the first few days of December.

Mean Clutch Size Sooty Shearwaters lay only one egg.

Incubation Period Incubation period has not been precisely determined. Richdale (1963), who based his remarks on incomplete observations at Whero Island, New Zealand, was able to state that "...an incubation period of approximately eight weeks is indicated."

Hatching Success Adequate data are not available.

Fledging Success Adequate data are not available.

Age at Fledging Richdale (1963) reported that 53 chicks at Whero Island, New Zealand, made their final departure from their burrows at an average age of 97 days (range = 86-106). For this species, this is very closely equivalent to age at fledging.

Age at First Breeding A 9-year-old bird at Whero Island is known to have bred, but few young were banded there and breeding probably occurs at an earlier age. Richdale (1963) suggested that Sooty Shearwaters breed "...on the average in their sixth year, with a certain amount of variation....", but adequate documentation of this comment is still lacking.

Mortality of Eggs and Young The Sooty Shearwater is one of those seabird species that traditionally have been used as a major source Of food by man. Richdale (1963) could offer no precise figures, but estimated that nearly 250,000 young "mutton-birds" were taken each year in New Zealand. Wekas (*Gallirallus australis*) and rats are known to attack chicks and destroy eggs at some colonies (Serventy et al. 1971).

Renesting We have no information on whether this species renests following nest failure, but most procellariiforms do not and it seems quite unlikely that this species would do so.

Maximum Natural Longevity Rydzewski (1978) listed a bird banded as an adult that attained an estimated minimum age of 11 years, 6 months. Maximum ages reached by this species are almost certainly greater. After analyzing band recoveries at Whero Island, New Zealand, Richdale concluded that average annual mortality might be as little as 6%; if this were true, average life expectancy would be about 16 years.

Weight (in grams) We list some pertinent information on weights of Sooty Shearwaters in Table 23.

Table 23. Weights of Sooty Shearwaters (in grams).

Mean weight	Range	N	Sample and season	Area	Source
787	666-978	100	adult males and females Dec.-Jan., before hatching	Whero Island, New Zealand	Richdale 1944a
824	775-898	5	males, Apr.-May	Eastern Pacific	Clapp, in prep.
806	759-906	23	females, Apr.-May	"	"
641	549-700	3	males, May	Central Pacific	"
622	556-673	4	females, May	Central Pacific	Richdale 1944a
816	----- (a)	28	both sexes, mid-Aug.to ? early Sep.	off Brier Is., Nova Scotia	Brown et al. 1981
883	744-1,005	6	males, Oct.	Alaska	Clapp, in prep.
794	750-838	2	females, Oct.	"	"
95	-------	25	fresh eggs	Whero Island, New Zealand	Richdale 1963
60	-------	1	dry, newly hatched chick	"	"
876	565-1,425	245	chicks (b) at maximum weight (64th - 70th days)	"	"
622	460-830	58	chicks (b), just before departure from burrow	Whero Island, New Zealand	Richdale 1963
717	635-829	6	chicks known to survive, just before departure from burrow	"	"

(a) SD = 86.6
(b) These weights are for chicks that Richdale thought would survive.

SUSCEPTIBILITY TO OIL POLLUTION

The strongly gregarious nature of Sooty Shearwaters, their readiness to

sit in flocks on the surface of the water, and the frequency with which they dive when feeding all suggest that this species could be vulnerable to large pelagic oil spills. King and Sanger (1979) recently devised an Oil Vulnerability Index for marine birds in the Northeast Pacific where this species winters in very large numbers. On a scale of 1-100 they rated the Sooty Shearwater at 51, a figure they regarded as indicating a species that might be adversely but not catastrophically affected. They suggested that there would be time to develop conservation measures in the event that oil development activities became injurious to such species.

We consider that the situation with regard to the Sooty Shearwaters in southeastern waters is similar but less critical because fewer birds occur in this area, and because the period of maximal abundance is shorter.

BIBLIOGRAPHY

1981

Brown, R. G. B., S. P. Barker, D. E. Gaskin and M. R. Sandeman. 1981. The foods of Great and Sooty Shearwaters *Puffinus gravis* and *P. griseus* in eastern Canadian waters. Ibis 123: 19-30.

1980

Jones, E. 1980. A survey of burrow-nesting petrels at Macquarie Island based upon remains left by predators. Notornis 27: 11-20.

1979

Gade, S. and M. Mattis. 1979. The Audubon Christmas Bird Count 1979-1980. Fort Morgan, Alabama. Am. Birds 33: 505-506.

Guzman, J. 1979. Molt in Sooty Shearwater (*Puffinus griseus*) and Short-tailed Shearwater (*P. tenuirostris*) in the North Pacific Ocean and Bering Sea. (Abstract only). Pac. Seabird Group Bull. 6: 28.

Marsh, P. 1979. Great Skua killing Sooty Shearwater. Brit. Birds 72: 435.

Moritz, D. 1979. Dunkler Sturmtaucher (*Puffinus griseus*) bei der Forschungsplattform "Nordsee", Deutsche Bucht. Ornithol. Mitt. 31: 59. [In German.]

1978

Brown, R. G. B., W. R. P. Bourne and T. R. Wahl. 1978. Diving by shearwaters. Condor 80: 123-125.

Krasnow, L. 1978. Feeding energetics of the Sooty Shearwater, *Puffinus griseus* in Monterey Bay. (Abstract only). Pac. Seabird Group Bull. 5: 33-34.

1977

Baltz, D. M. and G. V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. Auk 94: 526-543.

Guzman, J. and M. T. Myers. 1977. Distribution of Puffinus griseus and P. tenuirostris in the Gulf of Alaska and Bering Sea. (Abstract only). Pac. Seabird Group Bull. 4: 22.

Holmes, G. 1977. The relationship of spring mortality patterns in the Short-tailed and Sooty Shearwaters. Notornis 24: 286-287.

1976

Barker, S. P. 1976. Comparative feeding ecology of Puffinus (Order Procellariformes) in the Bay of Fundy. M. S. thesis, Univ. Guelph/Ontario, Canada.

Despin, B. 1976. Observations sur le Petrel gris Procellaria cinerea. Oiseau R.F.O. 46: 432-433. [In French.]

1975

Secker, H. L. 1975. Birding for Sooty Shearwaters. RAOU Newsl. 17: 3.

1974

Barrat, A. 1974. Note sur le Petrel gris Procellaria cinerea. Recherches ecologiques et physioliques sur la fauna des T. A. A. F. C.N.F.R.A., 33: 19-24. [In French.]

Dacre, J. C. 1974. Residual organochlorine pesticides in the fat of mutton birds of New Zealand. Bull. Environ. Contam. Toxicol. 11: 517-522.

Duiven, P. 1974. Vondst van een Levende grauwe pijlstormvogel Puffinus griseus bij den Helder. Limosa 47: 144-145. [In Dutch with English summary.]

1973

Quigley, R. J. 1973. First record of Sooty Shearwater for Arizona. Auk 90: 677.

Schmidt, G. A. J. 1973. Das Problem "Irrgast" am Beispiel des Dunklen Sturmtauchers, Puffinus griseus (Gmelin, 1789). Faunistisch-okol. Mitt. 49: 355-364. [In German with English summary.]

1972

Probst, F. M. 1972. Reclamation of a Sooty Shearwater. Chat 36: 102-103.

1971

Oliver, P. J. 1971. Sooty Shearwaters in the English Channel. Brit. Birds 64: 56-60.

Jones, W. E. 1971. Sooty Shearwaters in the English Channel. Brit. Birds 64: 322-324.

1970

van Dijk, J., J. D. D. Hofman and W. de Wilde. 1970. Sooty Shearwater (*Puffinus griseus*) near Heligoland. Ardea 58: 264-265.

1969

Smith, F. T. H. 1969. Sooty Shearwaters at Altona, Victoria. Bird-Observ. No. 457: 5.

1968

Williams, R. B. and D. C. Williams. 1968. Leach's Petrel along the North Carolina coast. Chat 32: 45.

1967

Heimbach, H. L. 1967. Dunkler Sturmtaucher (*Puffinus griseus*) vor Amrum-Nordspitze. Ornithol. Mitt. 19: 83. [In German.]

Huyskens, G. and P. Maes. 1967. An important passage of Sooty Shearwaters around north-west Spain. Seabird Bull. 3: 41.

Merton, D. V. 1967. Sooty Shearwater and Grey-faced Petrel use common nesting burrow. Notornis 14: 81-82.

1965

Devillers, P. 1965. Passage de puffins fuligineux (*Puffinus griseus*) au Cap Griz-Nez. Alauda 33: 236-244.

Holmes, R. P., III. 1965a. Sooty Shearwater at Bogue Banks, North Carolina. Chat 29: 85.

Holmes, R. P., III. 1965b. Shearwaters and petrels off of Morehead City, North Carolina. Chat 29: 106.

1964

Rees, E. I. S. 1964. The Sooty Shearwater *Procellaria grisea* on the Newfoundland Banks. Ibis 106: 118-119.

Robinson, F. N. 1964. The breeding of the Sooty Shearwater on Court's Island, Tasmania and Montagu Island, N.S.W. Emu 63: 304-306.

Stonehouse, B. 1964. A wreck of juvenile Sooty Shearwaters (Puffinus griseus) in South Canterbury. Notornis 11: 46-48.

Warham, J. 1964. Marked Sooty Shearwaters Puffinus griseus in the Northern Hemisphere. Ibis 106: 390-391.

Van den Oord, A. M. and J. Swaab. 1964. Waarnemingen van grauwe pijlstormvogels. [Sight record of the Sooty Shearwater (Puffinus griseus)]. Limosa 37: 191.

1963

Phillips, J. H. 1963a. Distribution of the Sooty Shearwater around the British Isles. Brit. Birds 56: 197-203.

Phillips, J. H. 1963b. The pelagic distribution of the Sooty Shearwater (Procellaria grisea). Ibis 105: 340-353.

Richdale, L. E. 1963. Biology of the Sooty Shearwater Puffinus griseus. Proc. Zool. Soc. (Lond.) 141: 1-117.

1962

Eisenmann, E. and D. L. Serventy. 1962. An erroneous Panama record of Puffinus tenuirostris and other misidentifications of P. griseus. Emu 62: 199-201.

1961

Mathiasson, S. 1961. The first record of Sooty Shearwater (Puffinus griseus (Gm.)) in Sweden. Var Fagelvarld 20: 151-156.

1960

Kenyon, K. W. and D. W. Rice. 1960. The Sooty Shearwater in the Hawaiian Islands. Murrelet 41: 46.

Post, P. W. 1960. First specimens of Sooty Shearwater for Delaware. Auk 77: 82.

1959

Brennecke, H. E. 1959. Beobachtungen einen Dunklen Sturmtauchers (Puffinus griseus) in der Lubecker Bucht. Ornithol. Mitt. 11: 26-28.

1957

Richdale, L. E. 1957. Recovery of Sooty Shearwater in Northern Hemisphere. Ibis 99: 116.

1956

Bourne, W. R. P. 1956. Migrations of the Sooty Shearwater. Sea Swallow 9: 23-25.

1954

Cawkell, E. M. 1954. The field-characters of the Sooty Shearwater. Brit. Birds 47: 283.

Gnecchi-Ruscone, G. and E. Moltoni. 1954. Prima cattura in Italia di Berta grigia (Puffinus griseus Gmelin). Riv. Ital. Ornitol. 24: 125-127. [In Italian.]

Richdale, L. E. 1954. Duration of parental attentiveness in the Sooty Shearwater. Ibis 96: 586-600.

1951

Duffey, E. 1951. Sooty Shearwater in the Barents Sea. Brit. Birds 44: 179.

1948

Ball, W. H. 1948. Sooty Shearwater in western North Carolina. Auk 65: 143.

Keast, J. A. and A. R. McGill. 1948. The Sooty Shearwater in Australia. Emu 47: 199-202.

1946

Mackenzie, L. L. 1946. Migration of the Sooty Shearwater off the Washington coast. Auk 63: 257-258.

Sharland, M. S. P. 1946. Sooty Shearwater in Tasmania. Emu 46: 228-229.

Williamson, K. 1946. Great and Sooty shearwaters north of Orkney. North West Nat. 21: 247.

1945

Richdale, L. E. 1945. The nestling of the Sooty Shearwater. Condor 47: 45-62.

1944

Richdale, L. E. 1944a. The Sooty Shearwater in New Zealand. Condor 46: 93-107.

1931

Gutsell, J. S. 1931. Sooty Shearwater and Audubon's Shearwater in North Carolina. Auk 48: 105-106.

1930

Longstreet, R. J. 1930. Sooty Shearwater at Daytona Beach, Florida. Auk 47: 552.

1925

Coles, R. J. 1925. Sea-birds at Cape Lookout, North Carolina. Auk 42: 123-124.

1924

Stresemann, E. 1924. Puffinus griseus (Gmelin) Brutvogel in der nord chienischen Pampa. [Puffinus griseus breeding in the north Chilean Pampa.] Ornithol. Monatsber. 32: 63-64. [In German.]

1923

Miller, R. F. 1923. The Sooty Shearwater in New Jersey. Auk 40: 689-690.

Stone, W. 1923. The Sooty Shearwater (Puffinus griseus) on the New Jersey coast. Auk 40: 689.

1898

Magness, E. 1898. Shearwater inland. Osprey 3: 45.

MANX SHEARWATER

(*Puffinus puffinus*)

[DA: Skrape, Nordlig Skrape; DU: Noordse Pijlstormvogel, EN/US: Common Shearwater, Newell's Shearwater, Townsend's Shearwater, Black-vented Shearwater, Balearic Shearwater, Eastern Mediterranean Shearwater; FI: Tavallinen myrskysukeltaja, FR; Puffin des Anglais, Puffin des Baleares, Puffin yelkouan; GE: Schwarzschnabel-Sturmtaucher, IC: Skrofa, IT: Berta minore, NW: Havlire, PO: Burzyk popielaty, PR: Fura-buxo, Frulho; RU: (Small Shearwater), SP: Fardela Atlantica, Pardela pichoneta, SW: Mindre lira]

GENERAL DISTRIBUTION

North America In North America Manx Shearwaters breed primarily on islands off the Pacific coast. A recent instance of breeding in Massachusetts as well as former breeding in Bermuda suggest that this species once may have bred at other localities on the Atlantic coast and may do so again in the future.

Off the Pacific coast of North America, populations breed on Clarion, Socorro, and San Benedicto islands in the Revilla Gigedos, and on San Martin, Guadelupe, San Benito, and Natividad islands off the west coast of Baja California (Jouanin and Mougin 1979).

We know of one unequivocal breeding record for the Atlantic coast of North America. On 4 June 1973, a Manx Shearwater was found incubating an egg under a board on Penikese Island west of Martha's Vineyard, Massachusetts. On 22 July the burrow contained a large downy chick (Bierregard 1974, Bierregard et al. 1975). Jouanin and Mougin (1979) indicate that the species also breeds "on islands off Newfoundland." We are unaware of the basis for this statement, but a specimen in the USNM (#395071) collection dated 24 May 1947 from St. Anthony, Newfoundland (Post 1967), bears on its label the annotation "many eggs well developed". However, neither Peters and Burleigh (1951), who first reported the specimen, nor Godfrey (1966) considered the bird anything but a vagrant.

Taxonomic note: Also appears in recent literature as *Procellaria puffinus*. Birds breeding in the Pacific have often been treated as distinct species. These include *Puffinus p. auricularis* (Townsend's Shearwater) of the Revilla Gigedos Islands, *P. p. opisthomelas* (Black-vented Shearwater) of islands off Baja California, and *P. p. newelli* (Newell's Shearwater) of Hawaii, included here with the Atlantic and Mediterranean races. Two additional southwestern Pacific populations, the Fluttering Shearwater (*Puffinus gavia*) that breeds on islands off northern New Zealand, and Hutton's Shearwater (*Puffinus huttoni*) are here treated as distinct species following Serventy et al. (1971), Condon (1975), and Jouanin and Mougin (1979). There has been considerable controversy over the specific status of populations, however, and many recent authorities (e.g., Palmer 1962, BOU 1971, Cramp et al. 1977) consider them best treated as races.

Breeding birds of the west coast of Baja California disperse into the Gulf of California, north along the Pacific coast, and wander north to British Columbia. Virtually nothing, however, is known of the dispersal of the population in the Revilla Gigedos (Bourne in Palmer 1962). As shown by recoveries of birds in Newfoundland and Texas of birds banded in Great Britain (Thomson 1965, Webster 1975c, 1976a), birds occurring along the Atlantic coast of North America are probably migrants from populations breeding in the eastern North Atlantic.

World Distribution In the North Atlantic, aside from the above, birds of the nominate race breed on the Westmann Islands off Iceland, on the Faeroes, in and off Great Britain, off France, inland on Madeira, and in the Azores. Two other populations breed in the Mediterranean. In the west, *P. p. mauretanicus* breeds on the Pityusae and in the Balearic Islands, and to the east *P. p. yelkouan* breeds on islets off France, in Corsica, Sardinia, Italy, Sicily, and in the Adriatic and Aegean seas (Jouanin and Mougin 1979). In the Pacific, this species breeds on Kauai in the Hawaiian Islands, and perhaps at a few other localities (Kepler et al. 1979).

North Atlantic Manx Shearwaters largely migrate from Europe to winter off the west coast of South America (off Brazil, Uruguay, and northern Argentina) from about 17° to 36° S latitude (Blake 1977, Cramp et al. 1977). Birds from the western Mediterranean population largely migrate through the Straits of Gibralter, occurring off western Morocco, and with some moving north to winter off Europe. Post-breeding birds from eastern Mediterranean populations disperse widely in the Mediterranean, with the greatest numbers wintering in the Adriatic, Aegean, and Black seas, and off the Levant Coast (Cramp et al. 1977). Dispersal or migration patterns of the Hawaiian race of the Manx Shearwater are poorly known, but available data suggest extensive movement (King and Gould 1967).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Manx Shearwaters rarely have been recorded in the southeastern United States, with records from only three states. Two of these states are those in which the most intensive offshore observations have been made. Consequently, it seems likely that the species may be somewhat more common in southeastern waters, at least off the Atlantic coast, than the present records would indicate. The species almost certainly occurs off the coasts of South Carolina and Georgia but, as Buckley (1973) pointed out when he first reported the species from North Carolina, the absence of coastal records "probably reflects only a paucity of observers and offshore trips". The few records available indicate that the primary period of occurrence in southeastern waters is from late fall through early spring, a period during which a considerably smaller proportion of the offshore observations has been made.

North Carolina There are four records of Manx Shearwater for North Carolina, as well as a putative sighting 17 April 1978 (Lee and Rowlett 1979). It may occur more frequently over colder offshore waters than these records indicate. It would not be surprising if some were misidentified Audubon's Shearwaters, which are similar in appearance and much more abundant.

1970	31 May	2 seen	just beyond breakers 4 mi NE Hatteras Inlet	Buckley 1973
1978	early spring	1 oil-soaked bird found dead, coll. (NCSM 6554)	Cape Hatteras Point	LeGrand 1979a, Lee and Booth 1979, Lee and Rowlett 1979
1978	5 Dec.	1 seen	40 mi SSE Oregon Inlet near Gulf Stream	Lee and Rowlett 1979
1978	30 Dec.	4 of 5 seen coll. (NCSM 7091-7094)	ca. 40 mi SSE Oregon Inlet, near edge of Gulf Stream	Lee and Rowlett 1979, LeGrand 1979b

Florida - Atlantic Coast The 16 records of Manx Shearwater from Florida that we have found are all from the Atlantic coast, and the majority (10) of observations have been made during fall and winter. Dates of occurrence have ranged from 11 July to 8 May. The fact that considerably more have been recorded from Florida than from North Carolina may reflect a greater amount of winter observation in the former area.

1959	21 Jul.	1 seen	30 mi E Port Canaveral	Post 1967
1960	30 Oct.	1 found freshly dead (1), coll. (USNM 473608)	Jupiter Inlet, Palm Beach Co.	Green 1961
1965	11 Jul.	1 seen	33 mi E Port Canaveral	Post 1967
1967	31 Aug.	2 seen	within 20 feet, 22 mi off Grant, Brevard Co.	Robertson and Ogden 1968
1969	8 Dec.	1 female (1) coll. (USNM 566279)	Key Largo	this paper
1972	26 Oct.	1 seen	off Cocoa Beach	Robertson 1972
1974	9 Oct.	3 seen	off Canaveral	Edscorn 1975
1975	24 Mar.	1 seen	off Canaveral	Stevenson 1975
1975	7 Apr.	1 seen	18 mi off Cape Canaveral	Kale 1975
1975	30 Nov.	1 seen	off Canaveral	Edscorn 1976
1976	8 May	1 seen	off Miami Beach	Kale 1976

(1) This bird was identified as of the nominate race *P. p. puffinus*.

1977	9 Jan.	1 seen	10 mi off Cocoa Beach	Stevenson 1977
1977	19 Oct.	1 seen	off Canaveral	Edscorn 1978
1978	6 Dec.	2 seen	15 mi off Cape Canaveral	Stevenson 1979
1979	1 Jan.	1 found dead, coll. (Brev. Mus.)	Sebastian Inlet	Stevenson 1979
1979	11 Feb.	1 seen	off Fort Pierce	Stevenson 1979

Texas Skeletal remains consisting of a skull and a leg constitute the only record of the Manx Shearwater from Texas. The bird was not thought to have been long dead, and had been banded at Hallival, Inverness, Scotland, on 8 August 1973 (Webster 1975c, 1976a).

1975	Feb.	1 skeleton coll. (CC Mus.)	N. Padre Island, just S Bob Hall Pier	Webster 1975c

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Manx Shearwaters are birds of temperate or warm waters that breed primarily off the west coasts of North America and Europe, as well as in the Mediterranean Sea and Hawaii (Vaurie 1965).

World population figures for this species are unavailable, but Cramp et al. (1977) considered it the most common shearwater in the western Palearctic. These authors summarized available population figures for this region: 10,000 pairs in the Faeroes, 175,000 to as many as 300,000 pairs or more in Great Britain and Ireland, and fewer than 10 pairs in France.

Winter and Migration Migration or dispersal patterns of many races of the Manx Shearwater are poorly understood. Those from the nominate North Atlantic race migrate from Europe in September and October to winter off the west coast of South America. Judging from the temporal distribution of records and from racial determinations of the few available specimens from the southeastern United States, it seems that most Manx Shearwaters in the southeast are from these populations and that they occur both as migrants and as wintering birds.

Post (1967) reported observations by Wingate in Bermuda that suggest that a substantial migration may occur well offshore, with a peak from late February through mid-March and a smaller flight in late May. Post stated that there was little doubt but that the first peak consisted of adults returning to Europe to breed, and suggested that the smaller flight consisted of young nonbreeders that apparently make up most of the birds seen off the North Atlantic coasts.

Manx Shearwaters have been recorded only rarely in southeastern waters

and have occurred almost exclusively in waters off the Atlantic coast. None has yet been recorded from South Carolina or Georgia, but these shearwaters doubtless occur offshore there. Manx Shearwaters are mostly reported during fall and winter in the southeast, and may be more common than the records suggest. There is only one record of Manx Shearwater from the Gulf of Mexico; it is very likely that the species is genuinely rare there. It is undoubtedly less common in the southeast than any other shearwater (Greater, Audubon's, Sooty, Cory's) known to occur there.

The Manx Shearwaters occurring in the southeast are apparently solely of the form (*P. p. puffinus*) that breeds in the northwestern Atlantic. Remarks in the following sections are derived from information on the populations that comprise this race.

HABITAT

Nesting Manx Shearwaters are largely nocturnal at the breeding grounds and usually nest in dense, often very large colonies on turfy, inshore islands from sea level to about 700 m (Cramp et al. 1977). Occasionally they nest inland, as at Rhum, Inner Hebrides, where a colony is located about 2 miles inland and at over 2,000 feet (Cramp et al. 1974).

They almost always nest in cavities below ground, either in rocky crevices or in burrows dug by the birds. Exceptionally, these shearwaters have been recorded nesting under buildings (Cramp et al. 1974, Cramp et al. 1977). In the Faroe and Westmann islands, they nest in cliffs (Palmer 1962).

During the breeding season they may assemble in large rafts offshore before returning to the nesting areas after dark (Cramp et al. 1977).

Feeding Manx Shearwaters mainly feed at or near the surface, usually in offshore waters. Large aggregations are known to feed relatively close inshore (see below), and they often sit on the water (Palmer 1962). Harris (1966b) suggested that the foraging range for birds breeding on Skokholm, Wales, and other colonies in the Irish Sea was approximately 200 miles.

Nonbreeding and Offshore The nominate race *P. p. puffinus* is found primarily in waters of the continental shelves and avoids inshore waters except when nesting (Cramp et al. 1977). In such areas it prefers cold upwellings (Watson 1966). It disperses widely at sea, but is gregarious during migration (Palmer 1962).

FOOD AND FEEDING BEHAVIOR

This species feeds primarily on small fish, cephalopods, small crustaceans, and offal found at the surface. Cramp et al. (1977) noted that the fish taken were largely clupeids, mostly herring (*Clupea harengus*), sprat (*Sprattus sprattus*), pilchard (*Sardina pilchardus*), and anchovy (*Engraulis encrasicolus*).

Cramp et al. (1977) listed the primary prey-catching techniques of these

shearwaters as pursuit-plunging, pursuit-diving, and surface seizing. When diving for food, both wings and feet are used for propulsion underwater (Palmer 1962). Bourne (1976 in Brown et al. 1978) also described "belly flop" plunging in Manx Shearwaters feeding over schools of fish at the surface. In this feeding technique the birds plunge to the surface of the water and strike it with breast and belly; this action is immediately followed by active feeding at and below the surface.

Manx Shearwaters are gregarious, may feed in flocks at all times of year (Cramp et al. 1977), and are known to feed by both day and night (Watson 1966). They have been seen congregating in large flocks to feed on schools of anchovy in the eastern Crimean (Cramp et al. 1977). Flocks of several thousand or more have been seen feeding off Cornwall (King 1974b) and Devon, England (Jones 1975).

SUSCEPTIBILITY TO OIL POLLUTION

Although one of the few records of Manx Shearwaters from the southeastern United States was of a heavily oiled bird, this species is one for which oiling has rarely been reported (Bourne 1968a). An observation by Casement (1966) of birds in the Bosphorus apparently actively avoiding oil may account in part for the scarcity of records for this species. Bourne (1968a) suggested, however, that this species may be especially vulnerable to oiling when gathered in large rafts at dusk near the breeding stations.

Because it occurs in the waters of the southeastern United States only uncommonly and because most occurrences are well offshore in areas perhaps less likely to have substantial accumulations of oil, the susceptibility of this species to oil pollution should be considered slight in this area.

BIBLIOGRAPHY

1980

Conant, S. 1980. Recent records of the 'Ua'U (Dark-rumped Petrel) and the 'A'o in Hawaii. Elepaio 41: 11-13.

1979

Cleeves, T. R. 1979. Opportunistic predation of Manx Shearwaters by fox. Brit. Birds 72: 77.

Kepler, C. B., J. Jeffrey and J. M. Scott. 1979. Possible breeding colonies of Manx Shearwaters (*Puffinus p. newelli*) on the island of Hawaii. Elepaio 39: 115-116.

Penicaud, P. 1979. Nidification du Puffin des Anglais *Puffinus puffinus* aux Sept-Iles. [Nesting of the Manx Shearwater *Puffinus puffinus* at Sept-Iles.] Alauda 47: 112-113. [In French.]

Telfer, T. 1979. Successful Newell's Shearwater salvage on Kauai. Elepaio 39: 71.

1978

Brooke, M. de L. 1978a. Some factors affecting the laying date, incubation and breeding success of the Manx Shearwater, Puffinus puffinus. J. Anim. Ecol. 47: 477-495.

Brooke, M. de L. 1978b. The dispersal of female Manx Shearwaters Puffinus puffinus. Ibis 120: 545-551.

Brooke, M. de L. 1978c. Weights and measurements of the Manx Shearwater, Puffinus puffinus. J. Zool. (Lond.) 186: 359-374.

Brooke, M. de L. 1978d. A test for visual location of the burrow by Manx Shearwaters Puffinus puffinus. Ibis 120: 374-349.

Byrd, V., J. Sincock and T. Telfer. 1978. The status of Newell's Manx Shearwater: a threatened species. (Abstract only). Pac. Seabird Group Bull. 5: 80.

Jehl, J. R. 1978. The biology and identification of Townsend's Shearwater (Puffinus auricularis). (Abstract only). Pac. Seabird Group Bull. 5: 87.

Hall, J. B. 1978. Newell's Shearwater in the Kohala Mountains, Island of Hawaii. Elepaio 38: 131-132.

1977

Tulloch, R. J. 1977. Behaviour of Manx Shearwaters. Brit. Birds 70: 35.

1976

Jones, W. E. 1976. Manx Shearwaters plunge-diving. Brit. Birds 69: 513-514.

Perrins, C. M. and M. de L. Brooke. 1976. Manx Shearwaters in the Bay of Biscay. Bird Study 23: 295-299.

Rowlett, R. A. 1976. Maryland records of the Manx Shearwater. Md. Birdlife 32: 27-28.

Swann, R. L. and A. F. Leitch. 1976. Buzzard taking Manx Shearwater at night. Scott. Birds 9: 69.

Wormell, P. 1976. The Manx Shearwaters of Rhum. Scott. Birds 9: 103-118.

1975

Bierregaard, R. O., Jr., A. B. David, III, T. D. Baird and R. E. Woodruff. 1975. First northwestern Atlantic breeding record of the Manx Shearwater. Auk 92: 145-147.

Jones, W. E. 1975. Manx Shearwater plunge-diving. Brit. Birds 68: 119-120.

Lambert, K. 1975. Der Nachtsturmtaucher, Puffinus puffinus, vor Sudwest- und Sudafrika. Beitr. Vogelkd. 21: 228-232. [In German with English summary.]

Liedel, K. and W. Ufer. 1975 Schwarzschnabelsturmtaucher in der Goldenen Aue. Falke 22: 244-245.

Stromar, L. 1975. Noviji podaci o pojavi zovoja Malog, Puffinus puffinus (Brunn), u Kvarnerskom podrucju. [Recent data on the occurrence of Puffinus puffinus in the Kvarner Region of the Croatian coastland.] Larus 26-28: 83-88. [In Serbo-Croatian with German summary.]

Van Impe, J. 1975. Sur les mouvements du Puffin yelkouan Puffinus p. yelkouan en Mer Noire. Alauda 43: 185-187. [In French.]

1974

Bierregaard, R. O., Jr. 1974. Manx Shearwater breeds in North America. Am. Birds 28: 135.

King, B. 1974b. Aerial plunge-diving by Shags and Manx Shearwaters. Brit. Birds 67: 77.

Ramsay, A. D. K. 1974. Rhum and Canna Manx Shearwaters; some introductory observations. Seabird Rept. No. 4: 46-48.

Robel, D. 1974. Beobachtungen am Nachtsturmtaucher (Puffinus puffinus) an der Schwarzmeerkuste Bulgariens. Beitr. Vogelkd. 20: 173-175. [In German.]

1973

Besson, J. 1973. Remarques sur la mort accidentelle de Puffins yelkouans. Alauda 41: 165-167. [In French.]

Brooke, M. de L. 1973. Age of breeding Manx Shearwaters. Skokholm Bird Observ. Rept. 1973: 15-18.

Corkhill, P. 1973. Manx Shearwaters on Skomer: population and mortality due to gull predation. Brit. Birds 66: 136-143.

Greenhalgh, M. E. 1973. Balearic Shearwaters in the Forth. Scott. Birds 6: 329-330.

Kinsky, F. C. and J. A. Fowler. 1973. A Manx Shearwater Puffinus p. puffinus in New Zealand. Notornis 20: 14-20.

Monnat, J. Y. 1973. Statut actuel des oiseaux matins nicheurs en Bretagne. IX. Procellariiformes. Ar Vran 6: 1-10. [In French.]

Perrins, C. M. 1973. Some effects of temperature on breeding in the Great Tit and Manx Shearwater. J. Reprod. Fertil. Suppl. 19: 163-173.

Perrins, C. M., M. P. Harris and C. K. Britton. 1973. Survival of Manx Shearwaters (Puffinus puffinus). Ibis 115: 535-548.

Robel, D. 1973. Zum Nahrungserwerb des Nachtsturmtauchers (Puffinus puffinus (Brunn.)). Beitrage Vogelkd. 19: 222-223.

1972

Davis, J. W. F. and I. Packer. 1972. Melanistic Manx Shearwater. Brit. Birds 65: 527.

Doughty, R. W. 1972. A note on Newell Shearwater on Kauai. Elepaio 33: 44-45.

Elgood, J. H. 1972. Shearwaters wheeling over sand dunes. Brit. Birds 65: 480.

Harris, M. P. 1972. Inter-island movements of Manx Shearwaters. Bird Study 19: 167-171.

1971

Lockley, R. M. 1971. The life history of Puffinus puffinus: a review. Oiseau R.F.O. 41: 163-175.

Tekke, M. J. 1971. Een groot antal waarnemingen in 1970 van de noordse pijlstormvogel, Puffinus puffinus. [Large numbers of observations of Manx Shearwater in 1970.] Limosa 44: 184-185. [In Dutch with English summary.]

1970

Beintema, A. J. and J. Wattel. 1970. Een onopgemerkte vondst van Puffinus puffinus mauretanicus. [A Dutch record of Puffinus puffinus mauretanicus.] Limosa 43: 136-137. [In Dutch with English summary.]

1969

Collins, C. T. 1969. A review of the shearwater records for Trinidad and Tobago, West Indies. Ibis 111: 251-253.

Freeman, H. J. 1969. Manx Shearwaters following ships. Brit. Birds 62: 76.

Sincock, J. L. and G. E. Swedberg. 1969. Rediscovery of the nesting grounds of Newell's Manx Shearwater (Puffinus puffinus newelli), with initial observations. Condor 71: 69-71.

Van Impe, S. 1969. Passage regulier de Puffinus p. yelkouan (Acerbi) et de Stercorarius pomarinus (Temme) le long de cote roumaine. Alauda 37: 163-164. [In French.]

1968

Anon. 1968. Eerste waarneming van een Noordse Pijlstormvogel, Puffinus puffinus puffinus (Brunnich), in het binnenland. Gerfaut 58: 162. [In Dutch.]

Harris, M. P. 1968. Manx Shearwater in Derbyshire with apparent puffinosis. Brit. Birds 61: 226-227.

1967

Condor, P. 1967. Puffinosis among Manx Shearwaters on Skokholm. Brit. Birds 60: 61-62.

King, W. B. 1967. Newell's Shearwater...a rare bird. Pac. Bird Observ. No. 6: 1-2.

King, W. B. and P. J. Gould. 1967. The status of Newell's race of the Manx Shearwater. Living Bird 6: 163-186.

Ogul'chanskii, A. Ya. 1967. [The Manx Shearwater in the Sea of Azov.] Ornitologiya 8: 377-378. [In Russian.]

Perrins, C. M. 1967. Manx Shearwaters on Skokholm. Seabird Bull. 3: 42-44.

Post, P. W. 1967. Manx, Audubon's, and Little shearwaters in the northwestern North Atlantic. Bird-Banding 38: 278-305.

Vande Weghe, J. P. 1967. Premiere observation pour la Belgique du puffin cendre Puffinus diomedea (Scopoli) et du puffin des Baleares Puffinus puffinus mauretanicus Lowe. Gerfaut 57: 125-138. [In French with Flemish summary.]

1966

Bennett, P. 1966. The Manx Shearwater on the Calf of Man. Seabird Bull. 2: 60-61.

Davis, P. 1966. Puffinosis among Manx Shearwaters. Brit. Birds 59: 84-85.

Diamond, A. W. 1966. Puffinosis among Manx Shearwaters. Brit. Birds 59: 82-84.

Harris, M. P. 1966a. Age of return to colony, age of breeding and adult survival of Manx Shearwaters. Bird Study 13: 84-95.

Harris, M. P. 1966b. Breeding biology of the Manx Shearwater Puffinus puffinus. Ibis 108: 17-33.

Perrins, C. M. 1966. Survival of young Manx Shearwaters Puffinus puffinus in relation to their presumed date of hatching. Ibis 108: 132-135.

Phillips, J. H. and S. L. B. Lee. 1966. Movements of Manx Shearwaters off Erris Head, western Ireland in the autumn. Bird Study 13: 284-296.

Spencer, R. 1966. Report on bird-ringing for 1965. Brit. Birds 59: 441-491.

1965

Bertelsen, N. O. 1965. Almindelig Skrape (Puffinus p. puffinus Brun.) pa Trollhovdi. Flora Fauna 71: 135-137.

Harris, M. P. 1965. Puffinosis among Manx Shearwaters on Skokholm. Brit. Birds 58: 426-433.

Thomson, A. L. 1965. The transequatorial migration of the Manx Shearwater (Puffin des Anglais). Oiseau R.F.O. 35 Suppl.: 130-140.

1964

Harris, M. P. 1964. Ring loss and wear of rings on marked Manx Shearwaters. Bird Study 11: 39-46.

McGill, A. R. 1964. A banded Manx Shearwater in Australia. Austr. Bird Bander 2: 50.

Matthews, G. V. T. 1964. Individual experience as a factor in the navigation of Manx Shearwaters. Auk 81: 132-146.

Post, P. W. 1964. The occurrence and field identification of small "black and white shearwaters" in New York. Kingbird 14: 133-140.

1962

Spencer, R. 1962. British ringed Manx Shearwater recovered in Australia. Brit. Birds 55: 86-87.

1961

Crosby, M. D. 1961. Manx Shearwater digging by daylight. Brit. Birds 54: 359.

Dorst, J. 1961. Capture d'un Puffin des Anglais (Puffinus p. puffinus) en Seine-et-Marne. Oiseau R.F.O. 31: 73-74. [In French.]

Green, Ms. D. 1961. Manx Shearwater found on beach at Juno. Fla. Nat. 34: 9.

Lockley, R. M. 1961. Shearwaters. Doubleday & Co., Inc., Garden City, NY. xvi and 257 pp.

Walker, I. M. 1961. Manx Shearwater nestling still unfledged in November. Brit. Birds 54: 242.

1960

Brun, E. 1960. The return of the Manx Shearwater. J. Manx Mus. 6: 103-104.

Mylne, C. K. 1960. Predation of Manx Shearwaters by Great Black-backed Gulls on Skomer. Bird Notes 29: 73-76.

1959

Coulson, J. C. 1959. The adult mortality of the Manx Shearwater on Skokholm. Skokholm Bird Observ. Rept. 1959: 24-26.

Hatch, G. 1959. Newell's Shearwater or 'A'o. Elepaio 20: 20-21.

1958

Orians, G. H. 1958. A capture-recapture analysis of a shearwater population. J. Anim. Ecol. 27: 71-86.

Sal'nikov, N. E. 1958. [Winter quarters of the Balearic Shearwater Puffinus puffinus yelkouan Acerbi on the Black Sea and its connection with the distribution of the Anchovy). Voprosy Ikhtiologii 8: 188-190. [In Russian.]

Snyder, D. E. 1958. Recent occurrences of the Manx Shearwater in Massachusetts. Auk 75: 213-214.

1957

McLachlan, G. and R. Liversidge. 1957. Flesh-footed Shearwater, Manx Shearwater and Light-mantled Sooty Albatross. Ostrich 28: 179.

Ripley, S. D. 1957. Another record of the shearwater Puffinus puffinus newelli. Condor 59: 402.

1956

Anon. 1956. Newell's Shearwater, or 'A'o. Elepaio 17: 44.

Jouanin, C. 1956. Une capture meconnue de Puffinus puffinus newelli Henshaw. Bull. Mus. Natl. Hist. Nat. (Paris) 28: 273-274. [In French.]

Ralphs, P. 1956. Notes on the development of the Manx Shearwater fledgling. Skokholm Bird Observ. Rept. 1955: 20-22.

1955

Richardson, F. 1955. Reappearance of Newell's Shearwater in Hawaii. Auk 72: 412.

van de Veer, J. 1955. Een vondst van de Vale Noordse Pijlstormvogel, Puffinus puffinus mauretanicus Lowe, in Nederland. Ardea 43: 308-309. [In Dutch.]

1954

Ash, J. S. and K. B. Rooke. 1954. Balearic Shearwaters off the Dorset Coast in 1953. Brit. Birds 47: 285-296.

Matthews, G. V. T. 1954. Some aspects of incubation in the Manx Shearwater Procellaria puffinus, with particular reference to chilling resistance in the embryo. Ibis 96: 432-440.

1953

Dane, D. S., J. A. Miles and M. G. P. Stoker. 1953. A disease of Manx Shearwaters: further observations in the field. J. Anim. Ecol. 22: 123-133.

Lockley, R. M. 1953. On the movements of the Manx Shearwater at sea during the breeding season. Brit. Birds 46 (special suppl.). 48 pp.

Matthews, G. V. T. 1953. Navigation in the Manx Shearwater. J. Exp. Biol. 30: 370-396.

Mazzeo, R. 1953. Homing of the Manx Shearwater. Auk 70: 200-209.

1952

Alder, L. P., D. D. Harber, C. M. James and A. R. Mead-Briggs. 1952. Balearic Shearwater off Sussex and Norfolk. Brit. Birds 45: 72.

Murphy, R. C. 1952. The Manx Shearwater, Puffinus puffinus, as a species of worldwide distribution. Am. Mus. Novit. 1586: 1-21.

Nicholson, E. M. 1952. Shearwaters in the English Channel. Brit. Birds 45: 41-55.

Thomson, A. L. and E. P. Leach. 1952. Report on bird-ringing for 1951. Brit. Birds 45: 265-277, 341-357.

1951

Ludwig, J. H., Jr. 1951. Puffinus puffinus. Bull. Mass. Audubon Soc. 25: 93-95.

1948

Dane, D. S. 1948. A disease of Manx Shearwaters (Puffinus puffinus). J. Anim. Ecol. 17: 158-164.

Miles, J. A. R. and M. G. P. Stoker. 1948. Puffinosis, a virus epizootic of the Manx Shearwater (Puffinus p. puffinus). Nature 161: 1016-1017.

1945

Blair, H. M. S. 1945. Manx Shearwater breeding on Durham coast. Brit. Birds 38: 276-277.

1944

Southern, H. N. and B. W. Tucker. 1944. The Manx Shearwater on Lundy. Brit. Birds 38: 122-129.

1943

Weaving, J. and J. Barlee. 1943. Gannets and Manx Shearwaters nesting on Great Saltee, Co. Wexford. Brit. Birds 37: 98.

1941

Munro, G. C. 1941. Birds of Hawaii and adventures in bird study. The Ao, Newell's Puffin. Elepaio 2: 9-11.

1936

Allen, F. H. 1936. Shearwaters and ships. Auk 53: 320-321.

1935

Lockley, R. M. 1935. Movements of Manx Shearwaters. Brit. Birds 29: 105-107.

Thorpe, W. H. 1935. Remarkable spring migration of Manx Shearwaters and other sea birds off Cape Cornwall. Brit. Birds 29: 43-44.

1931

Lockley, R. M. 1931. Further notes on the breeding-habits of the Manx Shearwater. Brit. Birds 24: 202-207.

Salmon, H. M. 1931. The Manx Shearwater's flea. Brit. Birds 25: 171-172.

1930

Lockley, R. M. 1930a. On the breeding-habits of the Manx Shearwater, with special reference to its incubation- and fledging-periods. Brit. Birds 23: 202-218.

Lockley, R. M. 1930b. Zur Brutbiologie des Nordischen Sturmtauchers mit besonderer Berucksichtigung der Brutdauer und Nestlingszeit. J. Ornithol. 78: 487-507. [In German.]

Roberts, B. B. 1930. Manx Shearwaters' departure flight from land. Brit. Birds 23: 223-224.

Robinson, H. W. 1930. Departure and landing of Manx Shearwaters. Brit. Birds 23: 224-225.

1929

Raikes, D. T. 1929. Manx Shearwater's departure flight from land. Brit. Birds 23: 164-165.

1927

Dwight, J. 1927. The "new" Bermuda Shearwater proves to be Puffinus puffinus puffinus. Auk 44: 243.

Eyma, C. J. 1927. Puffinus puffinus (Brunn.). Ardea 16: 134.

1925

Robinson, H. W. 1925. Manx Shearwaters laying in the open in Scilly. Brit. Birds 19: 76.

1923

Dwight, J. 1923. First definite capture in North America of the Manx Shearwater (Puffinus puffinus). Auk 40: 125.

1917

Brooks, W. S. 1917. The possibility of Puffinus bermudae Nichols and Mowbray in the North Atlantic. Auk 34: 206.

1916

Nichols, J. T. and L. L. Mowbray. 1916. Two new forms of petrels from the Bermudas. Auk 33: 194-195.

1900

Anthony, A. W. 1900. Nesting habits of the Pacific Coast species of the genus Puffinus. Auk 17: 247-252.

Henshaw, H. W. 1900. Description of a new shearwater from the Hawaiian Islands. Auk 17: 246-247.

1896

Anthony, A. W. 1896. The Black-vented Shearwater (Puffinus opisthomelas). Auk 13: 223.

AUDUBON'S SHEARWATER

(*Puffinus lherminieri*)

[DA: Audubons Skrape, DU: Westindische Pijlstormvogel, EN/US: Dusky Shearwater, FR: Puffin obscur, GE: Audubon-Sturmtacher, IT: Berta minore di Lherminier, PR: Pardela, SP: Pardela de Audubon, SW: Mork lira]

GENERAL DISTRIBUTION

North America In continental North America, Audubon's Shearwater occurs as an offshore visitor from island breeding stations in warm tropical waters. It is a widespread breeder in the Caribbean (Bond 1971) and breeds in Bermuda as well (Jouanin and Mougin 1979). It also nests on Tiger Rock at the end of the Valiente Peninsula, Panama (Wetmore 1965), and at Crab Cay off Old Providence Island, well off Nicaragua (Bourne *in* Palmer 1962).

World Distribution Audubon's Shearwater breeds on the Los Roques Islands off Venezuela (Blake 1977) and on St. Giles and Little Tobago off Tobago (ffrench 1973). In the Pacific it breeds in the Galapagos Islands, and from the Marquesas and Gambier islands in the southeast eastward through the Phoenix and Line islands south to Fiji, Samoa, and Tonga, and northwest to Palau and the Bonin and Volcano islands (1)(King 1967, Jouanin and Mougin 1979).

In the Indian Ocean and adjacent areas, Audubon's Shearwaters breed on the Mascarene, Aldabra, Seychelles, Amirante, and Maldive islands, and probably off Baluchistan and Pakistan (Jouanin and Mougin 1979). In the Indian Ocean and elsewhere a number of breeding stations may yet be discovered.

The extent of dispersal at sea and the migratory status of most populations is unknown, but many are thought to be non-migratory (Jouanin and Mougin 1979). Its regular occurrence in some numbers in the southern Atlantic coast waters (see below) implies at least moderate dispersal or migration by some populations.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Audubon's Shearwaters are common in summer off the coasts of North Carolina. Lee and Booth (1979) state that they have seen them "more or less continuously" between 23 April and 7 November, although numbers present varied considerably. They report that peak numbers were found from mid-May to early June and throughout the fall (Table 24).

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(1) Jouanin and Mougin (1979) suggested that the birds from the Bonin and Volcano islands (*P. l. bannermani*), those collected off northern New Britain (*P. l. heinrothi*), and those in the Arabian Sea (*P. l. persicus*) may represent distinct species.

We have found nearly 70 published observations reporting the occurrence of this shearwater in or off North Carolina, and are aware of additional unpublished observations. Below, we list only records of 10 or more birds seen, those that resulted in collected speciemsn, and those which represent temporal extremes of occurrence off North Carolina.

1910	28 Jul.	1 found dead, coll. (USNM 305653)	near Beaufort	Pearson et al. 1919
1924	25 Jul.	12+ of 100+ coll.	near Cape Lookout	Coles 1925
1925	26 Jul.	1 found stranded, coll. (USNM 395653) (1)	Bogue Banks	Gutsell 1931
1938?	Jul?	17 found dead	along beach, Oregon Inlet	Brimley 1941
1939	10 Aug.	1 found dead, coll.	Snead's Ferry	Pearson et al. 1942.
1940	5 Feb.	"a few" seen	Diamond Lightship off Hatteras	Pough 1940
1952	29-30 Jul.	70 counted	off Fort Macon	Rankin 1952
1962	13 Sep.	10 seen	22-25 mi E Hatteras Inlet	Grant 1963
1963	3 Aug.	32 seen	38-48 mi off Cape Lookout	Sykes 1963
1969	26 Apr.	1 seen	51 mi off Cape Lookout	Enders 1972
1969	17 Sep.	25 seen	30-55 mi off Morehead City	Browne and Grant 1970
1972	12 Aug.	30 seen	off Hatteras	Teulings 1973a
1972	19 Aug.	162 or 187 seen	off Morehead City	Teulings 1972d, 1973a
1972	27 Aug.	30 seen	off Morehead City	Teulings 1973a
1973	19 May	16 seen	off Hatteras	Teulings 1973c
1973	14 Jul.	75+ seen	off Wrightsville Beach	Teulings 1973d

(1) Pearson et al. (1942) incorrectly listed the collection as 6 July.

1973	28 Jul.	19 seen	off Morehead City	Teulings 1973d
1973	29 Jul.	40 seen	off Hatteras	Teulings 1973d
1973	19 Aug.	42 seen	off Hatteras	Teulings 1974e
1973	20 Aug.	14 seen	off Morehead City	Teulings 1974e
1974	3 Aug.	21 seen	off Hatteras	Teulings 1975a
1974	13 Sep.	82 seen	off Morehead City	Teulings 1975a
1975	7 Sep.	48 seen	50 mi SE Cape Lookout	Teulings 1976d
1975	26 Oct.	"several" seen	off Cape Hatteras	Teulings 1976d
1976	1 Aug.	21 seen	off Hatteras (peak count 1976)	LeGrand 1976
1976	6 Sep.	24 seen	off Hatteras	Teulings 1977a
1977	Jun.	50+ seen	peak count off Oregon Inlet	LeGrand 1977b
1978	8 Oct.	204 seen	off Hatteras	LeGrand 1979d
1979	23 Apr.	22 seen	off Oregon Inlet	LeGrand 1979d
1979	10 May	40 seen	off Oregon Inlet	LeGrand 1979d
1979	16 May	42 seen	off Oregon Inlet	LeGrand 1979d

South Carolina Although Sprunt and Chamberlain (1949) considered this shearwater a rare summer visitor off the coast, Wayne (1910) had considered it fairly abundant earlier. Despite the fact that we have found only about 18 published records (1) of Audubon's Shearwater in South Carolina, it is highly likely that Wayne was right and that, like several other pelagic species occurring along the coast, its "rarity" results only from no one having looked where they were, i.e., offshore. Except for three birds reportedly seen on 11 and 16 December 1964 (Parnell 1965b) that could have been some other species, all records known to us fall between the dates listed by Sprunt and Chamberlain: 19 May and 31 August.

(1) In addition, Parnell (1966a) reported that an Audubon's Shearwater had been found dead on the beach near Garden City on 25 June 1965. Earlier, Chamberlain (1965) reported that a bird had been found freshly dead there on 25 July 1965. We have not included these records in our list because it seems very likely that both reports refer to the same bird, and because we have no way of determining which date is correct.

????	????	1 coll.	Charleston Harbor	Wayne 1910
1888	4 Aug.	1 coll.	Stono Inlet	Wayne 1910
1888	4 Aug.	1 found dead	Folly Island	Wayne 1910
1893	26-27 Aug.	1 "specimen observed"	Long Island, E Sullivan's Island	Palmer 1931
1911	10 Aug.	1 found dead	Sullivan's Island	Sprunt and Chamberlain 1949
1926	2 Aug.	ca. 15 found dead	Isle of Palms	Sprunt and Chamberlain 1949
1935	24 Jul.	1 found dead	Deveaux Bank, mouth of Edisto River	Sprunt and Chamberlain 1949
1938	24 Jul.	1 found dead	Edisto Beach	Sprunt and Chamberlain 1949
1949	19 May	2 seen	off Charleston Sea Buoy	Sprunt and Chamberlain 1949
1940	15 Aug.	ca. 5 found dead	Isle of Palms	Sprunt and Chamberlain 1949
1963	1 Aug.	1 found alive, later coll. (CM 64.22)	Isle of Palms	Burton 1970
1964	11 Dec.	1 seen	30-35 mi off Charleston	Parnell 1965b
1964	16 Dec.	3 seen	50-60 mi off Charleston	Parnell 1965b
1965	9 Jun.	1 seen	16 mi off Charleston	Chamberlain 1965
1968	25 Aug.	2 seen	ca. 50 mi off Charleston	Parnell 1968c
1973	25 Jul.	2 seen	off Charleston	Teulings 1973d
1976	23 Jun.	1 found dead	of Kiawah Beach	LeGrand 1977c
1978	4 Aug.	4 seen	off Charleston	LeGrand 1979d

Georgia Denton et al. (1977) listed Audubon's Shearwater as accidental in Georgia on the basis of two specimen records. Its status in offshore waters is unknown but probably not greatly different from that in the Carolinas.

1966	25 Jul.	1 coll.	Little Cumberland Island	Denton et al. 1977
1973	12 May	8 seen	near shore Jekyll Island	Teulings 1973c
1973	27 Sep.	1 found moribund, coll. (UG)	Cumberland Island	Teulings 1974a

Florida - Atlantic Coast Kale (1979 ms a) considers Audubon's Shearwater the second most common shearwater off the coast (after Cory's Shearwater). Peak numbers are present from July through early November. We have found nearly as many records for the Florida Atlantic Coast as for North Carolina, but the number of birds involved is far fewer and the temporal spread of observations is far greater (Tables 24, 25). Although evidently more abundant from late spring through fall, our data clearly indicate that Audubon's Shearwater may be found off the Florida Atlantic coast at any time of year. We list below only those records that involve three or more birds, or those we know resulted in the collection of a specimen.

18??	----	flock seen	Gulf Stream opposite Cape Florida	Audubon 1835 in Howell 1932
early 1800's	----	1 coll.	Cape Florida, mouth Biscayne Bay	Palmer 1931
ca. 1916	----	1 coll.	Lake Worth Inlet	Howell 1932
1952	25 Nov.	18 seen	to ca. 10 mi E Miami	Castenholz 1954
1961	25 May	16 seen	7-25 mi E Miami	Abramson 1961
1962	4 Jul.	1 coll.	Gulf Stream, 10 mi E Baker's Haulover, Dade Co.	Robertson 1962
1963	10 Sep.	3 seen	off Miami	Cunningham 1964a
1963	13 Sep.	40-50 seen	22 mi E Port Canaveral	Post 1967
1966	23 Jul.	1 found, coll. (FSU)	near Fort Pierce	Stevenson 1966b
1967	23 Oct.	4 seen	ca. 5 mi off Palm Beach	Robertson and Ogden 1968
1968	18 Jul.	1 coll. (FSU)	near Lake Worth, Palm Beach Co.	Stevenson 1968b

1968	20 Dec.	1 coll. freshly dead (UM)	Biscayne Bay	Stevenson 1969
1969	30 Jun.	1 found freshly dead (USF)	near Fort Pierce	Ogden 1969
1971	14 Aug.	3 seen	off Cocoa	Ogden 1971
1972	13 May	1 found dead, coll. (FTU 977)	on Melbourne Causeway	Anderson 1972
1972	23 Jul.	3 seen	off Cocoa	Ogden 1972
1974	14 Jul.	5 seen	ca. 20 mi off Cocoa	Ogden 1974
1975	20 Jul.	3 seen	off Canaveral	Ogden 1975
1975	Aug.	up to 4 seen	off Canaveral	Edscorn 1976
1976	11 Dec.	1 found dead, coll. (USF)	near Fort Pierce	Stevenson 1977
1977	21 May	21 seen	off Ponce de Leon Inlet	Kale 1977
1977	30 May	5 seen	off Boynton Inlet	Kale 1977
1979	27 Apr.	5 seen	off Pompano Beach	Kale 1979

Florida - Keys Audubon's Shearwaters are reported frequently in the warm waters near the Florida Keys. They have been seen there in larger numbers than anywhere else in southeastern waters; this perhaps reflects the fact that there are breeding colonies only a relatively short distance away in the Caribbean. All but two of the 22 records known to us fall between 25 April and 25 July. Audubon's Shearwaters are probably also common later in the year but have gone unrecorded for lack of observation.

1934	5,13 Jun.	several seen	between Key West and Havana	Hundley and Hames 1960-62
1952	20 Jul.	2 seen	near Alligator Reef Light	Sprunt 1954
1954	13 Dec.	4-5 seen	S Key West	Hundley and Hames 1960-62
1957	15 Jun.	1 seen	Florida Straits	Stevenson 1957b
1957	1 Jul.	18 seen	Florida Straits	Stevenson 1957b
1958	10 May	1 seen	near Key West	Stevenson 1958c
1958	11 May	(1?) seen	ca. 20 mi E Dry Tortugas	Stevenson 1958c

1967	30 May	400 seen	off Marathon	Edscorn 1974
1971	25 Jul.	1 seen	in Florida Straits SW Key West	Ogden 1971
1972	25 Apr.	several seen	between Key West and Dry Tortugas	Kale 1972
1972	16-20 May	260+ seen	5-10 mi off Duck Key, N Marathon	Kale 1972
1973	2 May	1 seen	S East Key, Dry Tortugas	Kale 1973
1974	6-12 May	4-20 seen daily	Florida Straits, off Duck Key	Kale 1974
1976	5-7 Jul.	14 seen	between Keys and Cay Sal Bank	Ogden 1976
1977	1 May	1 seen	off Islamorada	Kale 1977
1977	8 May	420 seen	off Islamorada	Kale 1977
1978	8 May	1 seen	in Gulf Stream, S Bahia Honda Key	Kale 1978
1979	10 Jan.	1 seen	Cocoplum Beach	Stevenson 1979
1979	5 May	1 seen	between Marathon and Dry Tortugas	Kale 1979
1979	7 May	1 seen	between Marathon and Dry Tortugas	Kale 1979
1979	9 May	60 seen	in Gulf Stream, 6-15 mi off Islamorada	Kale 1979

Florida - Gulf Coast According to Kale (1979 ms b), this species is "relatively frequently seen" off the Florida Gulf Coast, particularly at more southerly areas. We have found but five records for this area, although some of those listed above for the Keys could be included here as well.

1972	Jun.	2 seen	10 mi off Venice	Kale 1979 ms b
1975	23 Sep.	1 seen	off Alligator Point, Franklin Co.	Edscorn 1976
1976	10 Jul.	1 seen	8 mi off Dog Island, Franklin Co.	Ogden 1976
1978	9 Apr.	1 seen	off Pasco Co.	Kale 1978

1978	9 Apr.	1 seen	off Pinellas Co.	Kale 1978

Alabama There are only two records of Audubon's Shearwater from Alabama, but neither is based on a specimen.

1978	30 Jun.	1 seen, photogr.	between Dauphin and Sand islands	Duncan 1978
1978	Aug.	(1?) seen	off Dauphin Island	Duncan and Havard 1979 ms

Louisiana There are now 10 records of Audubon's Shearwater for Louisiana and its offshore waters. Although considered of casual occurrence in the Gulf of Mexico by Duncan and Havard (1979 ms), the number of records from Louisiana and Texas, as well as the number of sightings of flocks, indicate that this species is at least fairly regular in this area. All the records from Louisiana, with one exception (March 1972), have been made between 3 May and 16 September.

1954	26 Aug.	2 of ca. 200 coll.	28° 54' N, 88° 00' W, 92 mi due S Mobile, 64 mi E mouth of Southeast Pass, La. (nearest land)	Newman 1955
1954	27 Aug.	(?) seen	in Gulf to west, ca. 30 mi from Southeast Pass	Newman 1955
1961	15-16 Sep.	14 found dead, 13 coll. (LSU)	beach near Johnson's Bayou, Cameron Par.	Imhof 1962a, Lowery 1974
1970	9 Jul.	1 coll.	ca. 38 mi of S. Pass	Stewart 1970
1970	3 Sep.	12 seen	18-30 mi offshore	Purrington 1971
1970	4 Sep.	15 seen	18-30 mi offshore	Purrington 1971
1972	29 Mar.	1 seen	Hackberry	F. James 1972
1972	3 May	1 seen	20 mi off S. Pass	Imhof 1972
1972	4 May	1 seen	8 mi off S. Pass	Imhof 1972
1978	22 Jul.	1 examined	Gulf, S Grand Isle	Jackson and Cooley 1978b

Texas Oberholser (1974) regarded Audubon's Shearwater as casual in Texas; he knew of 11 "definite" records, 9 of which he listed (see below). Records now available are predominantly from fall through spring, suggesting that the Audubon's Shearwaters occurring off the Texas coast may be wintering birds from Caribbean populations.

1929	29 Mar.	1 found (1) dying, coll. (USNM 330257)	Sabine Pass, Jefferson Co.	Oberholser 1974
1947	28 Jan.	1 found dead	Brazos Island, Cameron Co.	Oberholser 1974
1955	29 Apr.	1 found dead, coll. (LSU 20388)	beach, Port Aransas	Oberholser 1974, Blacklock 1978 ms
1961	20 Jul.	1 seen	7 mi offshore, 18 mi from Freeport	Webster 1961b
1961	11 Sep.	2 seen	out of Galveston	Webster 1962a
1961	13 Sep.	1 seen	out of Galveston	Webster 1962a
1961	17 Sep.	1 found dead	Galveston Island	Webster 1962a, Oberholser 1974
1961	20 Sep.	1 found dead	Stewart Beach	Webster 1962a, Oberholser 1974
1964	26 Apr.	1 male found dead, coll. (WWF 900)	beach, Padre Island, 15 mi S Bob Hall Pier	Webster 1964c, Oberholser 1974
1965	1 Jun.	1 seen	4 mi off Port Isabel	Webster 1965
1967	22 Sep.	remains found	Padre Island, Kleberg Co.	Blacklock 1978 ms
1967	23 Sep.	12 found dead, 1 female coll. (WWF 1433)	N. Padre Island	Oberholser 1974
1967	23 Sep.	1 female coll. (Texas A&M 7170)	Padre Island, 20 mi S Bob Hall Pier	Oberholser 1974
1968	19 Nov.	1 male found dead, coll. (WWF 1524)	Padre Island, Kenedy Co.	Oberholser 1974
1973	4 Nov.	1 found in surf, coll.	off south jetty, Galveston	Webster 1974a

(1) Oberholser (1974) listed the date this specimen was collected as 27 May. Data given on the label are listed here.

1977	8 Mar.	1 seen	40 mi off Port Aransas	Webster 1977c
1978	21 Oct.	1 seen	ca. 20 mi off Port Aransas	Webster 1979a
1979	24 Feb.	2 ssen	off Port Aransas	Webster 1979b

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Audubons's Shearwaters are pelagic birds of warm tropical waters and pantropical distribution. The total world population is unknown because details of breeding distribution are imperfectly known, and because data on the size of colonies are scant, usually well out of date, and often no more than mere speculation. As long ago as 1936 Murphy (1936) noted that numbers were diminishing throughout much of the range, a phenomenon that continues to the present day. Indeed, two of the Phoenix Islands populations which he wrote about in 1952 were almost certainly extirpated or decimated by then, probably as the result of the introduction of domestic cats. In other areas decrease in numbers has been attributed to human predation (Murphy 1936) and, on Bermuda, to rats, human interference, and perhaps Barn Owl (*Tyto alba*) predation (Wingate *in* Palmer 1962).

Migration and Winter Post-breeding Audubon's Shearwaters disperse from the nesting area, but the extent of dispersal is poorly known, and it is not known whether any populations are clearly migratory. Birds in the Galapagos disperse far north across the equator (Palmer 1962).

The reported status of Audubon's Shearwater in various distributional works dealing with the southeast is proportional to the recentness of the volume and to the extent of recent onshore and offshore observation of marine birds. Reported status varies from unreported (Mississippi) to "accidental" (Georgia)(Denton et al. 1977) to "common to abundant" (North Carolina)(Lee and Booth 1979), and to "second most common (Florida) shearwater" (Kale 1979 ms a). It seems to be less common in the Gulf of Mexico, but it is probably more common than the current paucity of records suggests. Audubon's Shearwater is probably seasonally common to abundant off all the states bordering the southern Atlantic coast. The period of greatest abundance is from May through October (Tables 24, 25).

HABITAT

Nesting Audubon's Shearwaters usually nest colonially and are largely noctural in their activities at most breeding stations. Those breeding in the Galapagos are unusual in that they are "entirely diurnal" in their activities (Harris 1969b). These shearwaters either dig burrows or use natural cavities, but the predominant type of nest varies from area to area. On Tiger Rock off Caribbean Panama, birds dug burrows that averaged less than 0.75 m in humus and fine clay that was heavily penetrated by the roots of the plants above (Wetmore 1965). On Phoenix Island in the Central Pacific, some of these shearwaters may dig much longer tunnels in sand beneath large boulders, but others

Table 24. Approximate number of Audubon's Shearwaters recorded by month in the coastal southeastern United States (a).

State/region	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	2	-	23	105	59	349	391	202	208	1	-
South Carolina	-	-	-	-	2	2	21	14	-	-	-	4
Georgia	-	-	-	-	8	-	1	-	1	-	-	-
Florida-Atlantic Coast	4	1	2	6	48	2	23	19	51	5	20	4
Subtotal-ATLANTIC COAST	4	3	2	29	163	63	394	424	254	213	21	8
Florida-Keys	1	-	-	2	1167	5	35	-	-	-	-	4
Florida-Gulf Coast	-	-	-	2	-	2	1	-	1	-	-	-
Alabama	-	-	-	-	-	1	-	1	-	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-	-	-	-
Louisiana	-	-	1	-	2	-	2	201	41	-	-	-
Texas	1	2	2	2	-	1	-	-	19	1	2	-
Subtotal-GULF COAST	1	2	3	4	2	4	4	202	61	1	2	-
Total-ALL AREAS	6	5	5	35	1332	72	433	626	315	214	23	12

(a) Birds found dead within the first 10 days of the month are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. If more than one was seen and the number is unknown (e.g., "several", "a few"), we have assumed two birds were seen.

may dig no burrows at all, nesting instead in open spaces beneath rock and coral rubble along the island rim. Those in Bermuda nest in rocky crevices beneath dense vegetation (Wingate in Palmer 1962), while those at South Plaza Island in the Galapagos nest mostly in holes or short tunnels in lava cliff-faces from high tide level to about 60 feet up (at the top of the cliffs). Other nests are among boulders, and a few are in holes inland (Snow 1965, Harris 1969b).

Feeding Off some breeding colonies such as those in the Galapagos, Audubon's Shearwaters may feed close inshore in dense aggregations of several thousand birds (Harris 1969b). Nonbreeding birds feed offshore and in pelagic waters.

Nonbreeding and Offshore These shearwaters are widespread in tropical pelagic waters, but tend to occur more abundantly where there are upwellings or strong currents around islands (Bourne in Palmer 1962). They usually occur solitarily or in small groups, but may form large feeding aggregations over tuna schools off the West Indies and northern South America (Watson 1966). In the vicinity of breeding colonies, in at least some areas (i.e., the

Table 25. Dates of occurrence for Audubon's Shearwaters in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence (a)
North Carolina	70	23 April - 7 November (5 February)
South Carolina	18	19 May - 31 August (11, 16 December)
Georgia	3	12 May - 27 September
Florida-Atlantic Coast	67	21 January - 27 December
Florida-Keys	22	25 April - 25 July (10 January, (13 December)
Florida-Gulf Coast	5	9 April - 23 September
Alabama	2	30 June - August
Mississippi	unrecorded	
Louisiana	10	3 May - 16 September (29 March)
Texas	18	11 September - 29 April (1 June, 20 July)

(a) Exceptional occurrences are listed in parentheses.

Bahamas), Audubon's Shearwaters may raft in extensive flocks on the surface of the water (Murphy 1936).

FOOD AND FEEDING BEHAVIOR

Audubon's Shearwaters feed primarily on fish and squid, but little specific information about their food habits is available. Palmer (1962) summarized all information available, but was essentially only able to report that they ate fish and cephalopods. Coles (1925) reported them feeding heavily on "sardines" off the North Carolina coast. Murphy (1936) reported that small crustaceans were found in the stomachs of breeding birds from the Galapagos. Harris (1969b) reported on regurgitations from 39 downy young and 8 adults from that area. In the great majority (36), the contents consisted of either planktonic larval fish up to 7 mm long or small planktonic crustacea. The rest consisted of mixtures of these and remains of fish up to 30 mm in length.

Harris (1969b) watched Audubon's Shearwaters feeding off a breeding colony in the Galapagos, and noted that most food was caught at or near the surface, but that some birds would occasionally dive and stay submerged for many seconds. In the same area, Loomis (1918 in Murphy 1936) saw them sitting in flocks on the surface, lowering their heads beneath the surface to peer for prey, and then diving in pursuit of prey for periods as long as a minute. These shear-

waters are also known to dive from the air (Brown et al. 1978), and Jehl (1974) noted an Audubon's Shearwater that leaped into the air from the water's surface to seize flying fish.

These shearwaters are usually not attracted to ships, but Murphy (1936) stated that birds in the West Indies occasionally gather behind local fishing vessels to scramble for food. Evidence of nocturnal feeding is scant, but Palmer (1962) suggested that they feed by both day and night. Watson (1966) noted that West Indian birds were particularly active at night when attracted to well-lit stationary ships.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying The egg laying period of Audubon's Shearwater varies widely from area to area. Those breeding on Tiger Rock lay at least in February (Wetmore 1965), while those on Bermuda evidently lay primarily in mid-March (Wingate *in* Palmer 1962). Murphy (1936) concluded from anecdotal data that eggs were present in the Caribbean largely from January or February to May. Egg laying may occur throughout the year in some equatorial areas such as the Galapagos (Snow 1965) and Phoenix Islands.

Mean Clutch Size Audubon's Shearwaters lay only one egg.

Incubation Period In the Galapagos Islands, Snow (1965) found a range of incubation periods of 48 $\pm$ 7 days to 56 $\pm$ 8 days, and estimated that the mean was between 50 and 53 days. As a result of later work in the same locality, Harris (1969b) reported a mean incubation period of 48.5 days (range = 45-53) for 10 eggs for which the period was measured precisely; the range found for 54 eggs for which incubation was less exactly known was 40 $\pm$ 4 days to 65 $\pm$ 5 days. Wingate (*in* Palmer 1962) gave the incubation period as about 51 days for birds breeding on Bermuda.

Hatching Success All quantitative data on hatching success are from the Galapagos Islands where considerable variation may occur within even a single year (Table 26).

Fledging Success Snow (1965) recorded a fledging success of 52.5% of 53 eggs laid for birds in the Galapagos. For the same area, Harris (1969b) reported that an average of 59% of the eggs hatched and, of these, 44% fledged. If fledging success is considered to be the proportion of eggs laid that fledge young, then these figures result in a fledging success of 26%, which is very low compared to most other seabirds.

Age at Fledging At South Plaza Island in the Galapagos Islands, Snow (1965) found a range of fledging periods from 68 $\pm$ 7 days to 88 $\pm$ 8 days (n = 12), with a mean estimated at about 70-80 days. More detailed observations at the same place by Harris (1969b) resulted in a mean fledging period of 75 days (n = 41) and a range of 62-100 days. Birds at Bermuda take flight at about 72 days (Wingate *in* Palmer 1962).

Age at First Breeding Age at first breeding has not been adequately

Table 26. Hatching success in Audubon's Shearwater in the Galapagos Islands (a).

	Hatching success (percent of eggs laid)	N	Period
	22.0	41	Jan.-Feb. 1966, 1967
	52.2	23	Mar.-Apr. 1966, 1967
	62.5	32	May-Jun 1966
	68.4	38	Jul. 1966
	76.9	13	Sep.-Oct. 1966
	40.0	55	Nov.-Dec. 1966, 1967
Total	49.0	202	

(a) Data partially recalulated from Table 8 in Harris (1969b).

established for this species. Harris (1969b) reported that one bird, banded as a nestling in the Galapagos Islands, was found breeding at an age of 8 years, 7 months.

Mortality of Eggs and Young Harris (1969b) listed primary sources of nesting failure in detail. Most egg failure occurred as a result of egg loss or desertion (79.7%, n = 94). Another 8.5% of the loss was due to the ejection of eggs from the nesting cavities by the adults.

Among 60 chicks that failed to fledge in the Galapagos, 48.3% disappeared without known cause (but possibly starved), and another 45% died of starvation. Two were eaten by predators, the Galapagos Short-eared Owl (*Asio galaopagoensis*) and the Grey (= Great Blue) Heron (*Ardea herodias*). At least 40 of 147 shearwaters killed by owls at this locality were juveniles (Harris 1969b). Murphy (1936) remarked that young were also collected as human food at many nesting grounds, and it seems likely that introduced predators have been a major factor in the elimination of other colonies.

Renesting In the Galapagos, pairs that nest unsuccessfully breed at somewhat shorter intervals (6.5 to 8 months) than do successful breeders (Harris 1969b), the latter initiating nesting cycles at approximately nine-month intervals (Snow 1965, Harris 1969b). There is no evidence that Audubon's Shearwater will re-lay after loss of an egg (Harris 1969b).

Maximum Natural Longevity The maximum recorded longevity for this species is an adult which lived to an estimated minimum age of 12 years (Rydzewski 1978). Abrasion of bands on birds banded in the Central Pacific resulted in almost complete loss within 2 years (Clapp, unpubl.), so it seems likely that maximum longevities may well be considerably in excess of the 12 year figure given above.

Weight (in grams) Our information on weights of Audubon's Shearwater is listed in Table 27.

Table 27. Weights of Audubon's Shearwaters (in grams).

Mean weight	Range	N	Sample and season	Area	Source
168	152-184	5	adult males in February	Phoenix Islands	Clapp in prep.
170	156-197	9	adult females in February	"	"
173	155-192	7	adult males in October	"	"
168	147-188	9	adult females in October	"	"
169	143-210	30	adult males	Galapagos Is.	Harris 1969b
167	128-211	48	adult females	"	"
153	123-184	20	non-breeding adults	"	"
168	123-225	82	pre-breeding adults	"	"
178	146-210	23	adults on eggs	"	"
165	143-186	16	adults with small young	"	"
169	127-230	26	adults with large young	"	"
29.2	-------	30	fresh eggs	"	"

SUSCEPTIBILITY TO OIL POLLUTION

We have found no records of oiling of this tropical, pelagic species. Bourne (1968a) noted the extreme rarity of oiling in a closely related species, the Manx Shearwater, and suggested this was the result of its largely pelagic distribution. Audubon's Shearwater is seldom seen in large numbers in southeastern waters, and as a result is probably relatively unsusceptible to the effects of oil pollution. The only area in the southeastern United States

where high mortality might occur is in the waters near the Florida Keys where large numbers of these birds have been seen on several occasions.

BIBLIOGRAPHY

1980

Brown, R. G. B. 1980. A second Canadian record of Audubon's Shearwater, *Puffinus lherminieri*. Can. Field Nat. 94: 466-467.

1979

Harris, M. P. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

1978

Bourne, W. R. P. and A. Loveridge. 1978. Small shearwaters from Ascension and St. Helena, South Atlantic Ocean. Ibis 120: 65-66.

Duncan, C. D. 1978. Bridled Tern and Audubon's Shearwater in Alabama. Ala. Birdlife 26: 16-17.

1976

Godfrey, W. E. 1976. Audubon's Shearwater, a species new for Canada. Can. Field Nat. 90: 494.

1974

Hatch, J. J. 1974. Homing experiments with Audubon's Shearwaters. Auk 91: 830-832.

Jehl, J. R., Jr. 1974. Aerial feeding by a shearwater. Auk 91: 188-189.

1973

McCrimmon, D. A., Jr. 1973. Leach's Storm Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47.

Rowlett, R. A. 1973. First Maryland specimen of Audubon's Shearwater. Md. Birdlife 29: 13-14.

1972

Anderson, B. H. 1972. Some uncommon avian records for central Florida. Fla. Nat. 45: 192.

1970

Binford, L. C. 1970. Audubon's Shearwater, Hudsonian Godwit and Long-tailed Jaeger in Oaxaca, Mexico. Condor 72: 366.

Browne, M. M. and G. S. Grant. 1970. Sooty Tern and Audubon's Shearwater off South Carolina in September. Chat 34: 102-103.

Jouanin, C. 1970. Note taxinomique sur les Petits puffins Puffinus lherminieri de l'Ocean indien occidental. Oiseau R.F.O. 40: 303-306.

Wallace, R. 1970. Good sightings of birds in 1969. [Audubon's Shearwater, Puffinus lherminieri.] Fla. Nat. 43: 177.

1969

Collins, C. T. 1969. A review of the shearwater records for Trinidad and Tobago, West Indies. Ibis 111: 251-253.

Harris, M. P. 1969b. Food as a factor controlling the breeding of Puffinus lherminieri. Ibis 111: 139-156.

1967

Pantelides, Ms. N. 1967. Audubon's Shearwater (Puffinus lherminieri) at Fort Pierce. Fla. Nat. 40: 65.

Post, P. W. 1967. Manx, Audubon's, and Little shearwaters in the northwestern North Atlantic. Bird-Banding 38: 278-305.

1965

Snow, D. W. 1965. The breeding of Audubon's Shearwater (Puffinus lherminieri) in the Galapagos. Auk 82: 591-597.

1964

Chamberlain, E. B. 1964. Notes on an Audubon's Shearwater at Charleston, South Carolina. Chat 28: 91-93.

Leveque, R. 1964. Notes sur la reproduction des oiseaux aux iles Galapagos. Alauda 32: 5-44, 81-96.

Post, P. W. 1964. The occurrence and field identification of small "black and white shearwaters" in New York. Kingbird 14: 133-140.

1963

Dyke, S. H. 1963. Audubon's Shearwater seen at Ocean City. Md. Birdlife 19: 67.

Grant, R. H. 1963. Bridled Terns off the North Carolina coast. Chat 27: 21-22.

Russell, W. 1963. Audubon's Shearwater at Barnegat. Cassinia 47: 38.

1959

Wetmore, A. 1959. Description of a race of the shearwater Puffinus lherminieri from Panama. Proc. Biol. Soc. Wash. 72: 19-22.

1954

Murray, J. J. 1954. Audubon's Shearwater (Puffinus lherminieri) at Fort Pierce, Florida. Fla. Nat. 27: 95.

1953

Cutler, D. A. 1953. Audubon's Shearwater off Asbury, New Jersey. Cassinia 39: 23-24.

1952

Rankin, H. J. 1952. Audubon's Shearwater off Morehead City, N.C. Chat 16: 24.

1951

Davis, L. I. 1951. Birds new for the Rio Grande delta area. Wilson Bull. 63: 333.

1940

Pough, R. H. 1940. Oceanic birds in winter. Chat 4: 49.

Storer, R. W. 1940. Audubon's Shearwater on New Jersey coast. Auk 57: 244.

1939

Lind, P. 1939. Audubon's Shearwater ashore on Long Island. Auk 56: 73.

1938

Richardson, J. 1938. Audubon's Shearwater in Massachusetts. Auk 55: 119.

Smyth, J. A. 1938. Audubon's Shearwater nesting on Mona Island, Puerto Rico. Wilson Bull. 50: 203-204.

1936

Harrison, J. M. 1936. Audubon's Little Shearwater in Sussex, a new British bird. Brit. Birds 30: 48-49.

1931

Gutsell, J. S. 1931. Sooty Shearwater and Audubon's Shearwater in North Carolina. Auk 48: 105-106.

Palmer, T. S. 1931. Audubon's Shearwater in the United States. Auk 48: 198-206.

1927

Murphy, R. C. 1927. On certain forms of Puffinus assimilis and its allies. Amer. Mus. Novit. 276: 1-15.

1926

Stone, W. 1926. Audubon's Shearwater at Cape May, N.J. Auk 43: 536.

Wayne, A. T. 1926. The Sooty Tern and Audubon's Shearwater in South Carolina. Auk 43: 534-535.

1925

Coles, R. J. 1925. Sea-birds at Cape Lookout, N.C. Auk 42: 123-124.

1906

Bradlee, T. S. 1906. Audubon's Shearwater and Peale's Petrel breeding in Bermuda. Auk 23: 217.

1901

Rives, W. C. 1901. Audubon's Shearwater (Puffinus auduboni) on the coast of Virginia. Auk 18: 189.

1889

Feilden, H. W. 1889. On the breeding of Puffinus auduboni in the Island of Barbados. Ibis (6th Ser.) 1: 60-63.

Lawrence, G. N. 1889. An account of the breeding habits of Puffinus auduboni in the island of Grenada, West Indies, with a note on Zenaida rubripes. Auk 6: 19-21.

LITTLE SHEARWATER

(*Puffinus assimilis*)

[DA: Lille Skrape, DU: Kleine Pijlstormvogel, EN: Allied Shearwater, FI: Kaapioliira, FR: Petit Puffin, Puffin obscur ou semblable; GE: Kleiner Sturmtaucher, Gelbschnabelsturmtaucher; IC: Dvergskrofa, IT: Berta minore di Bonaparte, Berta minore fosca; PR: Pintainho, Pardela; SP: Pardela chica, SW: Dvarglira]

GENERAL DISTRIBUTION

North America There are two records, both before 1900, one in Nova Scotia (Dwight 1897) and one in South Carolina (Peters 1924).

World Distribution Little Shearwaters breed in the eastern Atlantic on the Azores, Cape Verdes, Canaries, and (perhaps) the Desertas island groups. Related races occur in the South Atlantic, off southwest Australia, off New Zealand and Rapa Island, and have been recorded around the Juan Fernandez Islands (Palmer 1962, King 1967, Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

South Carolina A Little Shearwater was captured alive on the beach of Sullivan Island, Charleston County, sometime in August 1883. The specimen was originally misidentified as Audubon's Shearwater (Peters 1924).

HABITAT

Nesting Little Shearwaters nest in holes and crevices in or among rocks or tussocks of vegetation (Murphy 1936, Palmer 1962, Cramp et al. 1977).

Feeding, Winter and Offshore The Little Shearwater's habitat preferences when at sea are not well known. The species seems to prefer warm temperate seas, at least in the Atlantic, and perhaps occurs in areas of ocean temperature between those used by Audubon's (warmer) and Manx (colder) shearwaters (Murphy 1936, Cramp et al. 1977). At least some populations remain in the vicinity of their nesting islands, and individuals may often be found in burrows at any season of the year (Jouanin 1964, Cramp et al. 1977).

FOOD AND FEEDING BEHAVIOR

Little Shearwaters have been recorded eating fish and squid up to 3 inches (8 cm) in length (Falla 1954, Bourne 1955). *Puffinus assimilis* is one of the diving shearwaters that habitually feed by pursuit plunging or pursuit diving.

SUSCEPTIBILITY TO OIL POLLUTION

We have no records of oiled Little Shearwaters. This is not surprising, because Little Shearwaters are rare in those areas where beached bird surveys are regularly done. As a diving shearwater it may be more susceptible to floating oil than are the surface feeding species.

BIBLIOGRAPHY

1980

Bourne, W. R. P. 1980. The prions collected by R. H Beck off the Antipodes Islands and the breeding season of the Little Shearwater. Notornis 27: 297-298.

1978

Bourne, W. R. P. and A. Loveridge. 1978. Small shearwaters from Ascension and St. Helena, South Atlantic Ocean. Ibis 120: 65-66.

1977

Rozendaal, F. G. 1977. A record of the Little Shearwater *Puffinus assimilis* off the coast of South Africa. Ardea 65: 204.

Verrall, K. 1977. Little Shearwater in Argyllshire. Scott. Birds 9: 380-381.

1975

Dennis, R. H. 1975. Scottish bird report 1974. Scott. Birds 8: 395-467.

Wallace, D. I. M. 1975. Little Shearwater, *Puffinus assimilis*. Isles Scilly Bird Rept. 1974: 23.

1974

Smith, F. T. H., R. Swindley and R. Sympson. 1974. Little Shearwater near Barwon Heads, Vict. Austr. Bird Watcher 5: 186-187.

1972

Brown, R. G. B. 1972. Probable sightings of Little Shearwaters, *Puffinus assimilis*, on the southeastern Grand Banks. Can. Field Nat. 86: 293-294.

1967

Post, P. W. 1967. Manx, Audubon's, and Little shearwaters in the northwestern North Atlantic. Bird-Banding 38: 278-305.

1965

Merne, O. J. 1965. Little Shearwaters in Co. Donegal. Irish Nat. J. 15: 76-77.

Merne, O. J. and T. R. E. Devlin. 1965. Madeiran Little Shearwaters off Co. Donegal. Brit. Birds 58: 189-190.

1964

Bannerman, D. 1964. On the status of Puffinus assimilis baroli in the Azores archipelago. Bull. Br. Ornithol. Club 84: 111-112.

Jouanin, C. 1964. Le comportement en juillet des Petits Puffins, Puffinus assimilis baroli (Bonaparte), de l'ile Selvagen Grande. Bol. Mus. Munic. Funchal 18: 142-157. [In French with English summary.]

Post, P. W. 1964. The occurrence and field identification of small "black and white shearwaters" in New York. Kingbird 14: 133-140.

1961

Brun, R. 1961. Puffin obscur ou Petrel de Madere en Normandie. Oiseau R.F.O 31: 344.

Thorne, C. J. R. and R. M. Nedderman. 1961. Little Shearwater in Norfolk. Brit. Birds 54: 39.

1959

Bourne, W. R. P. 1959. A new Little Shearwater from the Tubaui Islands: Puffinus assimilis myrtae subsp. nov. Emu 59: 212-214.

1958

Warham, J. 1958. Photographic studies of some less familiar birds. XCII. Little Shearwater. Brit. Birds 51: 393-397.

1955

Warham, J. 1955. Observations on the Little Shearwater at the nest. W. Austr. Nat. 5: 31-39.

1952

Ryall, R. H. 1952. Little Shearwater in Caernarvonshire. Brit. Birds 45: 222.

1946

Glauert, L. 1946. The Little Shearwater's year. Emu 46: 187-192.

1943

Fleming, C. A. and D. L. Serventy. 1943. The races of Puffinus assimilis in Australia and New Zealand. Emu 43: 113-125.

1927

Murphy, R. C. 1927. On certain forms of Puffinus assimilis and its allies. Amer. Mus. Nov. 276: 1-15.

1924

Peters, J. L. 1924. A second North American record for Puffinus assimilis. Auk 41: 337-338.

1897

Dwight, J., Jr. 1897. A species of shearwater (Puffinus assimilis Gould), new to the North American fauna. Proc. Biol. Soc. Wash. 11: 69-70.

WILSON'S STORM-PETREL

(*Oceanites oceanicus*)

[DA: Wilson's Stormsvale, DU: Wilson's stormvogeltje, FI: Merikiitaja, FR: Petrel oceanite, GE: Buntfussige, Buntifussige Sturmsschwalbe; IC: Hafsvala, IT: Uccello delle tempeste di Wilson, JA: Ashinaga koshijiro umitsubame, NW: Wilson's stormsvale, PO: Nawalnik Wilsona, PR: Cosquilho, Painho; SP: Paino de Wilson, Petrel de las Tormentas; SW: Havslopare]

GENERAL DISTRIBUTION

North America In North America, Wilson's Storm-Petrel is an offshore migrant and visitor during the Southern Hemisphere winter (northern summer). It is the most frequently seen and most abundant storm-petrel off the Atlantic coast, where migrant and wintering birds occur regularly in considerable numbers along the shores north to about 45°-47° N latitude (Nova Scotia, New Brunswick, and Newfoundland)(Godfrey 1966, Cramp et al. 1977). Birds regularly enter the Gulf of Mexico and are apparently somewhat more abundant in the eastern portion (Duncan and Havard 1979 ms), but are less abundant there than off the Atlantic coast. Wilson's Storm-Petrels do not occur off the Pacific coast of the United States except casually and in small numbers, but they straggle fairly frequently to about 31° N latitude (AOU 1957, Crossin 1974).

World Distribution Wilson's Storm Petrel breeds in many areas of the Antarctic north to about 49° S latitude near the Subantarctic Convergence (BOU 1971). They breed on the Antarctic Continent and Antarctic Peninsula and at many islands off the coast, among them South Georgia, South Orkney, South Shetland, and South Sandwich. South of Australia and New Zealand this petrel breeds at Scott Island and perhaps other localities, and in the Indian Ocean it breeds at least on Kerguelen and Heard islands (Watson 1975, Jouanin and Mougin 1979). In and off South America, Wilson's Storm-Petrel breeds on Tierra del Fuego, Argentina, in the Falkland Islands, and on islands around Cape Horn, including at least Wollaston, Deceit, and Herschel (AOU 1957, Blake 1977).

These birds migrate north primarily along the eastern shores of North and South America, with smaller numbers moving north off both shores of Africa. The species winters widely in tropical waters of the Indian Ocean and north to about 20° N latitude in the Red Sea; smaller numbers occur in the eastern Mediterranean Sea (Cramp et al. 1977). This is the most commonly seen storm-petrel in the Australian seas (Serventy et al. 1971), and it is widely distributed in the Pacific Ocean, although in relatively much smaller numbers than in the Atlantic and Indian oceans. Large numbers occur north along the western South American coast to Peru, and in the western Pacific they occasionally reach Japanese waters (Crossin 1974, Watson 1975, Blake 1977). Wilson's Storm-Petrels are considerably less common in the tropical waters of the Central Pacific than along the South American Continent, but occur regularly during migration in the Marshall Islands (Huber 1971, Watson 1975).

The southward migration in the Atlantic begins in September, and most birds are gone from the northwestern portion by the end of the month. Migration continues south, apparently largely along the South American coast, and by December most birds are south of 30° S latitude and on the breeding grounds (Palmer 1962).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Wilson's Storm-Petrel is the most common petrel off North Carolina during the summer (Lee and Booth 1979), where it has been recorded more frequently than any other procellariiform. We have found over 80 records of its occurrence in the waters but include here only those observations that involve collected specimens or 75 or more birds seen during one day, and those that represent the presently known extremes of temporal occurrence. These petrels have been records offshore from 8 March through 22 October (Lee and Booth 1979), but peak numbers are present in late May and early June. Unlike Leach's Storm-Petrel, Wilson's Storm-Petrel frequently occurs in inshore waters, which accounts in part for the relatively large number of observations.

1893	28-30 Aug.	many thousands	driven ashore on 10 mi of beach, Beaufort Harbor to Cape Lookout, following storm	Pearson et al. 1919
1921	11 Jun.	1 coll.	New River Inlet, Onslow Co.	Pearson et al. 1919
1963	12 Jul.	150+ seen	13.5 mi E Currituck Lighthouse	Sykes 1963
1963	12 Jul.	ca. 250 seen	11 mi E Oregon Inlet	Sykes 1963
1969	17 May	"large numbers"	off Cape Lookout	Parnell 1969a
1970	31 May	750+ seen	off Hatteras Inlet	Buckley 1973
1970	1 Jun.	250+ seen	off Hatteras Village	Buckley 1973
1972	3 Jun.	"at least 100" seen	Cape Lookout	Teulings 1972e
1972	19 Aug.	93-106 seen	off Morehead City	Teulings 1972d, 1973a
1972	22 Oct.	3 seen	off Morehead City	Teulings 1973a
1973	19 May	116 seen	off Hatteras	Teulings 1973c
1973	26 May	150 seen	off Morehead City	Teulings 1973c
1973	3 Jun.	110 seen	off Morehead City	Teulings 1973c

1973	23 Jun.	75 seen	along beach, Cape Hatteras	Teulings 1973d
1973	25 Jun.	75+ seen	off Hatteras	Teulings 1973e
1973	2 Sep.	92 seen	off Hatteras	Teulings 1974e
1973	16 Sep.	100 seen	off Hatteras	Teulings 1974e
1974	8 Mar.	2 seen	25 mi off Morehead City	Teulings 1974c
1974	17 Jul.	191 seen	Gulf Stream, 35-40 mi off Oregon Inlet (peak count Jun.-Jul.)	Teulings 1974d
1974	9 Aug.	99 seen	off Hatteras	Teulings 1975a
1974	1 Sep.	75 seen	off Hatteras	Teulings 1975a
1974	13 Sep.	76 seen	off Morehead City	Teulings 1975a
1975	18 May	60-75 seen	off Hatteras	Teulings 1975d
1975	5 Jul.	60-75 seen	off Hatteras	Teulings 1975e
1975	7 Sep.	ca. 350 seen	off Oregon Inlet	Teulings 1975e
1976	11 Aug.	137 seen	off Oregon Inlet	Teulings 1977a
1977	1 Jun.	150+ seen	off Outer Banks (peak Jun. count)	LeGrand 1977b
1978	17-18 May	1000+ migrants seen	counted offshore	Lee and Booth 1979
1979	23 Apr.	79 seen	off Oregon Inlet (peak count)	LeGrand 1979c
1979	10 May	71 seen	off Oregon Inlet	LeGrand 1979d
1979	13 Jun.	168 seen	off Oregon Inlet	LeGrand 1979d

South Carolina Although early state avifaunal works (Wayne 1910, Sprunt and Chamberlain 1949) considered Wilson's Storm-Petrel a common to fairly common summer visitor offshore, we have found only 19 published records for the state. There is no good reason to believe that the species is less common off the shore of South Carolina than it is off North Carolina. This species has been recorded from 5 May through 15 October in South Carolina, and peak abundance in offshore waters is probably the same as for North Carolina.

1913	15 Jun.	1 seen	Bird Bank, Bull's Bay	Sprunt and Chamberlain 1949
1938	14 Aug.	1 coll.	off Charleston jetties	Sprunt and Chamberlain 1949
1939	5 May	1 coll.	off Charleston jetties	Sprunt and Chamberlain 1949
1947	2 Jul.	1 seen	inshore, Folly Beach	Chamberlain and Chamberlain 1947
1947	15 Oct.	1 seen	Charleston waterfront	Chamberlain and Chamberlain 1948
1961	2 Aug.	1 seen	off Litchfield Beach, Georgetown Co.	Chamberlain 1962a
1964	10 Sep.	1 seen	Hilton Head Island	Parnell 1965a
1965	9 Jun.	4 seen	16 mi off Charleston	Chamberlain 1965
1965	20 Jun.	25 seen	45 mi off Murrell's Inlet	Jones 1965
1965	late Jun.-early Sep.	present in small numbers	Murrell's Inlet	Parnell 1966a
1966	15 Jun.-4 Aug.	"plentiful"	off Murrell's Inlet	Parnell 1966c
1968	25 Aug.	12 seen	off Charleston	Parnell 1968d
1970	8 Aug.	7 seen	10-50 mi off Murrell's Inlet	Teulings 1970b
1971	11 Jun.	6 seen	near C-2 buoy off Charleston	Teulings 1971e
1972	10 Nov.	6 seen	off Charleston	Teulings 1973e
1973	20 Jun.	15 seen	off Charleston	Teulings 1973d
1973	25 Jul.	15 seen	off Charleston	Teulings 1973d
1973	28 Jul.	25 seen	off Charleston	Teulings 1973e

1975	5 Jul.	"good numbers" seen	outside Charleston	Teulings 1975d

Georgia Wilson's Storm-Petrel was regarded as a rare summer visitor along the coast in earlier state avifaunal works (Greene et al. 1945, Burleigh 1958), and most recently has been regarded as an uncommon but regular visitor offshore (Denton et al. 1977). We know of only eight records for the state, but consider this largely a result of lack of observation. This species is one of the most common procellariiforms along the coasts of the Atlantic States both to the north and to the south, therefore it seems likely that it is at least fairly common in Georgia waters as well.

1926	Sep.	2 spec. coll. (1 to U. Mich.)	15-20 mi off mouth of Savannah River	Greene et al. 1945, Burleigh 1958
1937	8 Aug.	1 caught, released	beach, Tybee Island	Eyles 1938b
1939	16 Jun.	1 seen	ca. 20 mi off St. Simons Island	Sciple 1939
1960	5 Jun.	1 seen	ca. 3 mi off Tybee Island	Sciple 1960
1961	11 Jul.	several seen	ca. 12 mi E Sapelo Island	Griffith and Kale 1961
1961	3 Aug.	several seen	off coast	Griffith and Kale 1961
1972	1 Jul.	1 coll.	Little Cumberland Island	Denton et al. 1977
1974	22 Jun.	(1?) seen	Jekyll Island	Denton et al. 1977

Florida - Atlantic Coast We have found 26 records (below) of Wilson's Storm-Petrel for the Atlantic coast of Florida, where it is regarded as the most abundant storm-petrel (Kale 1979 ms a). These petrels have been recorded as early as 21 April and as late as 3 November, but peak numbers are evidently present in May and June (Table 28).

1909	3 Jul.	4 seen	Mosquito Inlet	Howell 1932
1911	12 Aug.	3 seen	Mosquito Inlet	Howell 1932
1940's	-----	1 found alive	Daytona beach	Sprunt 1954
1956	12 Jun.	1 seen	ca. 20 mi off Canaveral	Stevenson 1956d

1960	5 Aug.	1 of ca. 5 coll.	off Canaveral	Stevenson 1960d
1960	11 Sep.	1 seen	off Cocoa Beach	Robertson and Paulson 1961
1961	12 Jun.	ca. 5 seen	15-20 mi off Miami	Robertson 1961
1962	31 May	3 seen	off Miami	Paulson and Stevenson 1962
1965	7 Sep.	1 found injured	Vero Beach	Stevenson 1966a
1967	13 May	2 seen	12 mi S Fort Pierce	Stevenson 1967b
1969	30 May	1 found alive	Ormond Beach	Starkey 1969
1968	6 Jun.	1 found	Sebastian Inlet	Stevenson 1968b
1971	3 May	1 seen	5-20 mi E Cocoa Beach	Kale 1971
1971	14 Aug.	9 seen	off Cocoa	Ogden 1971
1972	21 Apr.	1 seen	off Port Canaveral	Kale 1972
1972	15 May	20 seen	off Cocoa	Ogden 1972
1974	20 May	7 seen	E Cape Canaveral	Kale 1974
1974	29 May	16 seen	E Cape Canaveral	Kale 1974
1974	4 Jun.	51 seen	E Cape Canaveral	Kale 1974
1975	3 Nov.	1 seen	off Canaveral	Edscorn 1975
1975	3 Jul.	"common"	off Cape Canaveral	Ogden 1975
1976	18 May	"numerous"	50 mi E Cape Canaveral	Kale 1976
1977	May?	54 seen	off Ponce de Leon Inlet	Kale 1977
1978	29 Apr.	40 seen	100 mi E Ponce de Leon Inlet	Kale 1978
1979	3 May	11 seen	off Ponce de Leon Inlet	Kale 1979
1979	13 May	1 seen	off Fort Pierce Inlet	Kale 1979

Florida - Keys We have 12 records for the Florida Keys, although those from the Florida Straits could also be regarded as records for the Atlantic

coast. The period of occurrence indicated by the records (largely May-June) is probably biased by the timing of visits to the Dry Tortugas, most of which have occurred during these months. Wilson's Storm-Petrel doubtless occurs in the Keys over a wider span of time and in greater numbers than is suggested by the few records given below.

1936	Jun.	seen	Dry Tortugas	Sprunt 1954
1946	Jun.	seen	Key West harbor	Sprunt 1954
1947	Jun.	seen	Key West harbor	Sprunt 1954
1948	Jun.	seen	Key West harbor	Sprunt 1954
1956	13 Jul.	1 seen	near Marquesas Keys	Stevenson 1956d
1970	4 May	1 seen	10-12 mi E Dry Tortugas	Kale 1970
1970	10 Jun.	1 seen	15 mi E Dry Tortugas	Ogden 1970
1970	Jul.	"quite a number" seen	Florida Straits, off Upper Keys	Ogden 1970
1970	4 Oct.	1 seen	E Dry Tortugas	Robertson 1971
1972	16 May	2 seen	Florida Straits	Kale 1972
1972	17 May	10 seen	Florida Straits	Kale 1972
1972	21 May	12 seen	Florida Straits	Kale 1972
1972	25 May	50 seen	Florida Straits	Kale 1972

Florida - Gulf Coast Kale (1979 ms b) regards Wilson's Storm-Petrel as a regular but rare summer visitor off the Florida Gulf Coast. In the Gulf of Mexico as a whole it is the most frequently reported storm-petrel, and off the Florida Gulf Coast it has been recorded from 25 April through early September. Ten of the 18 records known to us have been made in May or July, strongly suggesting that the period of peak occurrence is the same here as it is in the Atlantic.

1926	5 Jul.	3 seen	off Pensacola	Howell 1932
1947	24 May	"in some numbers"	ca. 50 mi SE Pensacola	Weston 1947
1948	10 Jun.	1 seen	Bivan's Arm Lake, near Gainesville (inland)	Sprunt 1954
1950	ca. 1 May	? seen	15-30 mi off Pensacola	Lowery 1950b

1950	30 May	4 seen	off Pensacola	Lowery 1950b
1950	10 Jun.	3 seen	30 mi off Pensacola	Lowery and Newman 1950a, Sprunt 1954
1950	first week Sep.	3 seen	off Pensacola	Lowery and Newman 1951a
1953	26 Apr.	2 seen	off Pensacola	Lowery and Newman 1953
1963	29 May	12-25 seen	20 mi S Cape San Blas	Imhof 1963
1968	10 Aug.	1 seen	10 mi off Sarasota	Stevenson 1968b
1969	9 Jun.	1 seen	1 mi off NW coast, Everglades Natl. Park	Ogden 1969
1972	May?	1 seen	First Bay, Lostmans River	Kale 1972
1972	13 Jul.	1 seen	Horseshoe Beach	Ogden 1972
1973	26 Jul.	60 seen	4-6 mi S Seven-Mile Bridge, Monroe Co.	Ogden 1973
1977	25 Apr.	1 seen	on Marco River, E of Gulf	Kale 1977
1977	8 May	3 seen	87 mi off Clearwater	Buhrman and Hopkins 1978
1977	31 Jul.	1 seen	off Pasco Co.	Edscorn 1978
1977	31 Jul.	3 seen	70 mi off Clearwater	Buhrman and Hopkins 1978

Alabama As recently as 1976 (Imhof 1976b), the occurrence of Wilson's Storm-Petrel in Alabama was considered hypothetical, with only three sight records. There are now at least 10 records for the state, all from offshore waters, and the species is best regarded as regular, perhaps common, there. Peak numbers are present from May through July or perhaps August.

1946	27 Aug.	10 seen	off Fort Morgan	Imhof 1976b
1974	2 May	1 seen	9 mi S Dauphin Island	Imhof 1976b
1975	18 Jul.	2 seen	50 mi S Dauphin Island	Stewart 1975, Duncan and Havard 1979 ms

1977	Jun.	3 seen	offshore	Duncan and Havard 1979 ms
1978	27 May	25+ to 100 seen	to 70 mi S Dauphin Island	Imhof 1978, Duncan and Havard 1979 ms
1978	10 Jun.	seen	20-70 mi SSE Alabama Point	Imhof 1978
1978	11 Jun.	1 seen	30 mi S of Sand Island Light	Jackson and Cooley 1978b
1978	Jul.	100+ seen	offshore	Duncan and Havard 1979 ms
1978	Jul.	20 seen	offshore	Duncan and Havard 1979 ms
1979	Jun.	seen	offshore	Duncan and Havard 1979 ms
1979	Aug.	3 seen	offshore	Duncan and Havard 1979 ms

Louisiana We have found only 12 records of the occurrence of Wilson's Storm-Petrel in Louisiana, but are aware that there are at least a few more (see Lowery 1974). This storm-petrel is apparently fairly regular in offshore waters where it has been seen most frequently from June to early September (Lowery 1974). Extreme dates of occurrence for the state are 3 April and 9 September (Imhof 1973, Lowery 1974).

1915	25 Jun.	1 seen	off Cheniere Caminada, 7 mi W Grand Isle	Oberholser 1938
1933	9 Jun.	2 seen	off mouth of Bayou La Fourche	Oberholser 1938
1933	8 Jun.	13 seen	off coast between mouth of Mississippi River and Shell Island	Oberholser 1938
1970	18 Jun.	seen	off South Pass	Stewart 1970
1970	12 Aug.	2 seen	18 mi off South Pass	Stewart 1970
1970	23 Aug.	1 seen	26 mi off South Pass	Stewart 1970
1970	2 Sep.	15 seen	off South Pass	Stewart 1970
1970	3 Sep.	2 seen	off South Pass	Stewart 1970

1971	19 May	1-2 seen	ca. 20 mi SE South Pass	Imhof 1971a
1972	3 May	1 seen	20 mi S South Pass	Imhof 1972
1973	3 Apr.	1 seen	10-15 mi off Grand Isle	Imhof 1973
1975	17 Jun.	2 seen	from oil rig, ca. 110 mi S Morgan City, ca. 28° 15' N, 92° 30' W	J. Stewart 1975

Texas Wilson's Storm-Petrel is considered casual in Texas (Oberholser 1974) and we know of only three records for the state. Whether the species is actually as uncommon in offshore waters as these few records suggest is not yet established.

1912	5 Jun.	1 shot	mouth of Fish Bayou, San Jacinto Bay, Harris Co.	Oberholser 1974
1961	20 Apr.	1 seen	7 mi off Texas Point near Sabine Pass, Jefferson Co.	Oberholser 1974
1961	14 Jul.	2 seen	off Port Aransas	Webster 1961b

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Wilson's Storm-Petrel is an extremely abundant breeding bird on islands offshore and on the mainland of Antarctica (Palmer 1962). Beck and Brown (1972) considered this species "possibly the most abundant" of Antarctic seabirds. At only one of many breeding localities, South Signy Island in the South Orkney Islands, Beck and Brown (1972) estimated there were 200,000 pairs.

Winter This species of petrel winters widely in tropical and subtropical seas, where birds are regular to 45° or 47° N latitude on both sides of the Atlantic and where they concentrate in the offshore zone and in areas of abundant plankton (Palmer 1962, Cramp et al. 1977). In the southeastern United States, roughly 75% of all birds recorded have been seen from May through July, and over 95% have been seen from May through September (Tables 28, 29).

Most of the birds wintering in North American waters are thought to belong to the larger race (*Oceanites oceanicus exasperatus*) that breeds further south in the Southern Hemisphere (Palmer 1962). Evidence for this was provided by Beck and Brown (1972), who reported that a bird banded on Signy Island in early February 1970 was recaptured 4 months later off the coast of New Jersey.

Table 28. Approximate number of Wilson's Storm-Petrels recorded by month for the coastal southeastern United States (a).

State/region	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
North Carolina (b)	2	90	2223	1031	918	552	805	17	-
South Carolina	-	-	1	55	48	25	3	1	6
Georgia	-	-	-	3	3	3	2	-	-
Florida-Atlantic Coast	-	41	64	53	11	17	2	-	1
Subtotal-ATLANTIC COAST	2	131	2288	1142	980	597	812	18	7
Florida-Keys	-	-	74	5	3	-	-	1	-
Florida-Gulf Coast	-	3	22	5	68	1	3	-	-
Alabama	-	-	26	6	122	13	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-
Louisiana	-	1	2	19	-	3	17	-	-
Texas	-	1	-	1	2	-	-	-	-
Subtotal-GULF COAST	-	5	50	31	192	17	20	-	-
Total-ALL AREAS	2	136	2412	1178	1175	614	832	19	7

(a) Birds found dead within the first 10 days of the month are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. We found no records for January, February, or December.

(b) We have not included herein the "many thousands" driven ashore in late August 1893 since we feel that such inclusion would too severely distort the totals given above.

Migration In both the Atlantic and Indian oceans, most migration occurs during April to June and in September to November (Palmer 1962). Limited observations in the Central Pacific suggest similar periods of abundance there (Crossin 1974).

HABITAT

Nesting Wilson's Storm-Petrel is a loosely colonial species that nests in holes and crevices among rocks, or that may dig burrows in soil or moss (Watson 1975).

In the Argentine Islands, Wilson's Storm-Petrels commonly nested in crevices among shattered rocks, but also in shallow burrows in moss. Most of the latter had been excavated by the birds, but some were natural cavities. Bur-

Table 29. Dates of occurrence for Wilson's Storm-Petrel in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence
North Carolina	90	8 March - 22 October
South Carolina	19	5 May - 15 October
Georgia	8	5 June - ?? September
Florida-Atlantic Coast	26	21 April - 3 November
Florida-Keys	12	4 May - 4 October
Florida-Gulf Coast	18	25 April - early September
Mississippi	unrecorded	
Alabama	10	2 May - 27 August
Louisiana	12+	3 April - 9 September
Texas	3	20 April - 14 July

rows were short, averaging about 40 cm long with a diameter of 10-15 cm at the entrance. Usually a nest was built of vegetation, but rarely eggs were placed directly on the bare ground (Roberts 1940). Nests were found 20-50 cm deep inside rock crevices in the South Shetland Islands (Pefaur 1974). At Signy Island in the South Orkney Islands, nest sites were similar to those reported by Roberts (1940). In contrast, many sites on Adelaide Island, Marguerite Bay, were exposed and in the lee of large boulders (Beck and Brown 1972).

These storm-petrels have also been found nesting in burrows or natural holes in damp, peaty soil in the Cape Horn area (Reynolds 1935 in Roberts 1940), among blocks of ice among rocks in the South Orkney Islands (Ardley 1936 in Roberts 1940), and in burrows in volcanic ash at Deception Island in the South Shetlands (Beck and Brown 1972).

Feeding Although regularly feeding well offshore, Wilson's Storm-Petrel feeds inshore much more frequently than does Leach's Storm-Petrel. One was seen feeding only a few yards offshore in Encounter Bay, Australia (Eckert 1969).

Nonbreeding and Offshore In North American waters these petrels usually occur solitarily or in small flocks. They readily assemble in larger numbers where food is concentrated, and often follow ships in loose flocks (Palmer 1962). They occur inshore more often than other Procellariiformes occurring along the Atlantic coast, and have been noted as predominantly coastal elsewhere as well. Bailey (1966 in Beck and Brown 1972) "found that the majority of wintering birds in the Arabian Sea during July and August occurred along the edge of the continental shelf, less than 80 km. from land."

FOOD AND FEEDING BEHAVIOR

Food of Wilson's Storm-Petrel is mainly small crustaceans (particularly euphausiids) and small cephalopods (Watson 1975).

Roberts (1940) indicated that young Wilson's Storm-Petrels were fed partially digested krill (Euphausia superba) at the Argentine Islands, British Graham Land. Krill was also the only food identified in the stomachs of adults. This organism was the principal item of diet at Signy Island (Beck and Brown 1972). In Royal Sound, Kerguelen Island, the primary food was an abundant amphipod (Euthemisto sp.), but krill were also eaten in that area (Falla 1937 in Roberts 1940). Other foods taken include small cephalopods, floating globules of oil, and fat particles (Roberts 1940). Mougin (1968) reported that cephalopods predominated in the diet at the Pointe Geologie Archipelago, Adelie Land.

Other food items recorded at Signy Island (Beck and Brown 1972) included scraps left after penguins were killed by leopard seals (Hydrurga leptonyx), and oil from one of these seals that had apparently been killed by a killer whale (Orcinus orca).

Wilson's Storm-Petrels usually feed in flight (Cramp et al. 1977) by dipping (i.e., picking organisms from the surface of the water), but will also occasionally splash to the water's surface and surface-seize (Eckert 1969). They are infrequently seen on the water's surface, however, and only rarely dive for food (Cramp et al. 1977). Flocks of several hundreds may congregate about fishing vessels in North American waters (Palmer 1962).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying The egg laying period varies with latitude. Beck and Brown (1972), summarizing earlier data in addition to their own, reported that birds nesting on the Antarctic Continent laid eggs from as early as late November to early January; those in Graham Land laid from mid-December through early January. Birds in the South Orkney Islands laid from late December through early February and on Kerguelen, the northernmost of the localities mentioned, these petrels laid from early January through early February.

The laying period may be different in the same colony in different seasons. Wilson's Storm-Petrels at South Signy laid eggs from late December to early February in 1966-67, but in 1967-68 almost all eggs were laid in early and mid-January.

Mean Clutch Size Wilson's Storm-Petrel lays only one egg.

Incubation Period Roberts (1940) found that the usual incubation period at the Argentine Islands, British Graham Land, was from 39 to 48 days, with a mean of 43.4 days (n = 9).

At Signy Island, Beck and Brown (1972) determined the "real" (1) incubation period for eight eggs and the "apparent" incubation for 18 eggs. "Real" incubation periods ranged from 38 to 42.5 days (mean = 40.5), and "apparent" incubation periods ranged from 38 to 55 days (mean = 47.6); the latter figures include data obtained earlier by Jones and Pinder (1962 in Beck and Brown 1972) on two additional eggs.

Three other "apparent" incubation periods determined at Adelaide Island, Marguerite Bay, were 40, 40, and 41 days (Willey in Beck and Brown 1972).

Hatching Success Hatching success in Wilson's Storm-Petrel is relatively low. Beck and Brown (1972) recorded a hatching success of 35.3% (n = 82) for two nesting seasons at South Signy Island.

Fledging Success At Galindez Island, Argentine Islands, Roberts (1940) recorded that 35% (n = 20) of the eggs that hatched fledged young (this figure excluded those that were eaten by sledge dogs). During a 3 year study at Signy Island in the South Orkney Islands, the greatest fledging success recorded was 73% of the eggs that hatched; none fledged during the other two nesting seasons (Beck and Brown 1972). For all three seasons combined, 46% of the eggs that hatched subsequently produced fledglings.

Age at Fledging Fledging period in the Argentine Islands was highly variable due to intermittent starvation of young. The minimum fledging period for this area was 52 days (Roberts 1940). In Adelie Land, 12 chicks fledged at 46 to 51 days (mean = 47.7) (Lacan 1971), but at Signy Island in the South Orkneys, the average fledging period was 60 days (n = 12, range = 54-69) (Beck and Brown 1972).

Age at First Breeding No ringed chick returned to breed in the study area during a 2 year study (1936-37) in the Argentine Islands, therefore Roberts (1940) concluded that birds "probably do not breed until they are at least 2 years old." Beck and Brown (1972), basing their remarks on work done on other storm-petrels, suggested that some Wilson's Storm-Petrels might begin to breed at 3 years of age, but that most would probably first breed in their fourth or fifth years.

Mortality of Eggs and Young Most egg loss at Signy Island was attributable to the effects of weather. Drifting snow covered eggs, fostering desertion, and blocked tunnel entrances prevented incubating birds from returning to their eggs. Some eggs were lost by sinking partially into the loose damp material on the floor of the nest chamber; these eggs were usually deserted when the birds could no longer adequately incubate them. At still other nests

(1) By "real" incubation period they meant the actual amount of time spent in incubation by the adults; by "apparent" incubation period they meant the actual time elapsed between laying and hatching. These are not synonymous in Wilson's Storm-Petrel, because this species is one which practices "egg neglect", i.e., incubating adults may temporarily desert their eggs for short periods. The periods given by Roberts (1940) are "apparent" incubation periods.

eggs disappeared or were deserted without known cause. In one instance, water flowing into the nest cavity caused desertion (Beck and Brown 1972).

Lacan (1971) recorded a 41% mortality of eggs during one nesting season at Point Geologie in Adelie Land, and Beck and Brown (1972) recorded a 65% mortality of eggs during two seasons at Signy Island.

Loss of young is also primarily the result of weather conditions. Falling snow blocks burrows and prevents adults from feeding young, resulting in starvation. Roberts (1940) considered this the principal cause of nestling mortality in the Argentine Islands. It was also the primary source of nest loss in Adelie Land (Mougin 1968) and in the South Orkney Islands (Beck and Brown 1972).

Despite their relatively isolated nesting areas, nest loss related (at least indirectly) to the presence of observers has been noted for Wilson's Storm-Petrel. During Roberts' (1940) study of this species in British Graham Land, two "fully fledged" chicks were dug from their burrows and eaten by sledge dogs.

Renesting Although Roberts (1940) reported that Wilson's Storm-Petrel does not replace lost eggs, Beck and Brown (1972) recorded one instance in which egg replacement likely occurred. In this instance, renesting occurred 23 days after desertion of the first egg. However, renesting in Wilson's Storm-Petrel is probably as rare as it is in other Procellariiformes.

Maximum Natural Longevity We have no information on maximum natural longevity of Wilson's Storm-Petrel. For a small sample of banded birds, Beck and Brown (1972) recorded an adult survival rate of 90.8%. Thus, it seems likely that this species is relatively long-lived.

Weight (in grams) Cramp et al. (1977) stated that males are a little smaller than females, but that the differences are not significant. Some information on weight is briefly given in Table 30.

SUSCEPTIBILITY TO OIL POLLUTION

We have found no reports of oil-induced mortality for Wilson's Storm-Petrel, but consider this species moderately or highly susceptible to oil pollution in the southeastern United States for several reasons. The species is common in offshore waters through a protracted period and also tends to occur inshore to a greater extent than other Procellariiformes. These petrels readily follow ships and congregate in feeding flocks. Any large oil spill also might deny considerable feeding habitat to this surface-feeding species. This species might be the procellariiform that would suffer the highest numerical losses to oil development activities.

Wilson's Storm-Petrel is an immensely abundant breeding bird in Antarctic and Subantarctic areas, and even relatively large numerical losses to oil pollution might not have a marked effect on world populations.

Table 30. Weights (in grams) of Wilson's Storm-Petrels (a).

Mean weight	Range	N	Sample and season	Area	Source
39.5	34-45	61	adults on arrival at breeding grounds in November	Signy Island, South Orkney Islands	Beck and Brown 1972
37.6	33-43	75	adults during laying period in January	"	Beck and Brown 1972
40.9	36.5-48	22	adults at end of incubation period in February	Adelaide Island, Marguerite Bay	Beck and Brown 1972
46.4	42-50	14	adults at departure from breeding grounds in April	Signy Island, South Orkney Islands	Beck and Brown 1972
34.3	------	10	breeding adults	Graham Land, Antarctica	Roberts 1940
56.5	------	4	fledging chicks	"	Roberts 1940
36.7	35.0-39.0	7	birds taken at sea	Central Pacific	Crossin 1974
27.5	------	1	female, late July	off Surinam	Haverschmidt 1964
64.6	45-82	12	near-fledging chicks	Adelie Land	Lacan 1971
55.3	49-54	15	fledging chicks	Signy Island, South Orkney Islands	Beck and Brown 1972
76.0	60-88	12	maximum reached by chicks (at a mean of 31 days)	Adelie Land	Lacan 1971
73.4	62-81	12	maximum reached by chicks	Signy Island, South Orkney Islands	Beck and Brown 1972
11.0	10-12.5	8	fresh eggs	"	Beck and Brown 1972

(a) Birds breeding at the South Orkney Islands and on the Antarctic Continent belong to the larger race, *Oceanites oceanicus exasperatus*.

BIBLIOGRAPHY

1980

Zink, R. M. and J. C. Eldridge. 1980. Why does Wilson's Petrel have yellow on the webs of it's feet? Brit. Birds 73: 385-387.

1979

Boswall, J. 1979. Flight characteristics of Wilson's Petrel. Brit. Birds. 72: 330-334.

Withers, P. C. 1979. Aerodynamics and hydrodynamics of the "hovering" flight of Wilson's Strom-Petrel. J. Exper. Biol. 80: 83-91.

1978

Ainley, D. G., R. C. Wood and W. J. L. Sladen. 1978. Bird life at Cape Crozier, Ross Island. Wilson Bull. 90: 492-510.

King, B. 1978. Some field characteristics of Wilson's Storm-Petrels. Sea Swallow 27: 15-16.

1977

Kamenev, V. M. 1977. [Ecology of Wilson's Petrel (Oceanites oceanicus Kuhl.) on Haswell Islands.] Sov. Antark. Eksped. Inf. Biul. 94: 49-57. [In Russian.]

1976

Gray, M. S. and D. P. Scott. 1976. An inland record of Wilson's Storm Petrel. Fla. Field Nat. 4: 8.

Horning, D. S., Jr. 1976. Wilson's Storm Petrel at Kaikoura. Notornis 23: 119.

1974

Pefaur, J. E. 1974. Egg-neglect in the Wilson's Storm Petrel. Wilson Bull. 86: 16-22.

1973

McCrimmon, D. A., Jr. 1973. Leach's Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47-48.

1972

Beck, J. R. and D. W. Brown. 1972. The biology of Wilson's Storm Petrel, Oceanites oceanicus (Kuhl), at Signy Island, South Orkney Islands. Brit. Antarct. Surv. Sci. Rept. No. 69. 54 pp.

Grubb, T. C., Jr. 1972. Smell and forging in shearwaters and petrels. Nature 237: 404-405.

1971

Huber, L. N. 1971. Notes on the migration of the Wilson's Storm Petrel Oceanites oceanicus near Eniwetok Atoll, western Pacific Ocean. Notornis 18: 38-42.

Lacan, F. 1971. Observations ecologiques sur le Petrel de Wilson (Oceanites oceanicus) en Terre Adele. Oiseau R.F.O. 41: 65-89. [In French with English summary.]

Morzer Bruyns, W. F. J. 1971. Records of Atlantic Ocean migration routes of Wilson's Storm-Petrels, Oceanites oceanicus. Sea Swallow 21: 13-14.

Sharp, R., II. 1971. Hurricane-borne Wilson's Petrel in Chesapeake Bay. Md. Birdlife 27: 149.

1970

Swanson, N. 1970. Notes on Wilson's Storm Petrel. S. Austr. Ornithol. 25: 214.

1969

Eckert, J. 1969. Notes on the Wilson Storm Petrel. S. Austr. Ornithol. 25: 110.

Starkey, Ms. H. H. 1969. Wilson's Petrel, Oceanites oceanicus. Fla. Nat. 42: 171-172.

1968

Hader, R. J. 1968. Wilson's Petrels at Cape Lookout. Chat 32: 100.

Mougin, J. L. 1968. Etude ecologigue de quatre de Petrels antarctiques. Oiseau R.F.O. 38 (Special No.): 1-52. [In French with English summary.]

Ozawa, K. 1968. Two records of Wilson's Storm Petrel (Oceanites oceanicus) in Japanese waters in 1967. Misc. Repts. Yamashina's Inst. Ornithol. 5: 411-413. [In English with Japanese summary.]

Trimble, B. 1968. Aberrant Wilson's Petrel on the Newfoundland Grand Banks. Auk 85: 130.

1965

Clancey, D. A. 1965. The races of Oceanites oceanicus (Kuhl) occuring in South African waters. Ostrich 36: 142-143.

Holmes, R. P., III. 1965. Shearwaters and petrels off of Morehead City, North Carolina. Chat 29: 106.

Pryor, M. E. 1965. Cape Pigeon, Snow Petrel and Wilson's Petrel on Haswell Islet. Inf. Bull. Sov. Antarct. Exped. 5: 363-365.

Smith, Ms. E. D. 1965. Parasitic Jaeger and other seabirds off Murrell's Inlet, South Carolina. Chat 29: 85-86.

1964

Bourne, W. R. P. 1964. On the occurrence and nomenclature of certain petrels in North America. Bull. Br. Ornithol. Club 84: 114-116.

Haverschmidt, F. 1964. Wilson's Petrel (Oceanites oceanicus) near the coast of Surinam. Ardea 52: 118.

Jones, M. E. 1964. Storm petrels in the Arabian Sea. Sea Swallow 16: 67-68.

Newhall, C. 1964. Wilson's Petrel at Hilton Head Island, South Carolina. Chat 28: 133.

1963

Grant, R. H. 1963. Bridled Terns off the North Carolina coast. Chat 27: 21-22.

1961

Griffith, S. J. and H. W. Kale, II. 1961. Wilson's Petrel off Sapelo Island, Georgia. Oriole 26: 58.

Smith, Ms. E. D. 1961. Wilson's Petrel at Litchfield Beach, S.C. Chat 25: 86.

1960

Nisbet, I. C. T. and R. G. McCaskie. 1960. Wilson Petrel off the California coast. Condor 62: 141.

Sciple, G. W. 1960. Wilson's Petrel off Tybee Island. Oriole 25: 45.

1959

Dawson, E. W. 1959. Wilson's Storm Petrel, Oceanites oceanicus (Kuhl) at Columbo. J. Bombay Nat. Hist. Soc. 55: 562-564.

1956

Bastin, E. W. 1956. Wilson's Petrel in southern Ontario. Wilson Bull. 68: 76.

Phillips, W. W. A. 1955. Wilson's Petrel (Oceanites oceanicus (Kuhl)) in Indo-Ceylon waters, with special reference to the 1954 southward migration. J. Bombay Nat. Hist. Soc. 53: 132-133.

1953

Prevost, J. 1953. Notes sur l'ecologie des Petrels de Terre Adelie. Alauda 21: 205-222. [In French.]

1952

Serventy, D. L. 1952. Movements of the Wilson's Storm Petrel in Australian seas. Emu 52: 105-116.

1949

Bryson, A. G. S. 1949. Wilson's Stormy Petrel (Oceanites oceanicus) in the Gulf of Aden. J. Bombay Nat. Hist. Soc. 48: 362-364.

Sprunt, A., Jr. 1949. Wilson's Petrel in interior Florida. Auk 66: 76.

1947

Brongersma, L. D. 1947. Note on Oceanites oceanicus (Kuhl) in the Gulf of Aden. Ardea 35: 225-226.

1943

Kolb, H. and G. Bond. 1943. Unusual records for eastern Maryland. Auk 60: 451.

1940

Roberts, B. 1940. The life cycle of Wilson's Petrel. Oceanites oceanicus (Kuhl). British Graham Land Exp. 1934-1937. Br. Mus. Nat. Hist. Sci. Rept. 1: 141-194.

1939

Sciple, G. W., Jr. 1939. Wilson's Petrel near Brunswick. Oriole 4: 31.

1938

Eyles, D. 1938b. Wilson's Petrel in Georgia. Oriole 3: 35-36.

1934

Stoner, D. 1934. Occurrence of Wilson's Petrel (Oceanites oceanicus) in Franklin County, New York. Auk 51: 367.

1933

Eliot, S. A., Jr. 1933a. Wilson's Petrel banded at sea. Auk 50: 91.

Eliot, S. A., Jr. 1933b. Banding Wilson's Petrels. Bird-Banding 4: 45-49.

1932

Kiyosu, Y. 1932. [On *Oceanites oceanicus* newly obtained in Japan.] Tori 7: 269-270. [In Japanese.]

1925

Wetmore, A. 1925. Wilson's Petrel in Maryland. Auk 42: 262-263.

1921

Bagg, A. C. 1921. An oil-soaked Loon (*Gavia immer*) at Watch Hill, R.I. Auk 38: 594-595.

1918

Murphy, R. C. 1918. A study of the Atlantic *Oceanites*. Am. Mus. Nat. Hist. Bull. 38: 117-146.

1916

Chapman, F. M. 1916. Petrels on the Hudson. Bird-Lore 9: 245-248.

1915

Job, H. K. and A. S. Clisby. 1915. A new Louisiana bird. Wilson Bull. 27: 411-412.

1899

Pearson, J. G. 1899. Notes on some of the birds of eastern North Carolina. Auk 16: 246-250.

WHITE-FACED STORM-PETREL

(*Pelagodroma marina*)

[DA: Fregatstormvale, DU: Bont Stormvogeltje, Fregatstormvogeltje; EN: Frigate-Petrel, FR: Petrel fregate, GE: Weissgesichtsturmschwalbe, Fregattensturmschwalbe; IT: Uccello delle tempeste faccia blanca, Uccello delle tempeste fregata; PR: Calcamar, SP: Paino pechialbo, SW: Fregattstormsvale]

GENERAL DISTRIBUTION

North America A few stragglers have been found along the east coast of North America, but the species may be regular far offshore (Buckley and Wurster 1970).

World Distribution In the Atlantic, White-faced Storm-Petrels breed in the Salvage Islands and Cape Verde Islands (Cramp et al. 1977), and range north barely to Britain and New England.

Other subspecies occupy the northern Indian Ocean and the southern oceans from the South Atlantic east through the southern Indian Ocean into the South Pacific east of New Zealand (Palmer 1962). There seems to be a hiatus in the species' distribution in the eastern South Pacific, although it has been recorded off the Galapagos (Harris and De Vries 1968).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

White-faced Storm-Petrels have occurred in North Carolina, but are otherwise unknown from the southeastern states.

North Carolina There are several sight records. Two specimens have been collected, but one has since been lost (Lee and Rowlett 1979).

1971	2 Oct.	2 seen	Oregon Inlet, Dare Co.	Lee and Rowlett 1979
1977	31 Aug.	1 coll. (lost)	ca. 38 mi off Oregon Inlet	Lee and Rowlett 1979, Lee and Booth 1979
1977	24 Sep.	1 coll.	ca. 38 mi off Oregon Inlet	Lee and Rowlett 1979, Lee and Booth 1979
1977	fall	several seen (?)	"one professional fisherman reported seeing several"	Lee and Rowlett 1979

HABITAT

Nesting White-faced Storm-Petrels nest in burrows in soil. According to Cramp et al. (1977), they apparently do not use rock crevices to the extent that Harcourt's and some other storm-petrels do.

Feeding, Winter and Offshore These storm-petrels frequent the subtropic and warm temperate waters of the eastern Atlantic (Cramp et al. 1977). Southern Hemisphere populations apparently frequent cooler waters (Hagen 1952, Gillham 1963). They are apparently strongly oceanic, and in the Atlantic breed only on oceanic islands (but do utilize islands on the Continental Shelf in Australia). In the Atlantic at least, White-faced Storm-Petrels probably spend most of their lives over the deep ocean, off the Continental Shelf.

FOOD AND FEEDING BEHAVIOR

Ashmole (1971) indicated that *Pelagodroma* feeds by aerial dipping; Cramp et al. (1977) stated that it "feeds mainly by pattering, [a behavior included under aerial dipping in this report] snatching food as it runs along surface, and by lowering legs and splashing in with body." White-faced Storm-Petrels are known to take copepods and euphausiid crustacea (Hagen 1952). Fish otoliths, cephalopod remains, and barnacle larvae have also been found in stomachs or in regurgitations (Richdale 1944b, Bailey 1966 *in* Cramp et al. 1977).

SUSCEPTIBILITY TO OIL POLLUTION

Almost nothing is known about the susceptibility of storm-petrels to floating oil. The combination of very small body size and pelagic distribution greatly reduces the chances of any oiled birds reaching the beaches. Gas flares on production rigs may be a hazard to storm-petrels.

BIBLIOGRAPHY

1981

Brothers, N. P. 1981. Observations of breeding success in White-faced Storm-Petrel at a newly established colony. Corella 5: 29-33.

1979

Lane, S. G. 1979. Summary of the breeding seabirds on New South Wales coastal islands. Corella 3: 7-10.

Reed, S. M. 1979. Albino White-faced Storm Petrel. Notornis 26: 197.

1977

Lane, S. G. 1977. White-faced Storm-Petrels on Belowla Island, N.S.W. Corella 1: 35.

1976

Anon. 1976. White-faced Storm Petrel in the North Pacific. Sea Swallow 25: 45.

Andriesen, A. A. and M. J. Tekke. 1976. Bont Stormvogeltje (Pelagodroma marina) een nieuwe Soort voor Nederland. [White-faced Storm-Petrel (Pelagodroma marina) new to the Dutch list.] Limosa 49: 9-11. [In Dutch with English summary.]

Claugher, D. 1976. A trematode associated with the death of the White-faced Storm Petrel (Pelagodroma marina) on the Chatham Islands. J. Nat. Hist. 10: 633-641.

Lauro, A. J. 1976. Hurricane Belle. Kingbird 26: 184-189.

1975

Roselaar, C. S. 1975. A record of the Frigate Petrel Pelagodroma marina off the Atlantic coast of North America. Ardea 63: 152-153.

1973

Barnhill, M. V., III and P. G. DuMont. 1973. Observation of a White-faced Storm-Petrel off Delaware. Am. Birds 27: 17.

1970

Buckley, P. A. and C. F. Wurster. 1970. White-faced Storm Petrels Pelagodroma marina in the North Atlantic. Bull. Br. Ornithol. Club 90: 35-38.

1968

Harris, M. P. and T. De Vries. 1968. White-faced Storm Petrels (Pelagodroma marina) near the Galapagos Islands. Ardea 56: 193.

1965

Jouanin, C. and F. Roux. 1965. Contribution a l'etude de la biologie de Pelagodroma marina hypoleuca (Webb, Berthelot et Moquin-Tandon). [Sci. Exped. to the Salvage Islands, IV.] Bolm. Mus. Munic. Funchal 19: 16-30. [In French with English summary.]

Richdale, L. E. 1965. Biology of the birds of Whero Island, New Zealand, with special reference to the Diving Petrel and the White-faced Storm Petrel. Breeding behaviour of the Narrow-billed Prion and the Broad-billed Prion on Whero Island, New Zealand. Trans. Zool. Soc. Lond. 31: 1-155.

Voous, K. H. 1965. White-faced Storm-Petrels in the Indian Ocean: corrections and additions. Ardea 53: 237.

1964

Morzer Bruyns, W. F. J. and K. H. Voous. 1964. White-faced Storm Petrels (Pelagodroma marina) in the Indian Ocean. Ardea 52: 223-224.

1961

Gillham, M. E. and J. A. Thomson. 1961. Old and new storm petrel rookeries in Port Philip Bay. Proc. R. Soc. Vict. N.S. 73: 37-46.

1963

Gillham, M. E. 1963. Breeding habitats of the White-faced Storm Petrel (Pelagodroma marina) in eastern Bass Strait. Pap. Proc. R. Soc. Tasmania 97: 33-41.

1955

Gordon, M. S. 1955. A western North Atlantic record for the Frigate Petrel (Pelagodroma marina hypoleuca). Auk 72: 81-82.

1953

Bourne, W. R. P. 1953. On the races of the Frigate Petrel Pelagodroma marina (Latham) with a new race [eadesi] from the Cape Verde Islands. Bull. Br. Ornithol. Club 73: 79-82.

1952

Hagen, Y. 1952. Pelagodroma marina marina (Latham). Pp. 124-125 in Norweg. Sci. Exped. to Tristan da Cunha, 1937-38. Results No. 20. 248 pp.

1951

Murphy, R. C. and S. Irving. 1951. A review of the Frigate-petrels (Pelagodroma). Am. Mus. Novit. 1506: 1-17.

1948

Rankin, M. N. and A. G. Duffey. 1948. A study of the bird-life of the North Atlantic. Brit. Birds 41 (suppl.): 3-42.

1947

Wood, C. E., Jr. 1947. The White-faced Petrel again off Massachusetts. Auk 64: 140.

1946

Abbott, J. M. 1946. The White-faced Storm Petrel off Cape Cod. Auk 63: 251.

1944

Richdale, L. E. 1944b. The White-faced Storm Petrel or Takahi-kare-moana (Pelagodroma marina maoriana Mathews.) Part III. Trans. Proc. R. Soc. N. Zeal. 73: 335-350.

1933

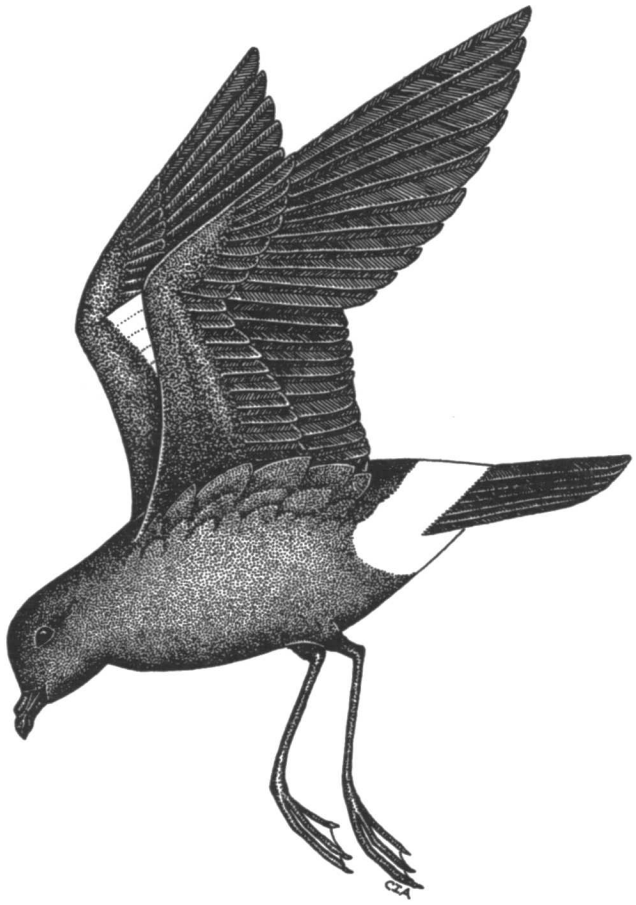
Campbell, A. G. 1933. The White-faced Storm-Petrel. Emu 33: 86-92.

1897

Clarke, W. E. 1897. On the occurrence of the Frigate Petrel (Pelagodroma marina) on the west coast of Scotland. Ann. Scott. Nat. Hist. 1897: 88.

1891

Macpherson, H. A. 1891. On Pelagodroma marina, a petrel new to the British list. Ibis 6th Ser., Vol. 3: 602-604.



HARCOURT'S STORM-PETREL

(*Oceanodroma castro*)

[DA: Madeirastormsvale, DU: Madeirastormvogeltje, Westafrikaansvaal Stormvogeltje; EN: Madeiran Storm Petrel, FR: Petrel de Castro, GE: Madeira-Wellenlaufer, IT: Uccello delle tempeste di Madera, JA: Kuro koshijiro umitsubame, PR: Alma-de-Mestre, Pedreirinho; SP: Paino de Madeira, SW: Oceanlopare, US: Band-rumped Storm-Petrel, Hawaiian Storm Petrel]

GENERAL DISTRIBUTION

North America Harcourt's Storm-Petrel has straggled to the eastern United States, where it is most frequently associated with hurricanes or other severe weather. Storm-driven specimens are known from Ontario (Taverner 1934), Pennsylvania (Sutton 1927), and Washington D.C. (USNM #154436). The USNM has specimens from Indiana (#480403), Tennessee (#526349), Delaware (#567674), and North Carolina (see below). It has also been recorded from South Carolina, Florida, and Texas (see below).

World Distribution This storm-petrel breeds on oceanic islands in the Atlantic from St. Helena and Ascension north to the Azores, and in the Pacific on the Galapagos Islands, the Hawaiian Islands, and off Japan (Palmer 1962, Cramp et al. 1977). Its range at sea is very poorly known because it is difficult to distinguish from other, more common storm-petrels, but this species is probably restricted to warm seas.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

There are records (mostly specimens) from North Carolina, South Carolina, Florida, and Texas. These all fall in the months June - October, the period of warmest seawater temperature and the hurricane season. The first (and only) Cuban record, however, is of a bird collected 6 December 1964 (Garrido and Montana 1967), so winter occurrences are quite possible. We suspect that this bird is much more common than the records indicate, but is being missed because of its similarity to more common species.

North Carolina We know of one bird found following Tropical Storm Agnes.

1972	22 Jun.	1 spec. (USNM #566873)	Beaufort Inlet	Fussell 1974

South Carolina There is one specimen, also obtained following Tropical Storm Agnes.

1972	20 Jun.	1 spec.	McClellenville	Shuler 1973

Florida There are specimens from the Gulf Coast and the Keys, and a

sight record from the Atlantic coast.

1958	21 Oct.	1 spec.	Key West	Stevenson 1979
1969	18 Aug.	1 spec. (1)	Pensacola Beach	Purrington 1970
1973	1 Jun.	1 found	Upper Matacombe Key	Kale 1973
1974	15 Sep.	1 seen	off Cape Canaveral	Edscorn 1975
1975	10 Oct.	1 spec.	St. Petersburg Beach	Edscorn 1978

Texas There are three specimens and one sight record.

1954	25 Jun.	3 found, 1 spec. (Texas A&M 6358)	Edinburgh, Hidalgo Co.	Oberholser 1974
1965	30 May	1 seen	Kleberg-Kenedy Co. line	Oberholser 1974
1968	24 Jul.	1 spec.	Gulf beach, Kleberg Co.	Oberholser 1974
1969	3 Jun.	1 spec.	Padre Island,	Oberholser 1974

HABITAT

Nesting Harcourt's Storm-Petrels breed in crevices and crannies in lava flows and cliffs on volcanic oceanic islands (Nelson 1966, Cramp et al. 1977). Allan (1962) also found them occasionally burrowing in soil (but usually under boulders) on Ascension; even so, they seem to use crevices much more than most of the other storm-petrels.

Feeding, Winter and Offshore This storm-petrel seems to be highly oceanic. Its breeding colonies are on oceanic volcanic islands, so it may spend little time in continental shelf areas.

FOOD AND FEEDING BEHAVIOR

These are not well known, but presumably are similar to other *Oceanodroma*. Cramp et al. (1977) reported the food was "largely crustaceans, fish, oily scraps and refuse, taken from surface (King 1967, Watson 1966)". This statement is almost a direct quote from King where it described the food habits of both Harcourt's and Leach's storm-petrels but probably was largely derived from data on the latter. Fifteen stomachs of these storm-petrels from the

(1) This bird was caught, photographed, measured, and released.

Galapagos contained fish eye-lenses and a few cephalopod remains (Harris 1969 in Cramp et al. 1977).

SUSCEPTIBILITY TO OIL POLLUTION

We do not have any records of oiling of Harcourt's Storm-Petrel. Presumably its vulnerability is similar to that of other storm-petrels. Storm-petrels are often attracted to lighthouses and the lights of ships on foggy nights and may be similarly attracted to oil drilling and production rigs. The possibility of immolation in gas flares on production rigs should be investigated.

BIBLIOGRAPHY

1980

Brown, R. G. B. 1980. Flight characteristics of Madeiran Petrel. Brit. Birds 73: 263-264

1979

Harris, M. P. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

1974

Fussell, J. 1974. Specimen of Harcourt's Storm-Petrel found in North Carolina. Chat 38: 23.

1973

Shuler, J. 1973. First South Carolina record of Harcourt's Storm-Petrel. Chat 37: 78.

1969

Harris, M. P. 1969. The biology of storm petrels in the Galapagos Islands. Proc. Calif. Acad. Sci. 37: 95-166.

1967

Garrido, O. H. and F. G. Montana. 1967. Nuevo Oceanodroma (Aves: Hydrobatidae) para Las Antillas. Mus. Felipe Poey Acad. Cienc. Cuba Trab. Divulg. 48. 4 pp. [In Spanish.]

1966

Nelson, J. B. 1966. Flighting behaviour of Galapagos storm petrels. Ibis 108: 430-432.

Snow, D. W. and B. K. Snow. 1966. The breeding season of the Madeiran Storm Petrel Oceanodroma castro in the Galapagos. Ibis 108: 283-284.

1964

Leveque, R. 1964. Notes sur la reproduction des oiseaux aux iles Galapagos. Alauda 32: 5-44.

1962

Allan, R. G. 1962. Madeiran Storm Petrel, Oceanodroma castro. Ibis 103b: 274-275.

1934

Taverner, P. A. 1934. The Madeira Petrel in Ontario. Auk 51: 77.

1927

Sutton, G. M. 1927. Madeira Petrel (Oceanodroma castro) in Pennsylvania. Auk 44: 556-557.

1922

Kuroda, N. 1922. Additional notes on the Japanese species of Oceanodroma. Ibis 11th Ser., vol. 4: 437-440.

1914

Nichols, J. T. 1914. An undescribed race of Oceanodroma castro. Auk 31: 388-390.

1897

Palmer, W. 1897. An addition to North American petrels. Auk 14: 297-299.

LEACH'S STORM-PETREL

(*Oceanodroma leucorhoa*)

[DA: Stor Stormsvale, DU: Vaal stormvogeltje, FI: Myrskypaasky, FR: Petrel culblanc, GE: Wellenlaufer, IC: Sjosvala, IT: Procellaria a coda forcuta, JA: Koshijiro umitsubame, NW: Stormsvale, PO: Nawalnik Leacha, PR: Roquinho de fors, RU: (Northern Petrel), SP: Petrel rabadilla blanca, Paino de Leach; SW: Klystjartad stormsvala, US: Kaeding Petrel, Beal Petrel]

GENERAL DISTRIBUTION

North America On the Atlantic side of North America, Leach's Storm-Petrel breeds in Canada in southern Labrador, Newfoundland, Quebec, New Brunswick, and Nova Scotia, and in the United States in Maine and Massachusetts (Penikese Islands)(AOU 1957, Godfrey 1966). On the Pacific side, this petrel breeds on islands in the Aleutians and off the coast from Alaska south to the San Benitos Islands and Guadelupe Island, Baja California (AOU 1957, Jouanin and Mougin 1979).

Birds from populations in eastern North America winter primarily in tropical waters of the Atlantic (Palmer 1962) south to the latitude of Fernando Noronha off Brazil (Blake 1977). Some of these birds are believed to cross the North Atlantic to Europe (1) to winter off the coast of West Africa (Cramp et al. 1977), but the extent to which this occurs is as yet unknown.

The status of this species as a migrant along the Atlantic coast is poorly known, but it is probably more common than the relatively few available records might indicate (Lee and Booth 1979). Leach's Storm-Petrel occurs casually in the Gulf of Mexico, where the species is apparently genuinely uncommon.

Populations in western North American winter primarily in tropical waters. Those from eastern areas winter in the Galapagos region (Palmer 1962) and off central and southern California south to equatorial areas (Crossin 1974). Those from the North Pacific winter widely in equatorial areas of the Central Pacific (Crossin 1974).

World Distribution This petrel breeds only on islands in or near the

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Taxonomic note: Swinhoe's Storm-Petrel (*Oceanodroma monorhis*) which breeds on islands in Japan, southern and western Korea, and Shantung, China, has been treated as a race of Leach's Storm-Petrel, but most recent authorities (AOU 1957, Vaurie 1965, Cramp et al. 1977, Jouanin and Mougin 1979) prefer to retain it as a distinct species.

(1) A bird banded on Gull Island, Newfoundland, 15 August 1962 was found dead 9 January 1963 on the Spanish Atlantic coast (Weickert 1963 *in* Bauer and Glutz von Blotzheim 1966).

North Atlantic and North Pacific oceans. In the Atlantic, a very small proportion of the world population breeds at a few colonies in northern Scotland, at a colony on the Loftotens Islands, Norway, in the Faeroes, in the Westmann Islands off Iceland, and at least formerly in Ireland (Cramp et al. 1977, Jouanin and Mougin 1979). Other breeding localities in the North Pacific include the Shumagin, Kurile, and Commander islands, and islands off eastern Hokkaido, Japan (Vaurie 1965, Cramp et al. 1977, Jouanin and Mougin 1979).

European populations migrate south in the eastern Atlantic to winter in tropical waters off West Africa where they may be fairly numerous in the outer Gulf of Guinea (Cramp et al. 1977). Considerable numbers of birds may summer in at least some parts of the winter range (Crossin 1974), and others may straggle well south of the usual wintering areas. Stragglers have been recorded as far south as New Guinea, Australia, and New Zealand in the southwestern Pacific (Jouanin and Mougin 1979), and from South Africa to about 58° S latitude in the South Atlantic (Cramp et al. 1974, Watson 1975).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

Leach's Storm-Petrel has been recorded from all the southeastern coastal states except Georgia and Mississippi. It probably occurs regularly off Georgia but has gone unnoticed for lack of offshore observation.

Many of the observations of Leach's Storm-Petrel listed below should perhaps be disregarded because the observers did not indicate how they distinguished the birds from the similar appearing Harcourt's Storm-Petrel which may be the more common of the two in the Gulf of Mexico. Most of the Leach's Storm-Petrels reportedly seen on the Atlantic coast probably are correctly identified because this species is undoubtedly the more abundant in that area. However, the proportion of specimens from the Atlantic of "White-rumped Storm-Petrels" that are Leach's rather than Harcourt's Storm-Petrels is at serious odds with the proportions reported in sight records. All but one of the Atlantic coast sight records of these two species are attributed to Leach's Storm-Petrels, but two of six specimens examined in the hand have been Harcourt's. In the Gulf, five of about 11 well documented records have been the latter species. Consequently, although we include previously published records of Leach's Storm-Petrel below, we believe they should be regarded with circumspection.

North Carolina Leach's Storm-Petrel is apparently fairly uncommon off the North Carolina coast, but it may be more common than the relatively few sightings indicate (Lee and Booth 1979). Although Pearson et al. (1942) stated that birds may occur in North Carolina waters at any time, recently assembled records suggest that they are most common as spring and fall migrants. Spring records are from 12 May through 25 June (Lee and Booth 1979), and late summer and fall records extend from 16 August through the first week of November.

1955	16 Aug.	1 seen	along beach, Nag's Head	Chamberlain 1956a

1967	28 May	to 3 seen	over ocean near Morehead City	Williams and Williams 1968
1967	1-3 Jun.	seen	along Continental Shelf between Morehead City and Oregon Inlet	Williams and Williams 1968
1967	11 Jun.	seen	between Cape Lookout and Morehead City harbor	Williams and Williams 1968
1969	1st week Nov.	1 found, coll. (USNM 564835)	found alive on beach at Kill Devil Hills, Dare Co.	Blem and Sonneborn 1972
1971	2 Oct.	30 seen	Oregon Inlet	Teulings 1972a
1972	21 Jun.	1 found	Atlantic Beach	Teulings 1972d
1972	25 Jun.	5 seen	ca. 40 mi offshore, ca. 33° 56' N, 76° 08' W	McCrimmon et al. 1973
1973	12 May	2 seen (1)	off Cape Hatteras	DuMont and DuMont 1973
1973	16 Sep.	2 seen	off Hatteras	Teulings 1974a
1974	22 Jun.	5 seen	off Morehead City	Teulings 1974d
1974	10 Oct.	seen	off coast	Lee and Booth 1979
1975	26 Oct.	1 seen	23 mi SSE Hatteras Inlet	Teulings 1976a
1977	18 May	3-6 seen	offshore at eastern edge of Gulf Stream	Lee and Booth 1979
1977	25 May	3-6 seen	offshore at eastern edge of Gulf Stream	Lee and Booth 1979
1978	17 May	1 seen	a few mi off beach	Lee and Booth 1979
1978	10 Oct.	2 seen	off Oregon Inlet	LeGrand 1979a
1979	16 May	1 seen	a few mi off beach at Oregon Inlet	LeGrand 1979c, Lee and Booth 1979

(1) A record listed by Teulings (1973c) for 19 May is presumably the same sighting.

South Carolina We know of only two records of Leach's Storm-Petrel from South Carolina. This petrel is known to winter well to the south of South Carolina, thus it is doubtless more common than these records would suggest. There is insufficient information to determine whether there are any real differences in the abundance of Leach's Storm-Petrel in South Carolina waters as compared with other states along the southern Atlantic coast.

1926	20 Sep.	1 found, decomposed	on beach, Isle of Palms	Sprunt and Chamberlain 1949
1974	22 Jun.	5 seen	off Hilton Head Island	Teulings 1974d

Florida - Atlantic Coast We have found 10 records for the Florida Atlantic coast, where the species is considered rare by Kale (1979 ms a). Too few records have been accumulated to indicate periods of peak occurrence, but these are probably similar to those found farther north.

1944	12 May	1 found, coll.	in surf, Daytona Beach	Longstreet 1945a
1960	11 Sep.	1 found, coll.	near Eau Gallie, Brevard Co.	Robertson and Paulson 1961
1969	31 May	4 seen	15 mi E Fort Pierce	Ogden 1969
1973	10 Jun.	1 found moribund, coll.	Bear Island, Seminole Co.	Ogden 1973
1974	15 Jul.	2 seen	off Cocoa ?	Ogden 1974
1975	25 May	1 seen	8-9 mi ENE Mayport	Kale 1975
1975	3 Jul.	3 seen	off Cape Canaveral	Ogden 1975
1975	21 Sep.	1 seen	off Canaveral	Edscorn 1976
1978	29 Apr.	1 seen	100 mi E Ponce de Leon Inlet	Kale 1978
1978	19 Oct.	1 found moribund	near Jensen Beach, Martin Co.	Edscorn 1979

Florida - Gulf Coast We have six records of Leach's Storm-Petrel for the Florida Gulf Coast but, as in other areas, some of the sight records are not adequately documented (Rohwer and Woolfenden 1968). This petrel is probably less common off the Gulf Coast than off the Atlantic coast, but further information is needed.

1947	13 Jun.	1 seen	on Lake Jackson near Tallahassee (inland)	Sprunt 1954
1951	4 Jun.	1 seen	in St. Joseph Bay, Gulf Co.	Sprunt 1954
1965	30 May	1 male found oiled, coll. (USF)	entangled in seaweed, Anna Maria Island, 4 mi N Bradenton	Rohwer and Woolfenden 1968
1972	5 Jun.	1 found moribund	inland at Lakeland, Polk Co.	Ogden 1972
1976	4 Jul.	1 found	near Tallahassee	Ogden 1976
1976	15 Aug.	1 seen	80 mi W Clearwater	Edscorn 1977, Buhrman and Hopkins 1978

Alabama There is only one documented record of the occurrence of Leach's Storm-Petrel in Alabama. This species is probably genuinely uncommon in waters off Alabama.

1978	7 Oct.	1 ad. male found dead, coll. (Auburn U. Mus. 326)	200 km inland at Eufaula NWR, 25 m W Chattahoochee River bank	Brown and Ortego 1979

Louisiana We have found only two records. Leach's Storm-Petrel may be more common in offshore waters than these records suggest, but we suspect that it really occurs in very low numbers.

1956	5 Dec.	1 found, coll. (LSU)	came aboard ship, 28° 30' N, 88° 42' W, ca. 41 mi SE South Pass of Mississippi River	Lowery 1974
1972	23 Sep.	1 seen	on beach Grand Isle, Jefferson Par.	Lowery 1974

Texas We know of three records of Leach's Storm-Petrel from Texas, all recent and all well documented. The true status of this petrel in offshore waters is largely unknown, and will remain so until considerably more pelagic work has been done.

1970	31 May	1 captured, photogr.	from surf near Little Shell Beach, Padre Island Natl. Seashore	Oberholser 1974
1975	25 Jun.	1 ad. male coll. (WWF 1964)	2 mi N Malaquite Beach	Blacklock 1978 ms

1976	12 Jul.	1 found, coll. (CC Mus)	Corpus Christi, off Laguna Madre	Webster 1976d

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Leach's Storm-Petrel is a bird of colder waters that breeds on islands in the North Atlantic and North Pacific. It is relatively uncommon in the western North Pacific (Dement'ev and Gladkov 1951b) and in the eastern North Atlantic; about 10,000 pairs are present in Great Britain, and another 1,000 or so are present in the Faeroes (Cramp et al. 1977). By comparison, Erwin and Korschgren (1979) recently estimated that more than 19,000 pairs were breeding in Maine, where the vast majority of the birds of the eastern United States breed.

Much greater numbers breed to the north in eastern North America. Wilbur (1969) estimated that 15,000 pairs bred on Kent Island, New Brunswick, in 1965-1966. Populations for the rest of eastern Canada are unknown but may be enormous. Huntington (1963) thought that there might be "millions" breeding in Newfoundland, the center of distribution in the northwestern Atlantic where, in Witless Bay, Brown et al. (1975) reported 210,000 pairs on Gull Island and 170,000 pairs on Great Island in 1973.

The peak of the species' abundance, however, is probably along the coast of northwestern North America. Sowls et al. (1978) recently suggested that the breeding population in Alaska is on the order of four million birds, 1.5 million of them found in two colonies. An estimated 10,000 pairs more breed in British Columbia and Washington (Manuwal and Campbell 1979), and another 5,000 pairs breed at Little River Rock, California (Harris 1974).

Winter and Migration Birds from both Atlantic and Pacific populations winter mainly in tropical waters. Migration routes are poorly known and may be obscured by the presence of birds summering just south of the breeding areas (Crossin 1974).

Palmer (1962) indicated that the spring movement in the Atlantic was mainly during April and early May, and that the primary period of the post-breeding departure was in September - October. Cramp et al. (1977) stated that most of the northward movement is in March, with peak fall numbers (in the eastern Atlantic) in October - November. The limited information from the southeast (Table 31) suggests two peaks of abundance, one in May - June and the other in September - October, which corresponds reasonably well with the information given by Palmer (1962) and Cramp et al. (1977). The slightly later spring peak may represent concentrations of nonbreeding birds or those that are returning late to breeding colonies, or it may merely reflect a lesser amount of observation earlier in the year.

HABITAT

Nesting Leach's Storm-Petrels are mainly found in the areas of cold upwelling water near the polar convergences in both the Atlantic and Pacific,

Table 31. Approximate numbers of Leach's Storm-Petrels recorded by month for the coastal southeastern United States (a).

State/region	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	14	13	-	1	2	34	1	-
South Carolina	-	-	5	-	-	1	-	-	-
Georgia	-	-	-	-	-	-	-	-	-
Florida-Atlantic Coast	1	6	1	5	-	2	1	-	-
Subtotal-ATLANTIC COAST	1	20	19	5	1	5	35	1	-
Florida-Gulf Coast	-	1	3	1	1	-	-	-	-
Alabama	-	-	-	-	-	1	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-
Louisiana	-	-	-	-	-	1	-	-	1
Texas	-	1	1	1	-	-	-	-	-
Subtotal-GULF COAST	-	2	4	2	1	2	-	-	1
Total-ALL AREAS	1	22	23	7	2	7	35	1	1

(a) Birds found dead within the first 10 days of the month are arbitrarily assigned to the preceeding month. If the source did not make it clear whether one or more than one was seen, we have assumed only one was seen. There were no records for January, February, or March.

and off the United States west coast and Japan where similar cold upwellings are found (Palmer 1962). They usually nest on small islands off the coasts.

These petrels are hole dwellers that dig burrows in soft earth when possible, and otherwise nest in holes in cliffs or in crevices among rocks (Cramp et al. 1974). The burrows, usually about 3 feet long, may be dug in open fields or under brush, boulders, flat stones, stumps, or in banks (Ainslie and Atkinson 1937, Palmer 1962). Less frequently observed nest sites include a hollow log above ground (Palmer 1949 in Palmer 1962) and "artifical burrows of old automobile tires" (Harris 1974). Most burrows contain a single pair, but as many as five pairs have been found nesting in a single burrow (Bent 1922).

Little investigation of nest-site preferences has been made. On Little River Rock, California, Harris (1974) found 1.2 burrows per square foot in short coastal brushfields, 0.8 per square foot in grass sod, and 0.3 per square foot in succulents and ferns. The substrate chosen was apparently related to soil consistency and the ease with which burrows could be dug.

Colony densities are often very great. Dawson (1908 in Harris 1974) had 40,000 birds per acre in one colony in Washington, and Harris reported a density of approximately 43,600 birds per vegetated acre at Little River Rock.

Feeding Feeding habitat is apparently well out at sea both when breeding

and during the winter. Ainley et al. (1974) noted that a stomach from a petrel at the breeding colony on South Farallon Island, California, contained a siphonophore (Vellella vellella) that characteristically occurs in the open ocean.

Nonbreeding and Offshore Leach's Storm-Petrels are widespread in pelagic areas during nonbreeding periods, but reach their peak numbers in the vicinity of the Tropical Convergence near the equator in both Atlantic and Pacific oceans (Palmer 1962). Cramp et al. (1977) considered this petrel "less markedly pelagic than some other storm-petrels, frequently found throughout the year in shallower water of continental shelves...."

Ainley et al. (1974), however, remarked that the North Pacific Leach's Storm-Petrels were birds of open ocean that are seldom seen near the coast. These authors point out a great paucity of sightings of Leach's Storm-Petrel within 80 km of the California coast (as reported in Audubon Field Notes and American Birds, the primary source for much of the southeastern distributional data summarized herein). They also note data from extensive pelagic surveys in the Pacific (Crossin 1974) that showed that Leach's Storm-Petrel was abundant far out at sea. Gross (1935) presented anecdotal information from his study of the life history of this species on Kent Island that supports Ainley et al.'s (1974) point of view. Gross noted that birds were seldom seen at sea by day near this northwestern Atlantic colony, although a wintering species, Wilson's Storm-Petrel, could be found at almost any time.

For the southeastern United States we have comparable data only from inshore areas, and it seems unwise to conclude that these petrels are not more abundant in pelagic waters than they are closer inshore.

FOOD AND FEEDING BEHAVIOR

Leach's Storm-Petrels feed on surface-dwelling zooplankton (Cramp et al. 1974), and on fish, molluscs, crustaceans, oily subtances, and ship's garbage (Palmer 1962). This species is regarded as a feeding generalist by Ainley and Sanger (1979), one that will eat a wide variety of small organisms, alive or dead, that occur at the ocean's surface.

Relatively little is known of the specific food habits. Birds at Kent Island were recorded eating small squid and an oily material, but apparently mainly ate euphausiid crustaceans. In Britain, euphausiids (Meganyctiphanes norvegica), copepods (among them Temora longicornis), fish remains, and an isopod were recorded food items. Off California, floating (fish?) eggs were eaten, but the principal food in spring and summer was larval spiny lobster (Panulirus) (Palmer 1962).

Most of the food of Leach's Storm-Petrel is obtained by dipping (i.e., picking food from the water's surface while hovering above it). Birds may settle on the water briefly and surface-seize, but apparently never dive (Palmer 1962, Ainley and Sanger 1979). Birds at sea are usually solitary or found in small, loose flocks, but they readily congregate where food is concentrated.

These petrels follow whales to glean waste from their feeding (Palmer 1962) but seldom follow ships (Palmer 1962, Watson 1966, Cramp et al. 1974). Leach's Storm-Petrel may be attracted to oil chum near fishing vessels (Watson 1966), and may be attracted to small boats by deliberate "chumming" (Palmer 1962). Lee and Booth (1979), however, stated that this species was not attracted by chumming off North Carolina.

Opinions vary, but many believe that this petrel feeds largely after dark (Palmer 1962, Bourne in Cramp et al. 1977).

Wilbur (1969) calculated that breeding birds could travel at least 600 mi in 3 days, basing his estimate on an average incubation spell and the rate at which these birds homed across the Atlantic. This would allow incubating birds a foraging range up to about 300 miles, and, according to Wilbur, would allow birds on Kent Island, New Brunswick, to forage anywhere in the Bay of Fundy or Gulf of Maine.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Most egg laying in Leach's Storm-Petrel falls within the period May - June, but some variation occurs from area to area. Some of the available information is summarized by area below.

Japan Peak laying from mid- to late June (Austin and Kuroda 1953).

Little River Rock, California Laying from mid-May through early July; a peak in late May and early June (Harris 1974).

South Farallon Island, California Laying during a 5-and-a-half week period from early May through mid-June (Ainley et al. 1974). This information was based on only eight nests; it was necessary to extrapolate laying date from hatching or fledging dates for 4 of these nests.

Kent Island, New Brunswick Laying from ca. mid-May to mid-August, with a peak in mid- and late June (Wilbur 1969).

Great Britain Laying largely completed by the end of May (Cramp et al. 1974).

Mean Clutch Size Leach's Storm-Petrel, like other hydrobatids, lays only one egg.

Incubation Period The incubation period is 41-42 days (C. Huntington in Palmer 1962).

Hatching Success We have found no published figures on hatching success for this species.

Fledging Success We have found no information on fledging success when this is given a conventional definition (i.e., the percentage of eggs hatched

that result in fledged young). Morse and Buchheister (1979) reported a "nesting success" (defined as the percentage of eggs resulting in live young at last visit) of 65.9% to 81.7% for the years 1963 and 1974-1976 at Matinicus Rock, Maine. The actual fate of most of these nests is unknown, particularly in 1963 when 59 of 88 burrows were visited only in July, two months or more before the young fledge. Consequently, these figures can be considered only an approximation of what is usually regarded as fledging success.

Age at Fledging Age at first flight (n = 5) ranged from 63 to 70 days (C. Huntington *in* Palmer 1962) for birds from the northwestern Atlantic.

Age at First Breeding Details regarding age of first breeding are apparently unavailable; Huntington and Burtt (1972) reported that a few birds may breed in their fourth summer, but that most do not breed until 5 years old. Young birds may return to their natal colonies in their first summer (Gross 1947), but most do not do so until their second year (Huntington *in* Wilbur 1969). By the third year, young birds may even be found in burrows although these birds evidently do not breed (Huntington and Burtt 1972).

Mortality of Eggs and Young Although adults are known to suffer heavily from both mammalian and avian predation, mortality of eggs and young is apparently relatively light. The primary causes of egg loss appear to be nest abandonment and infertility, the latter seemingly rather seldom. Abandonment is occasionally quite high (Wilbur 1969), but in most reported instances apparently results from disturbance by the investigators.

Renesting Data on renesting are scanty. At Matinicus Rock, Maine, new eggs were laid in 25 of 130 (19%) burrows where the first clutch had been abandoned (Morse and Buchheister 1979). The methods by which data were obtained made it impossible to demonstrate that the same birds were involved in both layings.

Maximum Natural Longevity In the Old World, a young bird banded in Great Britain attained an estimated minimum age of 15 years and one month (Rydzewski 1978). In the New World, a bird banded by C. E. Huntington was recaptured as a breeding bird when not less than 27 years old (Clapp et al. 1979 ms).

Weight (in grams) A considerable amount of data on weights of Leach's Storm-Petrel has been reported. A selected sample of some of this information is listed in Table 32. Unless otherwise stated, all weights apply to the nominate race, *Oceanodroma l. leucorhoa*.

SUSCEPTIBILITY TO OIL POLLUTION

As the first specimen of Leach's Storm-Petrel from the Gulf of Mexico was obtained primarily as the result of oiling, it is clear that the species is somewhat susceptible to oil pollution. In northwestern North America, where there are large populations of Leach's Storm-Petrels and where considerable oil development is being undertaken, King and Sanger (1979) list the species as one of relatively high concern. Their index score of 63 (of a possible 100 points) for oil vulnerability for this species is the third high-

Table 32. Weights (in grams) of Leach's Storm-Petrels.

Mean weight	Range	N	Sample and season	Area	Source
48.4	40.1-57.3	103 (a)	incubating birds, mid-late Jul.	Kent Island, New Brunswick	Palmer 1962
45.0	39-55	28	adults, late Jun.-mid-Aug.	St. Kilda	Waters 1964 *in* Cramp et al. 1977
47.1	37-56	252	birds netted at colony, late June-early July	North Rona, Great Britain	Love 1978
39.3	33.3-49.4	287	birds netted over colony, mid-June; most birds in colony incubating (*O. l. beali*)	S. Farallon Island, California	Harris 1974
41.4	24.0-57.5	150	all seasons	at sea, Central and Eastern Pacific	Crossin 1974
39.9	33-52	14	wintering birds at sea, Aug.-Apr.	Azores to South Africa	Cramp et al. 1977
8.8	-----	45	partly incubated ? eggs	Kent Island, New Brunswick and vicinity	W. Gross *in* Palmer 1962
ca. 6	-----	?	hatching young	Little River Rock, California	Harris 1974
66.8	23-90 (most 44-88)	39	late chicks, early Sept.	Kent Island, New Brunswick	Huntington *in* Palmer 1962
29.5	25-31.5	10	emaciated storm-driven birds, fall	Scotland	Wynne-Edwards 1953
36.5	-----	1	oiled male, late May	Florida	Rohwer and Woolfenden 1968
39.9	29.0-53.0	124	*O. l. beali*, all seasons	at sea, Eastern Pacific and Coronados	Crossin 1974

Table 32. Continued.

Mean weight	Range	N	Sample and season	Area	Source
34.8	29.0-42.0	78	O. l. chapmani	San Benitos	Crossin 1974
31.7	22.4-44.0	152	O. l. socorroensis	at sea, Eastern Pacific and Guadelupe Island	Crossin 1974

(a) Sample includes data from 66 birds, some of which were reweighed.

est for any of 13 procellariids considered (1).

Eight birds of this species were among 1,276 birds recovered off eastern Canada, February-April 1970 (Brown et al. 1973).

The degree to which oil development in the southeast might affect this species is unclear. This storm-petrel is relatively scarce in waters of the southeastern United States, and apparently occurs there during only a small proportion of the year. The effect of oiling on individual birds might be great, but the effect on the total population, which is quite large, would be minimal.

BIBLIOGRAPHY

1981

Furness, R. W. and S. R. Baillie. 1981. Factors affecting capture rate and biometrics of storm petrels on St. Kilda. Ringing and Migration 3: 137-147.

1980

Ainley, D. G. 1980. Geographic variation in Leach's Storm Petrel. Auk 97: 837-853.

Marsh, P. 1980. Identification problem produced by Leach's Petrel in moult. Brit. Birds 73: 474.

(1) The higher scores were for the Fork-tailed Storm-Petrel (Oceanodroma furcata) and the Short-tailed Albatross (Diomedea albatrus), which received the rating almost entirely because it is on the Endangered Species list.

Ricklefs, R. E., S. C. White and J. Cullen. 1980a. Energetics of post-natal growth in Leach's Storm-Petrel. Auk 97: 566-575.

Ricklefs, R. E., S. C. White and J. Cullen. 1980b. Postnatal development of Leach's Storm-Petrel. Auk 97: 768-781.

1979

Atkin, K. 1979. Flight characters of Leach's Petrel. Brit. Birds 72: 334-336.

Banz, K. 1979. Ein Nachweis des Wellenlaufers, Oceanodroma leucorhoa (Viellot), im Erzgebirge. [Identification of Leach's Petrel Oceanodroma leucorhoa (Viellot) in the Erz Gebirge.] Beitr. Vogelkd. 25: 127. [In German.]

Brown, D. M. and B. Ortego. 1979. Alabama's first Leach's Storm-Petrel. Am. Birds 33: 808.

French, T. W. 1979. Great Horned Owl predation on Leach's Storm-Petrels in Maine. Auk 96: 202.

Grubb, T. C., Jr. 1979. Olfactory guidance of Leach's Storm-Petrel to the breeding island. Wilson Bull. 91: 141-143.

Morse, D. H. and C. W. Buchheister. 1979. Nesting patterns of Leach's Storm-Petrels on Matinicus Rock, Maine. Bird-Banding 50: 145-158.

Rabbitts, B., D. Page and P. Greaves. 1979. Leach's Petrels foot-pattering on water. Brit. Birds 72: 334.

Ricklefs, R. E. and H. Rahn. 1979. The incubation temperature of Leach's Storm-Petrel. Auk 96: 625-627.

Slud, P. 1979. First record of Leach's Storm-Petrel in Costa Rica: a correction. Condor 81: 102-103.

1978

Buhrman, C. B. and L. A. Hopkins. 1978. Leach's Storm-Petrel sighted in the eastern Gulf of Mexico. Fla. Field Nat. 6: 44.

Fooks, P. 1978. Leach's Fork-tailed Storm-Petrel. Notornis 25: 278.

Love, J. A. 1978. Leach's and Storm Petrels on North Rona: 1971-1974. Ringing and Migration 2: 15-19.

Quinlan, E. 1978. The effects of predation on storm petrel nesting success at Fish Island, Alaska. (Abstract only). Pac. Seabird Group Bull. 5: 47.

1977

Morse, D. H. and C. W. Buchheister. 1977. Age and survival of breeding Leach's Storm-Petrels in Maine. Bird-Banding 48: 341-349.

Ricklefs, R. E. 1977. Energetics of development in the Common Tern, Sooty Tern, and Leach's Petrel. (Abstract only). Pac. Seabird Group Bull. 4: 18.

Fitzpatrick, C. and W. Threlfall. 1977. The ectoparasities of three species of seabirds from Newfoundland, Canada. Can. J. Zool. 55: 1205-1209. [In English with French summary.]

1976

Ainley, D. G., T. J. Lewis and S. Morrell. 1976. Molt in Leach's and Ashy storm-petrels. Wilson Bull. 88: 76-95.

Hall-Craggs, J. and P. J. Sellar. 1976. Distinguishing characteristics in the burrow-calling of Storm and Leach's petrels. Brit. Birds 69: 293-297.

Owen, J. I. 1976. Petrel and Pilchard oil. Sea Swallow 25: 48-49.

1975

Eley, T. J., Jr. 1975. A sight record for Leach's Petrel north of the Aleutian Islands, Alaska. Murrelet 55: 44-45.

Love, J. A. 1976. Identification from measurements of small petrel remains in gull and skua pellets. Bird Study 23: 162.

Mainwood, A. R. 1975. Leach's Petrel breeding on Foula. Scott. Birds 8: 321-323.

1974

Ainley, D. G., S. Morrell and T. J. Lewis. 1974. Patterns in the life histories of storm-petrels on the Farallon Islands. Living Bird 13: 295-312.

Crossin, R. S. 1974. The Storm Petrels (Hydrobatidae). Pp. 154-205 in W. B. King [ed.]. Pelagic Studies of Seabirds in the Central and Eastern Pacific Ocean. Smithson. Contr. Zool. 158. iv and 277 pp.

Grubb, T. C., Jr. 1974. Olfactory navigation to the nesting burrow in Leach's Petrel (Oceanodroma leucorhoa leucorhoa). Anim. Behav. 22: 192-202.

Harris, S. W. 1974. Status, chronology and ecology of nesting storm-petrels in north-western California. Condor 76: 249-261.

Larsen, T. M. 1974. Stormsvale i Beitstadfjorden, Nord-Trondelag. [Leach's Petrel in Beitstadfjord, North Trondelag.] Fauna 27: 94. [In Norwegian with English summary.]

Threlfall, W. 1974. Foot injuries in Leach's Storm-Petrels. Wilson Bull. 86: 65-67.

1973

Grubb, T. C., Jr. 1973. Colony location by Leach's Petrel. Auk 90: 78-82.

McCrimmon, D. A., Jr. 1973. Leach's Storm Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47-48.

McCrimmon, D. A., Jr., L. Johnson and J. O. Fussell, III. 1973. Second specimen of Leach's Storm-Petrel collected in North Carolina. Chat 37: 47.

Ostern, S. 1973. Stormsvaler og Havsvaler pa Rost. [Leach's Petrel and Storm Petrel off Rost, Lofoten Islands.] Fauna 26: 72. [In Norwegian with English summary.]

Rothstein, S. I. 1973. Plastic particle pollution of the surface of the Atlantic Ocean: evidence from a seabird. Condor 75: 344-345.

Wassenich, V. 1973. Der Wellenlaufer (Oceanodroma leucorhoa) erstmals in Luxembourg nachgewiesen. Regulus 11: 27-30.

1972

Abe, M. T., N. Ichida, M. Shimizu, M. Hashimoto, O. Yunoki, N. Ozawa and S. Ozawa. 1972. [A new attempt to estimate the number of nesting petrel, Oceanodroma leucorhoa leucorhoa and wildlife of the Daikoku Island, Hokkaido.] Tori 21: 346-365. [In Japanese with English summary.]

Emmerich, K.-H. 1972. Erstnachweis des Wellenlaufers (Oceanodroma leucorrhoa) in Berlin. Ornithol. Mitt. 24: 32.

Blem, C. R. and D. W. Sonneborn. 1972. Leach's Petrel in North Carolina. Chat 36: 29.

Dathe, H. and W. Grummt. 1972. Erstnachweis des Wellenlaufers, Oceanodroma leucorhoa (Viell.), fur die Mark Brandenburg. Beitr. Vogelk. 18: 351-353.

Huntington, C. E. and E. H. Burtt. 1972. Breeding age and longevity in Leach's Petrel (Oceanodroma leucorhoa). (Abstract) Proc. XV Internatl. Ornithol. Congr., The Hague, 30 August-5 September 1970: 653.

Walti, E. 1972. Wellenlaufer (Oceanodroma leucorrhoa) bei Mainz am Rhein. Ornithol. Mitt. 24: 219.

1971

Grubb, T. C., Jr. 1971a. Stomach oil in Procellariiformes: an extraction technique. Ibis 112: 529.

Grubb, T. C., Jr. 1971b. Olfactory navigation in Leach's Petrel and other Procellariiform birds. Ph. D. thesis, Univ. Wisconsin/Madison, WI.

1970

Anon. 1970. Erstnachweis des Wellenlaufers im Gebiet von Berlin. Falke 17: 247.

Grubb, T. C., Jr. 1970. Burrow digging techniques of Leach's Petrel. Auk 87: 587-588.

Lapthorn, J., R. G. Griffiths and W. R. P. Bourne. 1970. Leach's Storm-Petrel Oceanodroma l. leucorhoa from the Indian Ocean and Sharjah, Per sian Gulf. Ibis 112: 260-261.

1969

Anon. 1969. Leach's Storm Petrel at Sharjah. Gulf Bird-Watchers Newsl. No. 3: 1.

Cangialosi, G. 1969. Nuova cattura di uccello delle tempeste codaforcuta. Riv. Ital. Ornitol. 39: 224-226.

Folz, H.-G. 1969. Wellenlaufer--Oceanodroma leucorhoa--am Rhein bei Bingen. Luscinia 40: 256.

Myrberget, S., V. Johansen and O. Storjord. 1969. [Petrels (Hydrobatidae) in Norway.] Fauna 22: 15-26. [In Norwegian with English summary.]

Parsons, B. T. 1969. A record of Oceanodroma leucorhoa from Kenya. Bull. Br. Ornithol. Club 89: 120-121.

Threlfall, W. 1969. Anomalous conditions in three species of birds. Can. Field Nat. 83: 384-388.

Wilbur, H. M. 1969. Breeding biology of Leach's Petrel (Oceanodroma leucorhoa). Auk 86: 433-442.

1968

Billings, S. M. 1968. Homing in Leach's Petrel. Auk 85: 36-43.

Hoffrichter, O. 1968. Ein Wellenlaufer (Oceanodroma l. leucorrhoa) in Freiburg im Breisgau. Vogelwarte 24: 282-283.

Rohwer, S. A. and G. E. Woolfenden. 1968. A specimen of Leach's Petrel from the Gulf Coast of Florida. Auk 85: 319.

Williams, R. B. and D. C. Williams. 1968. Leach's Petrel along the North Carolina coast. Chat 32: 45.

1967

Voous, K. H. 1967a. Leach's Storm-Petrel in the Caribbean. Ardea 55: 268-269.

Voous, K. H. 1967b. Leach's Storm-Petrel in the tropical Pacific. Ardea 55: 268.

1966

Lewis, R. W. 1966. Studies of the glyceryl ethers of the stomach oils of Leach's Petrel *Oceanodroma leucorhoa* Viellot. [sic.]. Compar. Biochem. Physiol. 19: 363-377.

1965

Baird, D. E. 1965. Ecology of Leach's Petrel. Ibis 107: 426.

Haarman, K. 1965. Wellenlaufer (*Oceanodroma leucorrhoa*) auf der Aussenalster in Hamburg. Vogelwelt 22: 100-109.

1964

Haverschmidt, F. 1964. Leach's Petrels (*Oceanodroma leucorrhoa*) near the coast of Surinam. Ardea 52: 118.

Waters, W. E. 1964a. Arrival times and measurements of small petrels on St. Kilda. Brit. Birds 57: 309-315.

Waters, W. E. 1964b. Observations on small petrels at St. Kilda, 1961-62. Scott. Birds 3: 73-81.

1963

Huntington, C. E. 1963. Population dynamics of Leach's Petrel. Proc. XIII Internatl. Ornithol. Congr., Ithaca 1962 Vol. 2: 701-705.

1959

Bagenal, T. B. 1959. Breeding of Leach's Petrel on the Flannan Isles. Brit. Birds 52: 311.

1958

Wilson, D. R. 1958. Leach's Petrels in Shetland. Brit. Birds 51: 77-78.

1957

McIntyre, J. D. 1957. Predation on Leach's Petrel on eastern Canadian bird islands. Ont. Field Biol. 11: 4-6.

1955

Todd, W. E. C. 1955. Taxonomic comment on races of Leach [sic] Petrel of the Pacific Coast. Condor 57: 122.

1954

Boyd, H. 1954. The "wreck" of Leach's Petrels in the autumn of 1952. Brit. Birds 47: 137-163.

Goethe, F. 1954. Invasionen von Wellenlaufern und Sturmschwalben in Mitteleuropa wahrend des Herbstes 1952. Vogelwelt 75: 89-100. [In German.]

1953

Jouanin, C. 1953. Note complementaire sur les Oceanodroma leucorhoa (Vieillot) echoues en France en automne 1952. Oiseau R.F.O. 23: 240-241. [In French.]

Lippens, L. 1953. Une invasion de Petrels cul-blancs (Oceanodroma leucorhoa Viell.) en Belgique. Gerfaut 43: 165-168. [In French with Dutch summary.]

Wynne-Edwards, V. C. 1953. Leach's Petrels stranded in Scotland in October-November, 1952. Scott. Nat. 65: 167-189.

1952

Austin, O. L., Jr. 1952. Notes on some petrels of the North Pacific. Bull. Harvard Mus. Comp. Zool. 107: 391-407.

Bruce, S. 1952. Leach's Fork-tailed Petrel on Whalsay, Shetland. Brit. Birds 45: 421.

Moltoni, E. 1952. Sugli uccelli delle tempeste codaforcuta, Oceanodroma leucorrhoa leucorrhoa (Vieillot), presi in Italia nel 1951. Riv. Ital. Ornitol. 22: 72-74. [In Italian.]

1950

Hawksley, J. 1950. Notes on Leach's Petrel. Bird-Banding 21: 60.

1949

Voous, K. H. 1949. Het voorkomen van het Gewone en het Vale Stormvogeltje, Hydrobates p. pelagicus (L.) en Oceanodroma l. leucorhoa (Viell.), in Amsterdam. Ardea 36: 265-268. [In Dutch with English summary.]

1948

Atkinson, R. 1948. Leach's Petrel. New Naturalist 1: 110-114.

1947

Gross, A. O. 1947. Recoveries of banded Leach's Petrels. Bird-Banding 18: 117-126.

1946

Pearse, T. 1946. Beal's Petrel breeding on Vancouver Island, B.C. Can. Field Nat. 60: 133.

1945

Longstreet, R. J. 1945a. Leach's Petrel in Florida. Auk 62: 148.

1944

Buchheister, C. W. 1944. Out of the gray mist. Audubon Mag. 46: 336-343.

Ruttledge, R. F. 1944. Results of exploration in search of Leach's Fork-tailed Petrel, Oceanodroma l. leucorrhoa (Vieill.). Irish Nat. J. 8: 180.

1942

van Rossem, A. J. 1942. Preliminary comment on some Pacific coast petrels. Proc. Biol. Soc. Wash. 55: 9-12.

1940

Atkinson, R. and J. A. Ainslie. 1940. The British status of Leach's Fork-tailed Petrel. Brit. Birds 34: 50-55.

Griffin, D. R. 1940. Homing experiments with Leach's Petrels. Auk 57: 61-74.

Toner, G. C. 1940. Leach's Petrel in Ontario. Wilson Bull. 52: 124.

1937

Ainslie, J. A. and R. Atkinson. 1937. On the breeding habits of Leach's Fork-tailed Petrel. Brit. Birds 30: 234-248, 276-277.

1935

Allen, F. H. 1935. The Leach's Petrels of Penikese Island, Massachusetts. Auk 52: 179-180.

Danforth, S. T. 1935. Leach's Petrel in the West Indies. Auk 52: 74.

Gross, W. A. O. 1935. The life history cycle of Leach's Petrel (Oceanodroma leucorhoa leucorhoa) on the outer sea islands of the Bay of Fundy. Auk 52: 382-399.

1934

Lincoln, F. C. (ed.) 1934. An influx of Leach's Petrels. Auk 51: 74-75.

Moltoni, E. 1934. Seconda cattura in Italia dell'Uccello delle tempeste a codaforcuta [Oceanodroma leucorhoa leucorhoa (Vieillot).] Riv. Ital. Ornitol. 4: 1-4. [In Italian.]

Norton, A. H. 1934. The breeding habits and breeding range of Leach's Petrel. Auk 51: 75-76.

1933

Townsend, C. W. and F. H. Allen. 1933. Leach's Petrel (Oceanodroma leucorhoa leucorhoa) breeding in Massachusetts. Auk 50: 426-427.

1932

Norton, A. H. and R. P. Allen. 1932. Leach's Petrel on the coast of Maine. Auk 49: 340-341.

Perkins, A. E. 1932. Destruction of petrels by cats. Auk 49: 212.

1931

Ball, W. H. 1931. Leach's Petrel (Oceanodroma leucorhoa) in the District of Columbia. Auk 48: 106.

1930

Blincoe, B. J. 1930. Leach's Petrel in Ohio. Auk 47: 72.

Huey, L. M. 1930. Notes on the habits and plumage of young Kaeding Petrels. Condor 32: 68-69.

1927

Dingle, E. von S. 1927. Leach's Petrel (Oceanodroma leucorhoa) in South Carolina. Auk 44: 244.

1924

Townsend, C. W. 1924. The songs of Leach's Petrel. Auk 41: 148-149.

1922

Kuroda, N. 1922. Additional notes on the Japanese species of Oceanodroma. Ibis 11th Ser., Vol. 4: 437-440.

1918

Grinnell, J. 1918. The status of the White-rumped Petrels of the California coast. Condor 20: 46.

1917

Oberholser, H. C. 1917. A review of the subspecies of the Leach Petrel, *Oceanodroma leucorhoa* (Viellot). Proc. U.S. Natl. Mus. 54: 165-172.

1915

Murphy, R. C. 1915. The Atlantic range of Leach's Petrel (*Oceanodroma leucorhoa* Viellot). Auk 32: 170-173.

1906

Emerson, W. O. 1906. *Oceanodroma leucorhoa* and its relatives on the Pacific coast. Condor 8: 53-55.

RED-BILLED TROPICBIRD

(*Phaethon aethereus*)

[DU: Roodsnavelkeekringvogel, FR: Paille en queue etheree, GE: Rotschnabeltropikvogel, IT: Fetonte beccorosso minore, PR: Rabo de Junco, SP: Rabijunco Piquirojo, Rabijunco comun; SW: Rodnabbad tropikfagel]

GENERAL DISTRIBUTION

North America On the Pacific side of North America, Red-billed Tropicbirds breed on islands off Mexico (Tres Marias, Rivilla Gigedos) and in the Gulf of California (AOU 1957). On the Atlantic side they breed on islands in the Caribbean (see below) and on Swan Cay in Almirante Bay off Panama (Blake 1977). Birds of this species have wandered far north of the normal range on both coasts. On the Pacific side they have ranged to Arizona (Phillips et al. 1964), California (Small 1974), and Washington (Flahaut 1947); on the Atlantic they have been found north to New York (Bull 1964) and Rhode Island (Finch 1973).

World Distribution The Red-billed Tropicbird has a less widespread distribution in tropical waters than the other two species of the genus. It is absent as a breeder from most of the Pacific Ocean and the eastern and central Indian Ocean. In the Indian Ocean and adjacent areas they breed on islands in the Gulf of Suez, the Red Sea, the Gulf of Aden, the Arabian Sea, and the Persian Gulf (Vaurie 1965, Cramp et al. 1977). They disperse widely from these areas and occur in western India and the Laccadive Islands (off the SW coast of India), and Ceylon, the Bay of Bengal, Madagascar (Cramp et al. 1977), and Mauritius (Vaurie 1965).

In the West Indies Red-billed Tropicbirds are found in the Virgin Islands and Lesser Antilles and on Tobago (Bond 1971). In the western Atlantic, they breed on at least Los Hermanos and Los Roques off Venezuela and on Fernando de Noronha (off Brazil), and wander to the Brazilian coast (Blake 1977). In the eastern Atlantic they breed on St. Helena and Ascension islands, the Cape Verde Islands, and islets off the coast of Senegal (Cramp et al. 1977).

In the eastern Pacific this tropicbird breeds on the Galapagos Islands, on Malpelo Island off Columbia, La Plata Island off Ecuador, and on San Lorenzo off Peru (Blake 1977). Birds wander rarely to the Central Pacific, where this species been recorded from Nihoa Island and French Frigate Shoals in the Northwestern Hawaiian Islands (Clapp and Woodward 1968, Amerson 1971), and Johnston Atoll (Amerson and Shelton 1976). Along the South American coast these tropicbirds disperse south to central Chile (Blake 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

There are only four records of Red-billed Tropicbirds from the southeast, two from North Carolina and two from Florida. These are as follows:

	North Carolina			
1979	16 May	1 ad. coll. (NCSM 7182)	off Oregon Inlet	D. Lee *in litt*.
1979	16 May	1 imm. female coll. (NCSM 7183)	off Oregon Inlet	D. Lee *in litt*., LeGrand 1979c
	Florida			
1975	9 Oct.	1 found moribund	Point Vedra Beach	Edscorn 1976
1979	1 Sep.	1 found, died later (USF 5223)	Hutchinson Island, Martin Co.	this paper

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Red-billed Tropicbird is widespread in tropical waters, but little is known concerning its status on a world-wide basis. At one of the major breeding stations in the Cape Verde Islands, the population is said to be in "alarming decline" due to the depredations of fishermen (Cramp et al. 1977); the total population there is perhaps less than 1,000 (de Naurois 1969b *in* Cramp et al. 1977).

We know of only six well-documented records from the eastern United States (Rhode Island to Florida), but the species may occur more frequently in offshore waters than the literature indicates. In any event, it appears to be far more uncommon in the eastern United States than its congener, the White-tailed Tropicbird.

HABITAT

Nesting Red-billed Tropicbirds nest colonially, laying a single egg in hollows and rocky crevices from near sea level among rocks (Nelson 1899 *in* Cramp et al. 1977) to niches in cliffs as much as 500 m above the sea (Meliss 1875 *in* Murphy 1936). Nests may be found in virtually any shallow cavity, on ledges under overhangs, on flat ground, or under boulders. These tropicbirds will also use hollows excavated by other species such as the Wedge-tailed Shearwater (*Puffinus pacificus*) (Palmer 1962). They have been reported in the Galapagos displacing both the White-tailed Tropicbird and Audubon's Shearwater from their nest holes (Harris 1969a).

Feeding The feeding range off the nesting grounds is not known. Available observations suggest that this tropicbird feeds primarily in pelagic waters well away from the nesting areas. They forage solitarily or by twos, and are seldom found in groups (Cramp et al. 1977).

Nonbreeding and Offshore Birds may be found in the nesting areas through-

out the year and in most areas the species has a prolonged breeding season that limits the extent to which they may wander. At least some proportion of the population disperses far from land, but little is known about these movements. Harris (1969a) reported that birds from the Galapagos population may move up to 1,500 km from the nesting areas. Among two birds banded there and later caught elsewhere, one was a young bird caught in the Gulf of Panama and the other an adult caught off Peru. These recoveries led Harris (1969a) to speculate that birds from this population might roam widely over the eastern Pacific. Red-billed Tropicbirds prefer warm waters (Murphy 1936), as do other members of the genus.

FOOD AND FEEDING BEHAVIOR

Authors agree that the principal foods of this species are fish and squid, but few have given more specific information. For birds nesting on Boatswain Bird Island in the Atlantic, Stonehouse (1962b) reported that the main food was flying fish (*Exocoetus volitans* and *Oxyporhamphus micropterus*), and suggested that the average size of fish taken by the Red-billed Tropicbird was somewhat greater than that taken by the smaller White-tailed Tropicbird. Additional food items taken at Boatswain Bird Island (off Ascension Island) included other species of flying fish (*Cypsilurus* spp. and *Hirundichthyes* spp.) and the squid *Hyaloteuthis pelagicus*. Harris (1969a) described food given to young birds in the Galapagos as either medium-sized fish (up to 20 cm long) or squid.

Red-billed Tropicbirds feed by deep-plunging, often from a considerable height (Cramp et al. 1977). According to Murphy (1936), the principal period when birds return from foraging (in both the Cape Verde and Galapagos islands) is in the early morning. At St. Helena in the Atlantic, a second period occurred in the late afternoon (Meliss 1875 *in* Murphy 1936).

SUSCEPTIBILITY TO OIL POLLUTION

We have not found any records of oiling in this species, but its diving habits of deep-plunging might result in contamination if these tropicbirds encountered floating oil. Their solitary or semi-solitary feeding habits as well as their pelagic foraging range should make Red-billed Tropicbirds relatively less vulnerable to the direct effects of oil pollution than most other Pelecaniformes. Their apparent rarity in southeastern waters also makes this species one of relatively little concern from the standpoint of susceptibility to oil in that area.

BIBLIOGRAPHY

1979

Harris, M. P. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

G[allagher], M. D. 1975. Red-billed tropic-bird. Gulf Bird-Watchers Newsl. No. 24: 3.

1973

Anon. 1973. The marine observers' log. Marine Observ. 41: 163-164.

1969

Harris, M. P. 1969a. Factors influencing the breeding cycle of the Red-billed Tropicbird in the Galapagos Islands. Ardea 57: 149-157.

1965

Garrido, O. H. and F. G. Montana. 1965. Aves neuvas para Cuba. Poeyana Instit. Biol. (Ser. A) 10: 1-6. [In Spanish with English summary.]

Snow, D. W. 1965. The breeding cycle of the Red-billed Tropic Bird in the Galapagos Islands. Condor 67: 210-214.

1964

Bull, J. L. 1964. Red-billed Tropicbird on Long Island, New York. Auk 81: 433-434.

Leveque, R. 1964. Notes sur la reproduction des oiseaux aux Iles Galapagos. Alauda 32: 5-44, 81-96. [In French.]

1962

Stonehouse, B. 1962b. The tropicbirds (genus Phaethon) of Ascension Island. Ibis 103b: 124-161.

1951

North, M. E. W. 1951. Tropic-birds at Ras Hafun. Ibis 93: 466.

1947

Flahaut, M. R. 1947. Red-billed Tropic-bird taken at Westport, Washington. Murrelet 28: 6.

1945

McAtee, W. L. 1945. Catesby's tropic-bird. Auk 62: 137-139.

1934

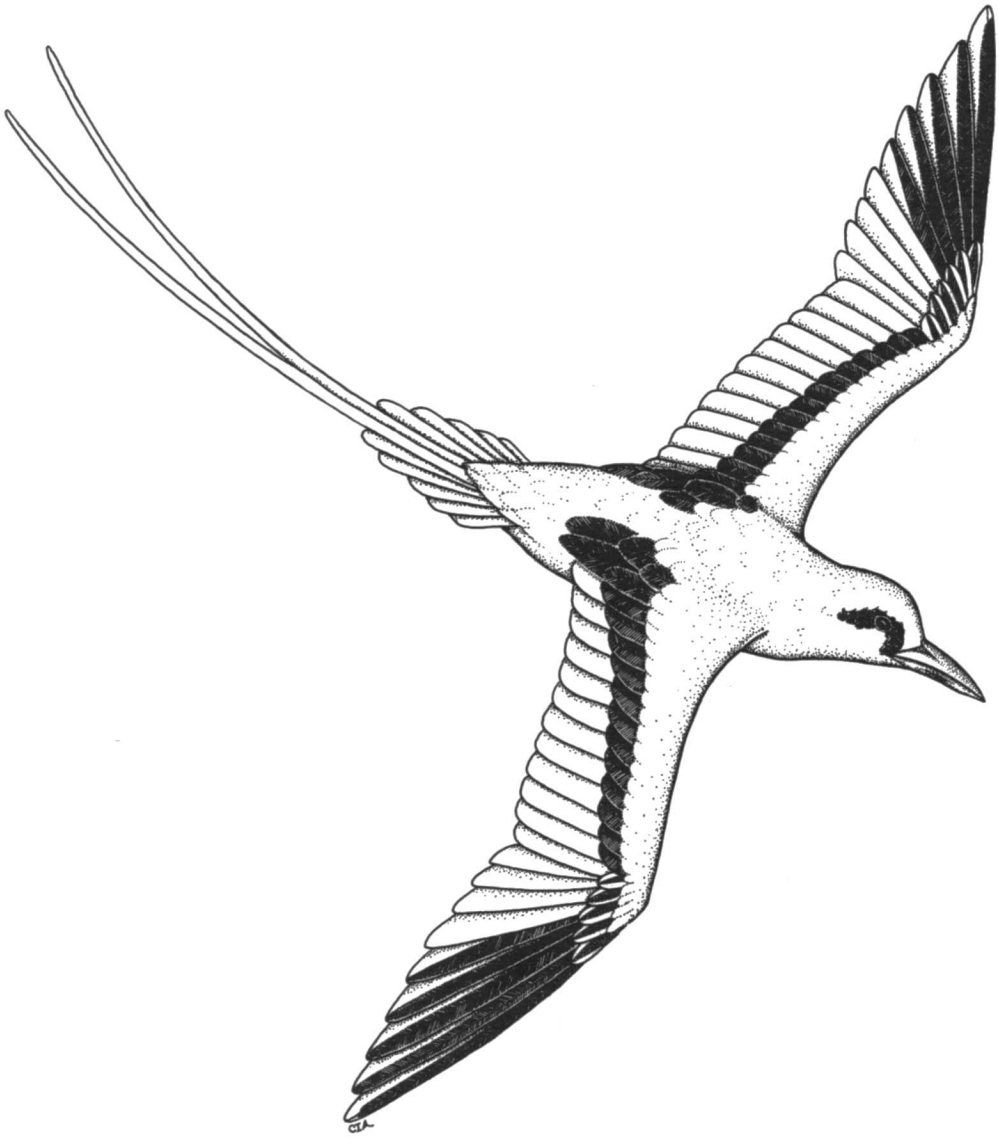
Vorhies, C. T. 1934. Second record of the Red-billed Tropic-bird in Arizona. Condor 36: 85-86.

1930

Peters, J. L. 1930. Two undescribed races of Phaethon aethereus. Occas. Pap. Boston Soc. Nat. Hist. 5: 261-262.

1925

Derscheid, J. M. 1925. Notes sur les convolutions intestinales de Phaeton. Ann. Soc. Roy. Zool. Bruxelles 55: 119-121.



WHITE-TAILED TROPICBIRD

(*Phaethon lepturus*)

[JA: Shirao nettaicho, SP: Rabi-junco, US: Yellow-billed Tropicbird]

GENERAL DISTRIBUTION

North America White-tailed Tropicbirds are not known to breed in North America, but they disperse with some frequency into offshore waters and into the Gulf of Mexico. They have wandered north along the Atlantic coast (and inland) to New York (Bull 1974), Pennsylvania (Bond 1964), Maine (Norton 1943), and Nova Scotia (Godfrey 1966). They are virtually absent from the eastern Pacific but have wandered to California (Hetrick and McCaskie 1965).

World Distribution In the Indian Ocean and adjacent areas, these tropicbirds breed from the Mascarene and Seychelle islands (the former east, the latter north of the Malagasy Republic) to the Andaman Islands (west coast of India) and Cocos-Keeling and Christmas islands (both southwest of Java) (AOU 1957, Serventy et al. 1971).

In the western Atlantic and Caribbean this tropicbird breeds on Bermuda, in the Bahamas and Antilles, possibly on islets off Tobago, and on Fernando de Noronha off Brazil (AOU 1957, Blake 1977). In the eastern Atlantic it breeds on Ascension and on islands in the Gulf of Guinea off western Africa (Palmer 1962, Blake 1977). It has also been recorded off the coasts of Colombia and Brazil (Blake 1977).

In the central and western Pacific, the White-tailed Tropicbird breeds from the Tuamotus north to the main Hawaiian Islands, west to Wake Island, and probably at least as far north as Maug in the northern Marianas (W. King 1967, Clapp, unpubl.). It breeds south to the Palau Islands and to Walpole Island, about 150 mi southeast of New Caledonia (Serventy et al. 1971), and east from there to Fiji, Tonga, and the Austral Islands (W. King 1967). White-tailed Tropicbirds occur widely at sea within this area and have wandered to Japan (Vaurie 1965), the Phillippines (Brodkorb et al. 1969), New Zealand (Brown 1973), and off the coast of Chile (Blake 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

White-tailed Tropicbirds are known to occur in the offshore waters of all the coastal southeastern states except Mississippi; their presence there will almost surely be documented at some future date. Many of the observations of "White-tailed Tropicbirds" in the southeastern states are very poorly documented and it is quite possible that some of these observations were of Red-billed Tropicbirds (*Phaethon aethereus*).

North Carolina We have found 20 records of at least 23 individual White-tailed Tropicbirds in North Carolina waters. All but six of these were made in the last 5 years, largely as a result of a considerable increase in off-

shore observation. All the North Carolina records fall between 1 June and 11 September, suggesting that this tropicbird is fairly regular in small numbers off the coast during summer. Lee (*in litt.*) suspects that this period is the normal season of occurrence off North Carolina, but there is little information available on its status in offshore waters in other months. Lee and Booth (1979) regard it as an uncommon but regular summer visitor in North Carolina. Records for the state, including many unpublished observations supplied by David Lee, are listed below:

1902	11 Sep.	1 seen	ca. 200 mi off Cape Hatteras	Gault 1902
1936	3 Aug.	1 seen (1)	ca. 15 mi off Cape Lookout	Pearson et al. 1942
1939	5 Jul.	1 found dead (head preserved, CM)	N shore Oregon Inlet	Grey 1940
1941	25 Jul.	1 seen	off Beaufort	Pearson et al. 1942
1958	25 Jul.	1 seen	30 mi off, 20 mi S Cape Hatteras	Harte 1959
1960	24 Aug.	1 seen	120 mi off coast	Anon. 1960
1972	28 Aug.	1 seen (2)	70 mi S Morehead City	Teulings 1973a
1974	Jul.	1 seen	off Cape Hatteras	Teulings 1975a
1975	18 Jul.	1 seen	ca. 45 mi SE Morehead City	Teulings 1976d
1976	8 Jun.	2 ad. seen	Oregon Inlet	Lee *in litt.*
1976	15 Jun.	3 ad. seen	Oregon Inlet	Lee *in litt.*
1976	25 Jun.	1 ad. seen	33.5 mi SE Beaufort Inlet	LeGrand 1976, Lee *in litt.*
1976	24 Aug.	1 seen	35 mi SSE Beaufort Inlet	Teulings 1977a

(1) The original report of this record by Brimley (1937) reads as follows: "One seen by a party from the U.S. Fish Commission Laboratory 20 miles off Cape Lookout, on or about August 12, 1936. R. Collie."

(2) The cited source lists 29 Aug., but C. Wilds (pers. comm.) informs us that the bird was actually seen on the 28th.

1976	1 Sep.	1(?) seen	12 mi SE of Marker 14, Beaufort Inlet	Lee *in litt.*
1976	4 Sep.	1 ad. seen	Oregon Inlet	Lee *in litt.*
1977	1 Jun.	1(?) seen	off North Carolina	Lee *in litt.*
1977	21 Aug.	1 seen	40 mi off, Oregon Inlet	Lee *in litt.*
1978	6 Jun.	1 seen	Oregon Inlet	Lee *in litt.*
1978	25 Jul.	1 seen	Oregon Inlet	Lee *in litt.*, LeGrand 1979a
1978	11 Sep.	1 ad. male coll. (NCSM)	Oregon Inlet	Lee *in litt.*, LeGrand 1979a

South Carolina We have five records of White-tailed Tropicbirds from South Carolina. Three of the five records are outside the time span in which the species has been recorded in North Carolina, suggesting a wider temporal spread of occurrence in South Carolina waters. The paucity of observations for South Carolina and Georgia probably reflects the difference in amount of observation between these states and North Carolina and Florida, where the species has been recorded much more frequently, rather than any real difference in offshore populations of these tropicbirds. The South Carolina records are as follows:

1926	30 Jul.	1 found alive (spec. CM)	Jocassee, Oconee Co. (inland)	Sprunt and Chamberlain 1949
1954	16 Oct.	1 found alive	Dillon, Dillon Co. (ca. 60 mi inland)	McCallum 1959
1959	29 May	1 seen	18 naut mi SSE Charleston sea buoy	Manigault 1959
1974	mid-Apr.	1 seen	70 mi off Charleston	Teulings 1974c
1975	14 Jun.	1 seen	ca. 40 mi SE Charleston	Teulings 1975d

Georgia There is but one sight record for Georgia which Burleigh (1958) considered "doubtless correct", but he chose to place the species on the hypothetical list because its occurrence was not documented by a specimen.

1940	15 Aug.	1 ad. seen	Atlanta (inland)	Griffin 1940

Florida The White-tailed Tropicbird has been seen in Florida more frequently than in any of the other southeastern states, with the great majority of records from the Atlantic coast and the Keys. It seems evident that the species is of regular occurrence in the latter area and perhaps in the former, as well.

Florida - Atlantic Coast

1886	21 Apr.	1 coll.	Merritt Island, Banana River	Brewster 1886
1950	7 Sep.	1 imm. found	Ponte Vedra Beach, St. Johns Co.	McKay 1951, Palmer 1962
1950	9 Sep.	1 primary feather found	Jacksonville Beach	McKay 1951
1957	ca. 3 Aug.	1 seen	30-40 mi off Canaveral	Stevenson 1957b
1957	8 Aug.	2 seen	20 mi off Eau Gallie, Brevard Co.	Stevenson 1957b
1959	6 Aug.	(1?) seen	off Cocoa	Stevenson 1959c
1960	19 Mar.	1 seen	New Smyrna Beach	Longstreet 1960
1965	8 Sep.	1 seen	Fort Lauderdale	Stevenson 1966a
1967	8 Sep.	1 seen	off Jacksonville Beach	Robertson and Ogden 1968
1969	15 Sep.	1 found dead (spec. USF)	Hillsboro Beach, Brevard Co.	Robertson 1970
1970	24 Sep.	1 imm. found, released	Cocoa Beach	Robertson 1971
1971	8 Sep.	1 ad. seen	off Port Canaveral	Robertson 1972
1972	15 May	1 seen	off Port Canaveral	Kale 1972
1972	17 Jun.	1 imm. female found dead (spec. FTU-1153)	Satellite Beach	Anderson 1972
1973	20 Oct.	1 found dead	near Vero Beach	Edscorn 1974
1974	25 Apr.	1 seen	off Sebastian Inlet	Kale 1974
1974	16 Aug.	1 seen	off Canaveral	Edscorn 1975
1974	18,22 Sep.	1 seen	off Canaveral	Edscorn 1975
1975	19 Sep.	2 seen	Biscayne Bay off Virginia Key	Edscorn 1976
1976	18 May	1 seen	50 mi E Cape Canaveral	Kale 1976

1977	7 Aug.	4 seen	off Canaveral	Edscorn 1978
1978	16 Jul.	1 seen	10 mi E Fort Pierce	Ogden 1978
	Florida - Keys (1)			
1832	summer	8-10 seen	Dry Tortugas	Audubon in Howell 1932
18??	Nov.	1 seen	in Gulf off Keys	Maynard 1881
1935	18-19 Jun.	1 seen	Dry Tortugas	Longstreet 1936
1952	28 Jun.	1 seen	15 mi S Alligator Reef Light	Sprunt 1954
1954	6 May	(1?) seen	Dry Tortugas	Sprunt 1962
1957	1 Jul.	1 spec. (UM)	Upper Matecumbe Key, Monroe Co.	Palmer 1962
1962	13 Jun.	3 seen	Dry Tortugas	Robertson 1962
1966	29 Apr.	1 seen	Dry Tortugas, Garden Key	Cunningham 1966b
1966	11 May	4 seen	Dry Tortugas	Stimson 1966
1966	9-10 Jun.	1 seen	Dry Tortugas, over Bush and Garden Keys	Stevenson 1966b
1967	10 Jun.	1 seen	Dry Tortugas	Stevenson 1967c
1970	28 Jun.	3 seen	Dry Tortugas, over Bush and Garden Keys	Ogden 1970
1973	6 May, 2 Jun.	2,1 seen	Dry Tortugas	Kale 1973
1974	5 Apr., 4-5 May	2(3?) seen	Dry Tortugas	Kale 1974
1974	16 May	1 ad. seen	off Marathon	Kale 1974
1975	early Apr., 3 May	2,1 seen	Dry Tortugas	Kale 1975

(1) Another was seen south of Sugarloaf Key in 1979 (Kale 1979) but due to a misprint in American Birds, no date was given.

1977	30 Apr., 5 May	1-2 seen	Dry Tortugas	Kale 1977
1978	22 Apr.	3-5 seen	Dry Tortugas	Kale 1978
1978	25 May	2 seen	20 mi NW Dry Tortugas	Kale 1978

Florida - Gulf Coast

1919	25 May	1 seen by fisherman	St. Marks	Williams 1919
1965	4 Jul.	1 seen (1)	3-4 hrs off St. Marks	Stevenson 1965b
1977	31 May	1 seen	off Siesta Key, Sarasota	Kale 1977
1977	31 Aug.	1 found dying (spec. #USF 5107)	Howard Franklin Causeway, near St Petersburg	Edscorn 1978, T. Bancroft pers. comm.

Alabama This species is presently considered casual in Alabama with only two sight records from the state, both from Mobile Bay.

1958	20 Oct.	1 seen	Cochrane Causeway	Imhof 1976b
1969	20 Aug.	1 seen	Cochrane Causeway	Imhof 1976b

Louisiana We know of only one record from Louisiana waters:

1973	15 Aug.	1 seen	Sabine Pass	Lowery 1974

Texas At least 13 sight records of White-tailed Tropicbirds have been made along the Texas coast, none substantiated by a photograph or specimen (Oberholser 1974, Blacklock 1978 ms). The species may be more common farther offshore where observations are seldom made.

1929	31 Dec.	1 seen	near Sabine, Jefferson Co.	Oberholser 1974
1935	27 Jul.	1 seen	Cove, Chambers Co.	Oberholser 1974
1936	8 Aug.	1 ad. seen	Fulton, Aransas Co.	Oberholser 1974
1937	6,7 Aug.	1 ad. seen	SW Matagorda Island	Oberholser 1974

(1) Stevenson notes that the description given him was inadequate to confirm the species identification. Other records listed here could have been inadequately identified.

1945	13 Jun.	2 seen	Rockport, Aransas Co.	Blacklock 1978 ms
1945	30 Jun.	2 seen	Ayres' Dugout, Aransas Co.	Oberholser 1974
1957	15 Nov.	(1?) seen	Galveston Island	Oberholser 1974
1960	20 May	1 seen	Morgan's Point, Harris Co.	Oberholser 1974
1963	26 Mar.	1 imm. seen	Texas City Dike	Webster 1963c
1966	12 Nov.	2 ad. seen	2.5 mi ESE Galveston	Webster 1967a
1967	30 Jun.	1 seen	14 mi E Angleton, Brazoria Co.	Webster 1967d
1969	15 Mar.	1 seen	over Gulf Beach, Kenedy Co.	Blacklock 1978 ms
1978	5 Oct.	1 ad. seen	Port Aransas jetty	Webster 1979a

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Although widespread in pelagic tropical waters, the White-tailed Tropicbird has been recorded relatively infrequently in the southeastern United States. The species has been recorded about three times as frequently on the Atlantic coast as in the Gulf of Mexico, but only about twice as many individuals have been involved (Tables 33, 34). The distribution of records suggests that there may be a somewhat wider latitude of temporal occurrence in the Gulf than on the Atlantic. It should be remembered, however, that there has been considerably more pelagic observations in the Atlantic area, and that there is a strong bias in the periods during which observations have been made. Distribution and occurrence of this species in both areas is still very poorly known. It seems likely that White-tailed Tropicbirds may be more common in offshore waters, particularly those of the Gulf, than data presently available might indicate.

HABITAT

Nesting The White-tailed Tropicbird nests in holes, crevices, and caves, usually on cliffs and ledges. Shallow surface excavations under herbage on sand dunes have been reported as nest sites in Bermuda (Gross 1912), and it has been found nesting in holes in trees in the Central Pacific. At Aldabra Atoll, Indian Ocean, Diamond (1975) found that White-Tropicbirds preferred to nest in solution holes in limestone cavities or on the surface between tussocks of grass. They also nested on the surface under bushes, in cavities below overhangs, and in holes in the sides of cliffs. Prys-Jones and Peet

Table 33. Dates of occurrence for White-tailed Tropicbirds in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence
North Carolina	20	1 June - 11 September
South Carolina	5	mid-April - 16 October
Georgia	1	15 August
Florida-Atlantic Coast (a)	22	21 April - 22 September
Florida-Keys	19 (±)	5 April - ?? November
Florida-Gulf Coast	4	25 May - 31 August
Mississippi	unrecorded	
Alabama	2	20 August - 20 October
Louisiana	1	15 August
Texas Coast	ca. 13	15 March - 31 December

(a) Does not include bird found dead 20 October.

Table 34. Approximate number of White-tailed Tropicbirds recorded by month for the coastal southeastern United States (a).

State/region	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	-	-	9	5	5	4	-	-	-
South Carolina	-	1	1	1	1	-	-	1	-	-
Georgia	-	-	-	-	-	1	-	-	-	-
Florida-Atlantic Coast	1	2	2	1	1	9	9	1	-	-
Subtotal-ATLANTIC COAST	1	3	3	11	7	15	13	2	-	-
Florida-Keys	-	11	15	11	1	-	-	-	1	-
Florida-Gulf Coast	-	-	2	-	1	1	-	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-	-
Alabama	-	-	-	-	-	1	-	1	-	-
Louisiana	-	-	-	-	-	1	-	-	-	-
Texas Coast	2	-	1	5	1	2	-	1	3	1
Subtotal-GULF COAST	2	-	3	5	2	5	-	2	3	1
Total-ALL AREAS	3	14	21	27	10	20	13	4	4	1

(a) Birds found dead within the first 10 days of a month are arbitrarily assigned to the preceding month. If the source did nor make it clear whether one or more was seen, we have assumed that one was seen. If the source indicated that more than one was seen (i.e., "several", "a few", "tropicbirds"), we have assumed two were seen. We found no records for January or February.

(1980) noted that 96% of 24 White-tailed Tropicbird nest-sites at Aldabra were at least partially covered by rock. Nest sites chosen there by its congener, the Red-tailed Tropicbird (Phaethon rubricauda) were significantly more exposed above.

Feeding These tropicbirds are deep water feeders and seldom feed in sight of land (Diamond 1975). Gibson-Hill (1947) reported that White-tailed Tropicbirds were only once seen feeding within sight of land during his observations at Christmas and Cocos-Keeling islands, Indian Ocean, and Stonehouse (1962b) indicated that none were seen feeding within sight of Boatswain Bird Island in the Atlantic Ocean.

Winter and Offshore Away from the breeding colonies, birds are usually seen singly or in twos. They disperse widely in warm oceanic waters. This species has been considered of regular occurrence to 40° N latitude in the Atlantic, although inshore records there are relatively few. It is apparently more abundant in the warmer waters of the western half than in the eastern portion (Jespersen 1930 in Murphy 1936).

FOOD AND FEEDING BEHAVIOR

Judging from several reports from tropical or subtropical waters, the diet of the White-tailed Tropicbird consists mainly of flying fish and squid.

Diamond (1975) reported on the regurgitations from 27 adults and 9 chicks at Aldabra Atoll. Ommastrephid squid (84.8% by weight) and flying fish (15.2%) made up the entire diet. Species of flying fish taken were Exocoetus volitans (7.8%), Oxyporhamphus micropterus (3.9%), Cypselurus furcatus (3.9%), and C. ?nigripennis (trace). Cephalopods taken varied from ca. 2 to 10 cm in length, with the majority (over 60%) between 4 and 8 cm. Flying fish ranged from 2 to 12 cm, most (nearly 70%) again between 4 and 8 cm. During the wet season a significantly larger proportion of the tropicbird diet (by weight) consisted of cephalopods.

Diamond (1975) also indicated that the proportion of squid in the diet at Aldabra was higher than that reported from Christmas Island (Indian Ocean) by Gibson-Hill (1947). In fact, Gibson-Hill did not distinguish between food taken by Phaethon lepturus and P. rubricauda, merely stating that "the adults were taking approximately 50-65% fish and 50-35% cephalopods...". This statement implies identical food habits, and was apparently so interpreted by Diamond, even though his own study suggested some strong differences between the two species.

A somewhat wider range of food items was found in the diet of the White-tailed Tropicbird at Boatswain Bird Island in the Atlantic (Stonehouse 1962a). The principal species of flying fish and squid taken were the same as those reported by Diamond for Aldabra Atoll. Stonehouse's observations suggest, however, that the tropicbirds on Boatswain Bird Island were depending on flying fish to a greater extent than did birds on Aldabra. Other fish found in the diet at Boatswain Bird Island included Ophioblennius webbii, Holocentrus ascensionis, and Selar crumenophtalmus.

Observations made at Bermuda suggest a similar diet there, too. Plath (1914) considered squid the primary food and Gross (1912), who examined the stomach contents of five adults, reported that the food was primarily squid and fish. Two of the five kinds of fish found were flying fish (Exocoetus furcatus and Exonautes exsiliens).

There are also two reports of stomach contents from pelagic areas. Jespersen (1930 in Palmer 1962) reported that the stomachs of eight adults from offshore areas contained only cephalopods, the largest 12 cm. Voous (1963) reported that the contents from a bird collected south of Truk in Micronesia consisted largely of a single Ommastrephid squid, Sympleuctoteuthis oualaniensis.

White-tailed Tropicbirds feed by deep plunging, often from a height of 15-20 m above the surface (Murphy 1936).

According to Palmer (1962), there are two principal feeding periods, one in the early morning, the other in the late afternoon. Stonehouse (1962b), on the other hand, found no evidence of a marked diurnal movement at Boatswain Bird Island.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Egg laying occurs throughout the year on Aldabra Atoll in the Indian Ocean (Diamond 1975, Prys-Jones and Peet 1980) and on Boatswain Bird Island in the Atlantic (Stonehouse 1962b). Data from egg collections reported by Bent (1922) indicate eggs present from mid-May to mid-June in the Bahamas, and from late April to mid-August in Bermuda.

Mean Clutch Size This species, like other tropicbirds, lays but one egg.

Incubation Period Stonehouse (1962b) reported a range of 40-42 days for incubation on Boatswain Bird Island for 1958-59, with an average of 41 days.

Hatching Success On Boatswain Bird Island, Stonehouse (1962b) reported that 48.1% of 821 eggs laid hatched.

Fledging Success Diamond (1975) indicated that 0.46-0.50 chicks fledged per egg laid (n = 14, 26) on Aldabra Atoll in two study periods, 1967-68 and 1969. Prys-Jones and Peet (1980) reported that 46% of 39 eggs laid from January 1976 to May 1977 resulted in fledged young. They noted that this figure is a maximum because it excludes eggs laid and lost between visits to the colony and assumes that all large young that had lost their natal down fledged successfully. On Boatswain Bird Island, 1958-59, Stonehouse (1962b) reported a success of 0.30 chicks per egg laid (n = 821), which amounted to 0.63 per egg hatched (n = 395).

Age at Fledging Age at first flight for a chick in Bermuda was 62 days, but the chick flew poorly (Gross 1912), suggesting that this may have been a premature fledging. A more accurate figure was reported by Diamond (1975), who estimated age of fledging as 80 days for birds at Aldabra Atoll. In the

Atlantic at Boatswain Bird Island, Stonehouse (1962b) reported most birds left the nest between the 70th and 80th day and thought the average age of first flight was 75 days.

Age at First Breeding Not known.

Mortality of Eggs and Young Stonehouse (1962b) found a much greater proportion of nest failure during the egg stage (74.5%, n = 572) than when chicks were present (25.5%). Most (55%) young lost were lost during the first 2 weeks after hatching. The primary cause of nest failure during both periods was intra- and inter-specific competition (primarily with the Red-billed Tropicbird) for nest sites. Two chicks were thought to have been eaten by juvenile frigatebirds (*Fregata aquila*), and another was killed by a Harcourt's Storm-Petrel (*Oceanodroma castro*) that occupied the same nesting burrow.

Diamond (1975) did not think that competition with the Red-billed Tropicbirds for nest sites was a major source of failure, presumably because the two species used relatively different sites.

Known predators on eggs and young are few, presumably due to the sheltered and often inaccessible nature of the nest site. In one instance, Gross (1912) found an introduced Black Rat (*Rattus rattus*) feeding on an egg, and Diamond (1975) suggested that the Coconut Crab (*Birgus latro*) might be a predator at Aldabra.

Renesting Renesting after the loss of an egg or chick has been reported for the White-tailed Tropicbird. At Aldabra Atoll, Diamond recorded three instances of renesting by White-tailed Tropicbirds at periods of from 41 to 52 days after loss of egg or small chick. It is not entirely clear from this paper what proportion of the pairs losing eggs and small young this may have represented.

Stonehouse (1962b) noted renesting at Boatswain Bird Island but considered it exceptional. He found a considerably smaller number of known or suspected renestings than he thought would follow the high incidence of egg and chick mortality during his study. He reported that the interval between loss of nest contents and their replacement ranged from 143 to 168 days (20 1/2 to 24 weeks), figures quite different from those reported by Diamond.

Maximum Natural Longevity We have no information for this species.

Weight (in grams) There is considerable variation in weight through the species' extensive range, as indicated in Table 35.

SUSCEPTIBILITY TO OIL POLLUTION

Despite its pelagic and solitary feeding habits, the White-tailed Tropicbird is one of the marine species of the southeast known to have suffered major adverse effects from oil pollution. Wingate (1978) estimated that the White-tailed Tropicbird population on Bermuda has been reduced by as much as 40% in the last 25 years due in part to pesticides, but perhaps even more to

oil pollution. Tar lumps, the residues of oil spills, have become heavily concentrated in the Sargasso Sea (central North Atlantic Ocean) due to comparatively still waters. Tropicbirds, numerous there, sit on the water and the tar lumps become entangled with the flank feathers, destroying the natural water repellancy of the plumage. Wingate (1978) reported that he had been monitoring over 200 nest sites for the last 6 years and stated that "not only has this survey revealed a slow but steady decline [in the White-tailed Tropicbird breeding population] but there is a clear correlation between the amount of "young" or sticky tar on the beaches, the number of oiled birds seen in flight and the percentage of breeding success as a whole". The proportion of White-tailed Tropicbirds exhibiting oil on the underparts rose from about 1 in 100 in 1968 to about 1 in 15-20 in 1971 (Wingate in Butler et al. 1973).

Table 35. Weights (in grams) of White-tailed Tropicbirds.

Mean weight	Range	N	Sample and season	Area	Source
334	------	59	adults in 1967-69	Aldabra Atoll	Diamond 1975
288	251-312	4	adult males in March	Fanning Island, Central Pacific	Clapp in prep.
281	273-284	5	adult females in March	"	"
324	279-400	14	males, year round	at sea, Central Pacific	"
333	290-386	10	females, year round	"	"
404	367-465	4	adult males	Bermuda	Gross 1912
414	402-425	2	adult females	"	"

BIBLIOGRAPHY

1980

Prys-Jones, R. P. and C. Peet. 1980. Breeding periodicity, nesting success and nest site selection among Red-tailed Tropicbirds *Phaethon rubricauda* and White-tailed Tropicbirds *P. lepturus* on Aldabra Atoll. Ibis 122: 76-81.

Wingate, D. B., I. K. Barber and N. W. King. 1980. Poxvirus infection of the White-tailed Tropicbird (Phaethon lepturus) in Bermuda. J. Wildl. Dis. 16: 619-622.

1979

Batchelor, A. L. 1979. Records of Redtailed and Whitetailed Tropicbirds in South African waters. Cormorant 7: 21-23.

Medway, D. C. and J. C. Medway. 1979. Second record of White-tailed Tropicbird in New Zealand. Notornis 26: 170.

Morris, A. K. 1979. The inland occurrence of tropic-birds in New South Wales during March, 1978. Austr. Birds 13: 51-54.

Thomas, R. N. and A. Gordon. 1979. White-tailed Tropic Birds on North Auckland west coast beaches. Notornis 26: 320.

1978

Wingate, D. B. 1978. Attracting Longtails to artificial nesting holes with decoys. Month. Bull. Bermuda Dept. Agric. Fish. 48: 80-83.

1975

Diamond, N. W. 1975. The biology of tropicbirds at Aldabra Atoll, Indian Ocean. Auk 92: 16-39.

1974

Olson, S. L. 1974. A melanistic White-tailed Tropicbird. Condor 76: 217-218.

1973

Brown, S. R. 1973. First record of White-tailed Tropic Bird in New Zealand. Notornis 20: 380-381.

1970

Buckley, P. A. and F. G. Buckley. 1970. Notes on the distribution of some Puerto Rican birds and on the courtship behavior of White-tailed Tropicbirds. Condor 72: 483-486.

1969

Brodkorb, P., R. B. Gonzalez and D. Empeso. 1969. White-tailed Tropic-bird, an addition to the Philippine avifauna. Auk 86: 357.

1965

Hetrick, W. and G. McCaskie. 1965. Unusual behavior of a White-tailed Tropicbird in California. Condor 67: 186-187.

1964

Bond, G. M. 1964. An additional record of the Yellow-billed Tropicbird (Phaethon lepturus catesbyi) from Pennsylvania. Auk 81: 552.

1963

Voous, K. H. 1963. Food of White-tailed Tropic Bird (Phaethon lepturus). Ardea 51: 252.

1962

Stonehouse, B. 1962. The tropic birds (genus Phaethon) of Ascension Island. Ibis 103b: 124-161.

1960

Longstreet, R. J. 1960. New record of White-tailed Tropic-bird. Fla. Nat. 33: 165.

1959

Harte, J. 1959. Tropic-bird, a sight record and a capture. Chat 23: 34.

Manigault, P. 1959. Tropic-bird off the South Carolina coast. Chat 23: 62.

McCallum, A. 1959. Tropic-bird, a sight record and a capture. Chat 23: 34.

1952

Hindwood, K. A. 1952. The White-tailed Tropicbird in Australia. Emu 52: 257-259.

1951

Grimes, S. A. 1951. Tern and tropic bird records from northeastern Florida. Fla. Nat. 24: 30-31.

McKay, R. R. 1951. Yellow-billed Tropic Bird, Phaethon lepturus catesbyi, on the north Florida coast. Auk 68: 371.

1947

Gibson-Hill, C. A. 1947. The normal food of tropic-birds (Phaethon spp). Ibis 89: 658-661.

1945

McAtee, W. L. 1945. Catesby's tropic-bird. Auk 62: 137-139.

1943

Norton, A. H. 1943. Yellow-billed Tropic-bird in Maine. Auk 60: 284.

1940

Griffin, W. W. 1940. Sight record of a Yellow-billed Tropic Bird at Atlanta. Oriole 5: 32.

1939

Chaffer, N. 1939. Another record of the White-tailed Tropicbird for Australia. Emu 39: 32.

1938

Hindwood, K. A. 1938. The occurrence of the White-tailed Tropicbird in Australia. Emu 38: 12-14.

1936

Mason, C. R. and R. J. Longstreet. 1936. The Florida Audubon Society Tortugas Expedition of 1935. Part I. Fla. Nat. 9: 17-42.

Williams, J. 1936. Notes from St. Marks, Florida, (*Phaethon americanus*). Auk 36: 586-587.

1935

Worth, C. B. 1935. Behavior of the Yellow-billed Tropic-bird. Auk 52: 442.

1927

Wayne, A. T. and F. Sherman. 1927. Two birds new to the fauna of South Carolina. Auk 44: 94.

1916

Plath, K. 1916. The Yellow-billed Tropic-bird (*Phaethon americana*). Wilson Bull. 28: 49-51.

1912

Gross, A. O. 1912. Observations on the Yellow-billed Tropic-bird (*Phaethon americana* Grant) at the Bermuda Islands. Auk 29: 49-71.

1901

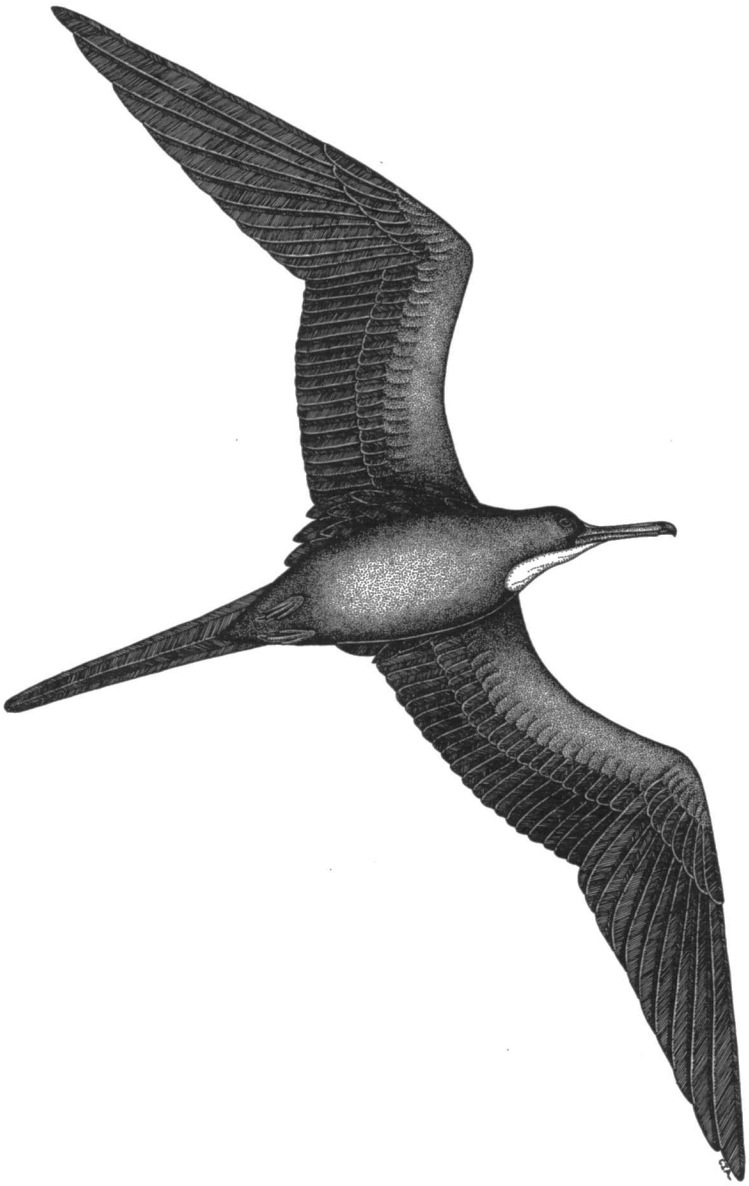
Henshaw, H. W. 1901. The Yellow-billed Tropicbird in the Hawaiian Islands. Auk 18: 105.

1891

Scott, W. E. D. 1891. Observations on the birds of Jamaica. I. Notes on the Yellow-billed Tropic Bird (Phaethon flavirostris). Auk 8: 249-256.

1886

Brewster, W. 1886. Occurrence of the Yellow-billed Tropic-Bird in Florida. Auk 3: 481.



MAGNIFICENT FRIGATEBIRD

(*Fregata magnificens*)

[DA: Pragtfregatfugl, DU: Amerikaanse Fregatvogel, EN: Magnificent Man-O'-War Bird, FI: Fregattilintu, FR: Fregate superbe, GE: Pracht-Fregattvogel, IT: Fregata, PR: Rabil, SP: Fregata magnifica, Rabihorcado grande; SW: Praktfregattfagel, US: Man-O-War Bird]

GENERAL DISTRIBUTION

North America In Pacific waters, Magnificent Frigatebirds breed on islands off Mexico from Baja California south to islands off Panama (AOU 1957); on the Atlantic side of North America they breed on the Marquesas Keys off Florida (Harrington et al. 1972), along the coast of Veracruz, Mexico (Vaurie 1965), on islands in the eastern Gulf of Mexico, and off British Honduras (AOU 1957). On the Pacific side these frigatebirds have dispersed north to Oregon (Jewett 1935). On the Atlantic side the species is common to abundant in the northern Gulf of Mexico and off Florida, and occurs north with decreasing frequency to Quebec, Nova Scotia, and Newfoundland (Godfrey 1966).

Magnificent Frigatebirds also straggle inland with relatively great regularity and have been recorded from at least Illinois (Bartsch 1922), Ohio (Trautman and Nye 1968), Indiana, Wisconsin, Kansas, (AOU 1957), Oklahoma (Sutton 1936), New Mexico (Zimmerman 1968), and Nevada (Lawson 1973).

World Distribution In the eastern Pacific the Magnificent Frigatebird also breeds in the Galapagos Islands and from islands off Colombia and Ecuador south to the Gulf of Guayaquil, thence wandering south to extreme northern Peru and occasionally Chile (Blake 1977).

The species breeds widely in the Caribbean from the Bahamas and Little Cayman southwest to islets off Tobago (AOU 1957). Along the South American coast, these birds breed locally from islets off Venezuela (e.g., Los Hermanos, Margarita Islands; AOU 1957) south to southern Brazil (Ilha dos Alcatrazes, Sao Paulo), and disperse south from there to the coast of Uruguay and northeastern Argentina (Palmer 1962, Blake 1977).

In the eastern Atlantic, Magnificent Frigatebirds breed only on two islands off Boa Vista, Cape Verde Islands. In Europe they have wandered to France, the Azores (Cramp et al. 1977), Scotland (Stephen 1953), and Denmark (Salomonsen 1969).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Although frigatebirds occur frequently to abundantly on most of the southeastern coasts, they are relatively uncommon in North Carolina waters. We are aware of 31 records but there may be others that have escaped our attention. Examination of these records clearly shows a mid-summer

(June-July) peak of occurrence, with over half (16) of the records falling in those months. Only four records fall outside the period May through August.

1889	5 Jul.	1 imm. male (coll.)	Pamlico Sound near Ocracoke Inlet	Pearson et al. 1942
1917	10 Jul.	1 found (exhausted)	near Cape Lookout	Pearson et al. 1942
1935	Sep.	"scores" seen	over Southport	Pearson et al. 1942
1939	30 Jan.	1 seen	Oregon Inlet	Pearson et al. 1942
1944	2 Aug.	5 seen (1 ad., 4 imm.)	Wrightsville Beach	Coffey 1944
1944	23 May	1 imm. seen	Pea Island	Grey and MacKenzie 1944
1946	19 May	1 seen	over Southport Harbor	Shaftesbury 1946
1946	20 May	1 seen	over Morehead City docks	Borden 1946
1949	28 Aug.	1 seen (1)	near Long Beach Causeway	Appleberry 1950
1949	29 Aug.	3 seen	Fort Caswell	Appleberry 1950
1949	29 Aug.	1 seen	Wrightsville Beach	Appleberry 1950
1949	29 Aug.	3 seen	Southport	Appleberry 1950
1949	2 Sep.	1 seen	Masonboro Sound	Appleberry 1950
1950	11 Jun.	1 seen	Southport harbor	Loftin 1950
1953	1 May	1 ad. female seen	Beaufort	Adams 1953, Chamberlain 1953a

(1) Some of the birds seen from 28 August through 2 September 1949 may be replicate sightings of the same birds.

1955	16,23 Apr.	1 seen	Carolina Beach	Chamberlain 1955a
1960	4 Jun.	1 female seen	over Rich's Inlet, Wilimington	Chamberlain 1960b
1962	15 Jun.	1 female seen	off Gull Island, Pamlico Sound	Hailman 1962
1964	11 Jun.	1 imm. seen	over Carolina Beach	Chamberlain 1964
1964	20 Jun.	1 female seen	over Carolina Beach	Chamberlain 1964
1966	12 Jul.	1 seen	Ocracoke	Parnell 1967c
1967	26 Jul.	1 seen	Wrightsville Beach	Parnell 1967c
1969	8 Jun.	1 ad. seen	over Alligator Bay, Sneads Ferry	Parnell 1969b
1973	21 Jun.	1 seen	near Southport	Teulings 1973d
1973	2 Aug.	1 seen	Morehead City	Teulings 1973d
1974	9 Jun.	1 seen	Topsail Island	Teulings 1974d
1975	14 Jul.	1 seen	Kill Devil Hills	Teulings 1975d
1976	20 Jun.	1 seen	Morehead City	LeGrand 1976
1977	4 Jun.	1 female seen	over Bear Island	LeGrand 1977b
1977	5 Jun.	1 imm. seen	Wrightsville Beach	LeGrand 1977b
1977	Aug.	1 seen	off North Carolina	Lee and Booth 1979
1979	10 May	1 imm. seen	Wrightsville Beach	LeGrand 1979c

South Carolina The Magnificent Frigatebird is considered a casual summer visitor along the South Carolina coast (Sprunt and Chamberlain 1949). We have found 23 records from the state, but this list may be incomplete.

1824	ca. Sep.(?)	1 coll.	James Island	Sprunt and Chamberlain 1949
1893	26 Aug.	1 seen	??	Wayne 1910
1906	20 Oct.	1 coll. (CM)	Sullivan's Island	Wayne 1910

1910	19 Oct.	1 seen	Porcher's Bluff	Sprunt and Chamberlain 1949
1925	24 May	1 seen	over Charleston Harbor	Sprunt and Chamberlain 1949
1925	2 Jun.	1 seen	Folly Island	Sprunt and Chamberlain 1949
1926	22 Sep.	2 seen	over S Battery, Charleston	Sprunt and Chamberlain 1949
1931	21 Jul.	1 seen	between Cape Romain and McClellanville	Burton 1970
1949	28 Aug.	2 seen	near Charleston	Denton and Chamberlain 1950
1951	10 Jun.	1 seen	off Charleston jetties	Burton 1970
1953	26 Jun.	1 seen	Charleston harbor	Burton 1970
1960	14 Nov.	1 seen	over Charleston	Burton 1970
1960	29 Nov.	1 seen	over Charleston	Burton 1970
1960	12 Jun.	2 seen	Garden City, Horry Co.	Cobey 1961
1961	23 Jun.	1 seen	Murrell's Inlet, Georgetown Co.	Burton 1970
1963	7 Jul.	2 seen (1 male, 1 female)	ca. 40 mi E Georgetown	Chamberlain 1963
1968	27 Jul.	1 imm. seen	near Wadmalaw Island, Charlestown Co.	Parnell 1968c
1972	23 Jun.	1 seen	McClellanville	Teulings 1972d
1973	12 Jun.	1 seen	Edisto Beach	Teulings 1973d
1975	4 Jul.	1 seen	off Pawley's Island	Teulings 1975d
1976	20 Jun.	1 seen	Cape Island	LeGrand 1976
1978	11 Jul.	1 imm. female seen	Charleston Harbor	LeGrand 1979d

1978	16 Jul.	1 imm. female seen	Charleston Harbor	LeGrand 1979d

Georgia Both Burleigh (1958) and Denton et al. (1977) considered the Magnificent Frigatebird a rare visitor along the coast, and earlier Greene et al. (1945) thought it extremely rare. Burleigh (1958) knew of but six records for the state. The species probably occurs more commonly in Georgia than the records available indicate, but at present we know of only 17 records from there.

1912	8 Jun.	1 coll.	Sapelo Lighthouse, McIntosh Co.	T. Palmer 1912
1928	??	1 captured	Townsend	Burleigh 1958
1933	16 May	1 shot	Wassaw Island	Tomkins 1934
1947	18 Sep.	2 seen	St. Simons Island	Burleigh 1958
1949	6 Jul.	1 seen	St. Simons Sound	Burleigh 1958
1949	28 Aug.	1 seen	St. Simons Sound	Burleigh 1958
1961	27 Apr.	2 seen	Tybee Beach, mouth of Savannah River	Chamberlain 1961a
1966	15 Oct.	(1?) seen	???	Denton et al. 1977
1965	27 Sep.	(1?) seen	Lake Sinclair, Baldwin Co. (inland)	Denton et al. 1977
1972	20 Jun.	2 seen	Fort Stewart, Liberty Co. (inland)	Teulings 1972d
1973	28 Apr.	1 seen	off Jekyll Island	Teulings 1973c
1973	29 Apr.	1 seen	St. Simons Island	Teulings 1973c
1973	3 Jun.	1 seen	St. Simons Island	Teulings 1973d
1973	10 Jun.	2 seen	Jekyll Island	Teulings 1973d
1973	4-10 Sep.	1 seen	Cumberland Island	Teulings 1974a
1973	11 Sep.	1 seen	Jekyll Island	Teulings 1974a
1977	28 May	1 seen	Jekyll Island	Teulings 1977b

Florida - Atlantic Coast On the Atlantic coast of Florida, Magnificent Frigatebirds occur throughout the year, but more commonly during the summer months from Mosquito Lagoon southward. Principal roosts along this coast are

at Pelican Island National Wildlife Refuge, where up to 60 birds or more have been found, and on keys in Florida Bay (Kale 1979 ms a).

Florida - Keys The only known breeding colony of the Magnificent Frigate-bird within the United States is found on the Marquesas Keys (Map 6). Although early reports by Audubon suggested the occurrence of nesting frigatebirds in the Keys (Howell 1932), it was not until 1969 that breeding was confirmed (Robertson 1978). Despite the uniqueness of this occurrence, information gathered on this colony has been incomplete and, in some years, no information of any kind was obtained (Table 36). From this sketchy data we can only conclude that the breeding population is at least several hundred birds, that birds may be breeding in every month, and that the breeding season starts very early in the year or possibly in late winter.

This species is on the Florida list of threatened species because of the small size and uniqueness of the colony and its vulnerability to disturbance and destruction (Robertson 1978).

In the Keys and elsewhere in Florida, there are a number of substantial roosts where several hundred to thousands of frigatebirds may be found (Robertson 1978). Only scattered information has been published on populations (Table 37), but numbers are smaller during the cooler portions of the year. The origin of these birds is thought to be the Caribbean (Robertson 1978), but no adequate study of movements in this species, possibly the poorest known of the frigatebirds, has ever been done.

Florida - Gulf Coast Magnificent Frigatebirds are common visitors to the Florida Gulf Coast and are more abundant during the summer. At the roost in Tampa Bay, frigatebirds are least abundant from November to March (Harrington et al. 1972). Kale (1979 ms b) considers the most important roosts in the Gulf of Mexico to be those at Seahorse Key, Tarpon Key (Tampa Bay), and in Charlotte Harbor.

Alabama Frigatebirds are common to abundant summer visitors to the Alabama coast. These birds have been recorded from 13 April to 5 December, with exceptional occurrences in early February and 31 December (Imhof 1976b).

Mississippi In Mississippi the status of the Magnificent Frigatebird is essentially the same as in Alabama, most numerous in summer and least common in mid-winter. Extreme dates of occurrence are from 6 May to 7 October, with exceptional reports of a bird or birds at Biloxi 24 November and 16 December 1977 (Burleigh 1944, Hamilton 1978, Purrington 1978).

Louisiana As in the two states above, frigatebirds are frequent to abundant visitors to the Louisiana coast. Lowery (1974) listed extreme dates of occurrence for the state as 25 March and 31 December. The largest single concentration of roosting birds in the United States is on the Chandeleurs. The number roosting here is often 10 times or more the maximum number known to breed in the United States, so these birds are clearly not all from the Florida colony. The origin of these frigatebirds, a major element of the coastal avifauna, is completely unknown. They probably come from colonies

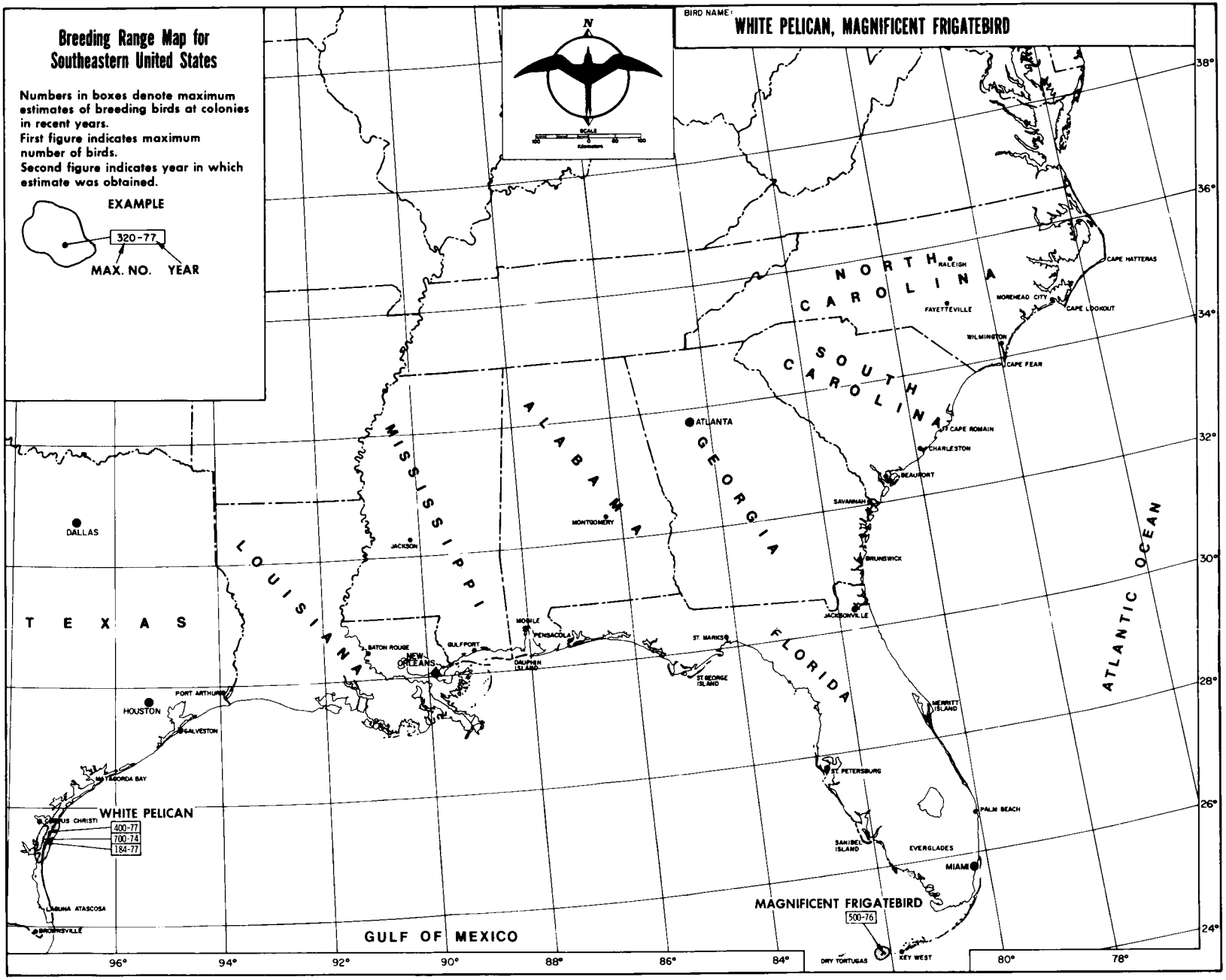

Breeding Range Map for Southeastern United States
Numbers in boxes denote maximum estimates of breeding birds at colonies in recent years.
First figure indicates maximum number of birds.
Second figure indicates year in which estimate was obtained.
EXAMPLE
320-77
MAX. NO.
YEAR
BIRD NAME:
WHITE PELICAN, MAGNIFICENT FRIGATEBIRD
N
SCALE
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
NORTH CAROLINA
SOUTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
WHITE PELICAN
400-77
700-74
184-77
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
DAUPHIN ISLAND
MOBILE
PENSACOLA
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
SAVANNAH
BRUNSWICK
JACKSONVILLE
MERRITT ISLAND
ST. PETERSBURG
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
MAGNIFICENT FRIGATEBIRD
500-76
DRY TORTUGAS
KEY WEST
RALEIGH
FAYETTEVILLE
MOREHEAD CITY
CAPE HATTERAS
CAPE LOOKOUT
WILMINGTON
CAPE FEAR
CAPE ROMAIN
CHARLESTON
BEAUFORT
38°
36°
34°
32°
30°
28°
26°
24°
96°
94°
92°
90°
88°
86°
84°
80°
78°

Table 36. Observations on breeding by Magnificent Frigatebirds at the Marquesas Keys, 1969-1979.

When observed		Estimate of numbers	Remarks	Source
1969	Mar.	ca. 200		Robertson 1978
	7 Aug.	ca. 108	54 nestlings counted; most, if not all, large	Ogden 1969
	13 Oct.	?	some young seen in nests; ca. 75 displaying males seen from air and an estimated 600 birds present	Robertson 1970
1970	mid-Apr.	ca. 80	ca. 40 seen incubating	Ogden 1970
	4 Jun.	?	colony believed deserted	Ogden 1970
	9 Sep.	8?+	4 large feathered young seen on flyover	Ogden 1970
1971	9 Aug.	ca. 200	ca. 200 birds seen on nests during flyover	Ogden 1971
1972-1973	NO INFORMATION OBTAINED			
1974	7 May	ca. 50	ca. 25 nests seen	Kale 1974
1975	26 Apr.	ca. 230	ca. 115 nests seen and 400-500 adults present	Kale 1975
	late Dec.	ca. 200	ca. 20 nests seen with large downy young	Robertson 1978
1976	10 Jul.	ca. 500	250 nests counted from air; most contained young	Ogden 1976
1977	May-Jun.	ca. 150	ca. 75 nests with young seen	Ogden 1977
1978	23 Feb.	ca. 100	many of 50 nests seen contained young	Stevenson 1978
1979	20 May	ca. 300	at least 150 active nests counted from air	Kale 1979

in the Caribbean or the southern Gulf of Mexico, but this will remain conjecture until studies with marked birds are done.

Texas Magnificent Frigatebirds are uncommon to common along the Texas coast from spring through fall (Blacklock 1978 ms), and reportedly nested in 1931 on Ship Island near Second Chain of Islands (Oberholser 1974). Numerical data are largely lacking, but maximal concentrations appear to be in the several dozens (Table 37).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Magnificent Frigatebirds breed primarily in tropical or subtropical waters of the New World, with outlying populations in the Galapagos in the Pacific and in the Cape Verde Islands in the Atlantic. Within the southeastern United States they breed only at Marquesas Key about halfway between Key West and the Dry Tortugas (Map 6), where at least several hundred birds nest. Little information is available on their breeding biology and distribution.

Migration Most works indicate or suggest that Magnificent Frigatebirds are resident within the breeding range. Both young and at least some nonbreeding adults may disperse considerable distances from the breeding areas (Palmer 1962, Cramp et al. 1977), but extremely little is known of this dispersal because no large banding studies have ever been done on this species. The appearance of very large numbers of frigatebirds in the Chandeleur Islands in the northern Gulf of Mexico, far more than could be accounted for by the breeding colony in Florida, implies at least a major dispersal of a distance not less than across the Gulf.

Winter and Offshore Large populations (from hundreds to low thousands) roost off Florida and in the Chandeleur Islands of Louisiana, and birds have been reported frequently from all the southeastern United States (Map 7). They appear to be least abundant off the northern portion of the Atlantic coast on the Gulf Coast of Texas, but reach peak abundance in the eastern Gulf of Mexico (Tables 38, 39). They are most abundant from about June-September and least abundant from November to February throughout the southeastern area. Palmer (1962) pointed out that periods of peak numbers on the Gulf Coast (cf. Table 38) correlate well with what is known of breeding cycles in the Bahamas and Caribbean.

This species is believed to be largely inshore in its distribution, but very little systematic information has been gathered on the extent of its pelagic occurrence.

HABITAT

Nesting Magnificent Frigatebirds nest colonially, usually on coastal islets, and build skimpy nests of twigs and other vegetation. The nest is usually in shrubs, bushes, or small trees at a height of 0.6 to 1.5 m (Cramp et al. 1977) or 5 to 15 feet (Palmer 1962) above the ground. Nests have been found as much as 70 feet up in trees (Lowe 1911 in Murphy 1936). This bird

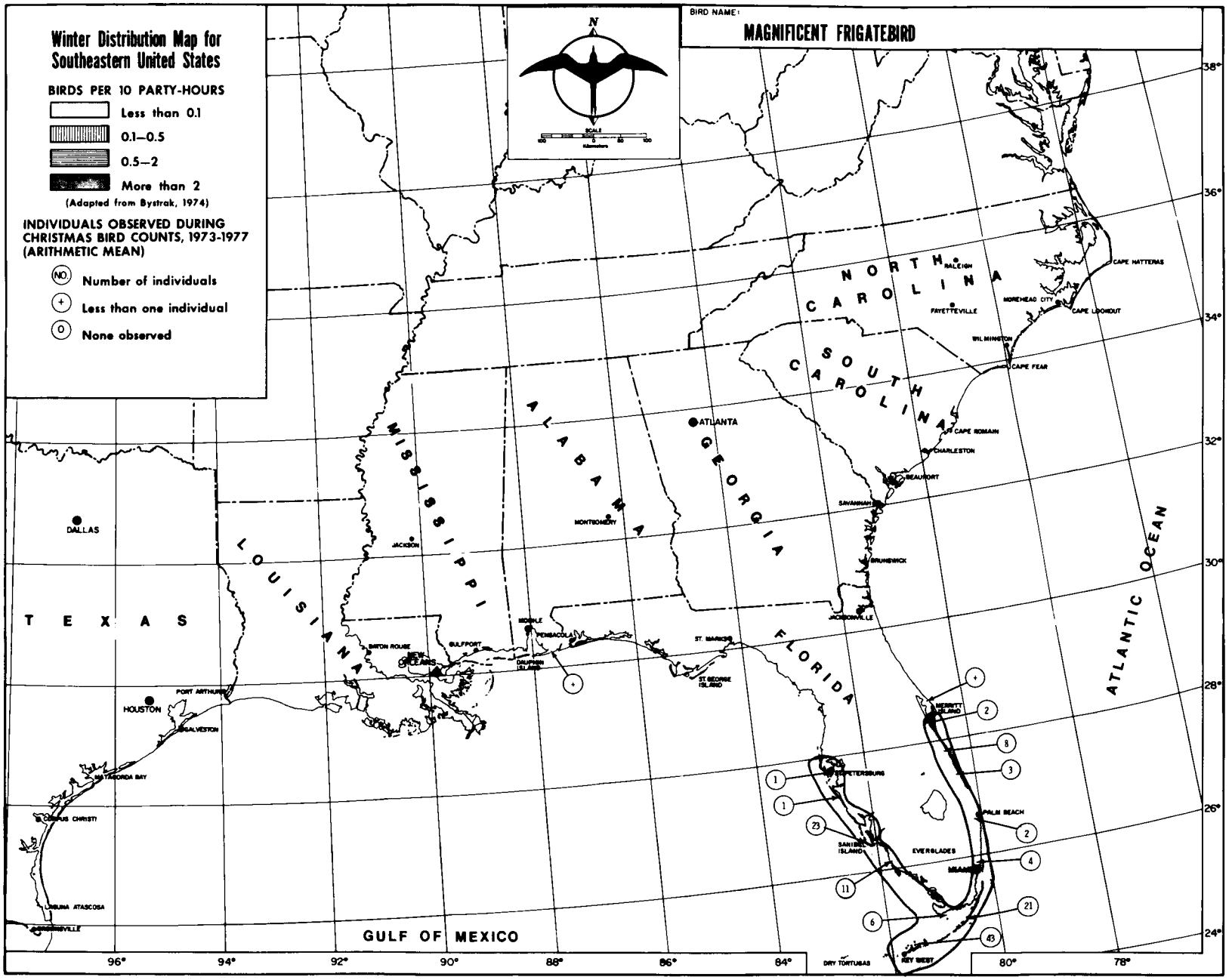

BIRD NAME:
MAGNIFICENT FRIGATEBIRD
Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1–0.5
0.5–2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
PENSACOLA
DAUPHIN ISLAND
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
JACKSONVILLE
BRUNSWICK
SAVANNAH
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
MERRITT ISLAND
ST. PETERSBURG
SANIBEL ISLAND
EVERGLADES
MIAMI
PALM BEACH
KEY WEST
DRY TORTUGAS
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°
+
2
8
3
1
1
23
2
4
11
21
6
43

Table 37. Peak concentrations of Magnificent Frigatebirds in states bordering the Gulf of Mexico (a).

Date seen		Number seen	Locality	Source
			FLORIDA - ATLANTIC	
1967	2 Jan.	210	Vero Beach CBC	Robertson 1967
			FLORIDA - KEYS	
1945	Jun.	200-300	Dry Tortugas	Sprunt 1954
1968	18 Jun.	140	Dry Tortugas	Harrington et al. 1972
1972	2 Jul.	110	Dry Tortugas	Harrington et al. 1972
1970	3 Jul.	133	Dry Tortugas	Harrington et al. 1972
1972	3 Jul.	222	Dry Tortugas	Harrington et al. 1972
1968	10 Jul.	121	Dry Tortugas	Harrington et al. 1972
1961	20 Dec.	95	Big Pine Key	Stevenson 1961
			FLORIDA - GULF	
1969	8 May	ca. 450	Tarpon Key, Tampa Bay	Pantelidis and Stevenson 1969
1918	10-15 May	ca. 400	Tampa Bay	Howell 1932
1971	late May	200+	Tarpon Key, Tampa Bay	Kale 1971
1973	2 Jun.	19	Shired Island, Dixie Co.	Ogden 1973
1970	Jun.	316 (b)	Tarpon Key, Tampa Bay	Harrington et al. 1972
1963	Jul.	ca. 1,000	Tarpon Key, Tampa Bay	Stevenson 1963d
1968	Jul.	299	Tarpon Key, Tampa Bay	Harrington et al. 1972
1969	Jul.	300	Tarpon Key, Tampa Bay	Harrington et al. 1972
1970	Jul.	358 (b)	Tarpon Key, Tampa Bay	Harrington et al. 1972
1969	Aug.	252 (b)	Tarpon Key, Tampa Bay	Harrington et al. 1972
1970	Aug.	242	Tarpon Key, Tampa Bay	Harrington et al. 1972
1967	9 Aug.	2,000	Pine Island Sound off Fort Myers	Stevenson 1967c
1960	7 Aug.	300+	island near Cedar Key	Stevenson 1960d
1965	14 Aug.	ca. 400	Cedar Key	Stevenson 1965b

Table 37. Continued.

Date seen		Number seen	Locality	Source
1960	16 Sep.	250+	off Pensacola	Newman 1961a
1971	16 Sep.	150+	near Pensacola	Purrington 1972
1973	30 Sep.	700	Cedar Key	Edscorn 1974
1964	4 Oct.	50+	Pensacola area	D. James 1965
1976	7 Oct.	66	St. George Island, Franklin Co.	Edscorn 1977
			ALABAMA	
1971	12 May	ca. 100	Dauphin Island	Imhof 1971b
1971	22 May	85	Dauphin Island	Imhof 1971b
1976	summer	24	(maximum count along coast)	Stewart 1976
1930	26 Jul.	300	near Petit Bois Island	Imhof 1976b
			MISSISSIPPI	
1977	21 May	210	East Ship Island	Weber and Jackson 1977
1977	28 Jun.	120	Biloxi Bay and Mississippi Sound	Weber and Jackson 1977
1976	summer	21	maximum count along coast	Stewart 1976
1977	3 Sep.	150	Biloxi to Bellefontaine Point	Weber and Jackson 1978
1960	12 Sep.	200+	off Biloxi	Newman 1961a
1936	7 Oct.	500	over Deer Island	Burleigh 1944
			LOUISIANA	
1976	12 May	3,000	Chandeleurs	Imhof 1976a
1975	13 May	ca. 200	Chandeleurs	Stewart 1975
1974	late May	100-	Chandeleurs	Kennedy 1974
1964	9 Jun.	ca. 2,500	North Island, Chandeleurs	Stewart 1964
1970	9 Jun.	3,000	North Island, Chandeleurs	Stewart 1970
1941	11 Jun.	ca. 5-10,000	North Island, Chandeleurs	Lowery 1974
1971	11 Jun.	ca. 1,500	North Island, Chandeleurs	Stewart 1971
1973	16 Jun.	87	Barataria Bay	Kennedy 1973
1975	19-20 Jun.	2,100	North Island, Chandeleurs	Stewart 1975
1970	17 Jul.	40	Grand Terre Island, Jefferson Par.	Stewart 1970
1974	mid-Jul.	3,000	Chandeleurs	Kennedy 1974
1969	1 Aug.	ca. 1,000	North Island, Chandeleurs	Stewart 1969
1960	7 Sep.	3,000+	Chandeleur Islands	Newman 1961a
1965	9 Sep.	500+	over Reserve (inland)	D. James 1966
1969	11 Oct.	ca. 500	North Island, Chandeleurs	Purrington 1970

Table 37. Continued.

Date seen	Number seen	Locality	Source
		TEXAS	
1960 23-26 Jun.	33	Rockport (Port Aransas area)	Webster 1960
1962 2 Jun.	18	Rockport	Webster 1962b
1970 late Jul.	42	Port Mansfield, Willacy Co.	Webster 1970d
1971 17 Jul.	25	Smith Point, Galveston Bay	Webster 1971c
1973 4 Sep.	75+	Port Aransas jetties	Webster 1974a

(a) Within states records are arranged chronologically by time of year. Records from the immediate vicinity of the breeding colony in Florida are omitted and records from the Chandeleurs in Louisiana are grouped separately.
(b) This is an average of two or more counts.

Table 38. Dates of occurrence for Magnificent Frigatebirds in the coastal southeastern United States.

State	Approximate number of occurrences	Dates of occurrence (a)
North Carolina	29	16 April - 2 September (30 January)
South Carolina	ca. 24	12 May - 22 September (19 October-14 November) (b)
Georgia	ca. 17	27 April - 27 September (15 October)
Florida	many	throughout year
Alabama	many	13 April - 5 December (31 December-early February)
Mississippi	many?	6 May - 7 October (24 November-16 December)
Louisiana	many	25 March - 31 December
Texas	many	12 March - 15 November (17 December-31 January)

(a) Exceptional occurrences are listed in parentheses.
(b) Sprunt and Chamberlain (1949) listed this date but present no other in-information on the observation.

Table 39. Approximate number of Magnificent Frigatebirds recorded by month from North Carolina to Georgia (a).

State/Region	JAN	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	1	1	5	11	5	15	1	-	-	-
South Carolina	-	-	1	9	8	3	2	2	1	1
Georgia	-	4	2	8	1	1	5	1	-	-
Total	1	5	8	28	14	19	8	3	1	1

(a) Our records may well be incomplete. The record of "scores" seen over Southport, North Carolina, is omitted. We have no records for February or March.

has also been noted nesting on bare ground in the Cape Verde Islands, an area on the periphery of the breeding range from which the species has nearly vanished (Cramp et al. 1977).

Palmer (1962) state that mangrove is the most frequent nest site but also reported the use of sea grape, cactus, and, on Bimini, dense thickets of cactus (Cory 1880 in Murphy 1936), sea lavender clumps, tea box trees, and gumbo limbo. In Venezuela, this species has used thick grass tussocks among boulders for nest sites, and in the Bahamas and off Brazil (Fernando de Noronha) Magnificent Frigate-birds nest on bare ground or rock on hills and cliffs (Palmer 1962).

Feeding According to Palmer (1962), these frigatebirds feed mainly in coastal waters generally within sight of land. More feeding may occur well offshore than this statement suggests, but observations that would adequately document this statement are lacking.

Winter and Offshore Magnificent Frigatebirds are found in warm tropical and subtropical waters in both inshore and offshore areas (Palmer 1962, Cramp et al. 1974).

FOOD AND FEEDING BEHAVIOR

Magnificent Frigatebirds feed actively on living prey and readily scavenge food or kleptoparasitize other species. As a result, they have a varied diet for a seabird. The main items in the diet are fish and squid, however these frigatebirds have also been recorded taking jellyfish, plankton, young turtles, young Sooty Terns, and eggs of Red-footed Boobies (Sprunt and Chamberlain 1949, Cramp et al. 1977). They also scavenge dead fish and offal, and scraps from slaughterhouses, docks, and sewage outlets.

Diamond (1973) examined 10 regurgitations from chicks at Barbuda in the Lesser Antilles. The principal food items were squid (a majority ommastrephids) and fish, primarily flying fish (Exocoetidae). Representatives of the fish

families Lutianidae, Balistidae, and Scombridae were also taken. Most of the squid were between 5 and 10 cm in length, but the fishes varied more.

Howell (1932) reported the contents of 25 stomachs (apparently from Florida). Thirteen of these contained menhaden (Brevoortia); others contained sea catfish (Galeichthys), pinfish (Lagodon rhomboides), and weakfish (Olothidae) (Palmer 1962).

Although primarily feeding at sea, Magnificent Frigatebirds straggling inland will feed on fish in freshwater habitats as well. Parkes (in Palmer 1962) noted that an inland stray in Pennsylvania had eaten freshwater fish (Stizostedion, Dorosoma, Pomoxis), and a stray in Ohio had apparently scavenged white crappies (Pomoxis annularis), yellow perch (Perca flavescens), and a largemouth bass (Micropterus salmoides) (Trautman and Nye 1968).

These frigatebirds feed primarily by aerial dipping, that is, picking prey from the surface of the water while in flight. The feeding bird almost never makes contact with the water because Magnificent Frigatebirds, like other frigatebirds, have "wettable" feathers, and may stay on the surface of the water for only extremely short periods without becoming waterlogged and drowning. Aerial seizing (e.g., flying fish taken in flight) is also used as a feeding technique (Cramp et al. 1977). Although highly social in roosting and nesting habits, Magnificent Frigatebirds tend to feed solitarily or in small numbers when foraging at sea. Foraging birds fly well above the water's surface, often at a height of 20-30 m (Cramp et al. 1977).

Food may also be obtained by kleptoparasitism, but the degree to which food is gotten this way has probably been overemphasized in the literature. Magnificent Frigatebirds have kleptoparasitized or attempted to kleptoparasitize a wide variety of birds. Boobies (Sula spp.) are apparently the most frequent victims (Palmer 1962, Cramp et al. 1977), but the species most often involved may vary from area to area. In Panama, the Brown Booby is apparently a primary target (Wetmore 1965), whereas Verner (in Palmer 1962) indicated that Red-footed Boobies were the primary victim at Half Moon Cay, British Honduras. In the latter instance, kleptoparasitism was solely by females. Other species that have been reported as victims of Magnificent Frigatebird kleptoparasitism include Brown Pelicans, Olivaceous (or Neotropical) Cormorants, Ospreys (Palmer 1962), Blue-faced Boobies (Eisenmann in Palmer 1962), Swallow-tailed Gulls (Creagus furcatus) (Gifford 1913 in Murphy 1936), and Kelp Gulls (Larus dominicanus) (Friedman 1927 in Murphy 1936). Wetmore (1965) reported unsuccessful chases of both Royal Terns and Laughing Gulls.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Isolated observations of breeding colonies summarized by Palmer (1962) indicate that in one part of the range or another eggs may be present throughout a wide span of time, very likely in every month; in some localities, perhaps most, laying is evidently discontinuous. An examination of observations of fresh eggs listed in Palmer strongly suggests that most laying occurs from November through March or perhaps April. In one colony observed over time (Barbuda, Lesser Antilles), laying was concentrated from

mid-September to late January, but at least some laying also occurred in February and March (Diamond 1973).

Mean Clutch Size The Magnificent Frigatebird, like other members of the genus, lays a single egg.

Incubation Period Unknown. Diamond (1973) estimated an incubation period of 50 days, basing this on incubation periods of three other species of *Fregata*.

Hatching Success Adequate information is not available.

Fledging Success Adequate information is not available.

Age at Fledging At Barbuda, Diamond (1973) found an average fledging period of 166 days (n = 9, range = 149-207). Males averaged 168 days and females 163 days. Young may be fed by the female for another 16 weeks (Diamond 1972).

Age at First Breeding Unknown.

Mortality of Eggs and Young Humans are apparently a major source of destruction and predation (Palmer 1962). Eggs are (or have been) taken for food in Baja California and Brazil (Palmer 1962).

Renesting Whether renesting occurs in this species following loss of eggs or young is unknown. Nelson (1975) indicated renesting within 4 to 21 days (mean = 12, n = 13) of egg loss in the related Great Frigatebird (*Fregata minor*), but these results were not based on marked birds.

Maximum Natural Longevity The oldest known Magnificent Frigatebird is a bird banded as a nestling in the Tres Marias Islands and recovered in Jalisco at an estimated minimum age of 5 years, 8 months (Clapp et al. 1979 ms). Other members of the genus regularly live 10 years or more, and as many as 30 years, which is doubtless far less than the maximum age this species may be expected to attain (Diamond 1973).

Weight (in grams) Very little information is available on weights of Magnificent Frigatebirds. Harrington et al. (1972) reported the weights of 10 adults from Florida in summer. Five males averaged 1,401 (range = 1,310-1,525), and five females averaged 1,633 (range = 1,500-1,840). In British Honduras, Russell (1964) reported that in April one male weighed 1,061, and one female weighed 1,419.

SUSCEPTIBILITY TO OIL POLLUTION

We have not found records of oiling in Magnificent Frigatebirds. This species, which seldom makes contact with the water's surface and whose feet are largely used for roosting on elevated perches, must be among the marine species of the southeast least vulnerable to the direct effects of oiling. Most of its food is obtained from seizing prey at the water's surface, thus

large coastal oil spills might deny this bird a considerable amount of foraging habitat. Other secondary effects might be incurred by eating oil-coated prey, particularly dead organisms scavenged from the water's surface following an oil spill.

BIBLIOGRAPHY

1978

Bleich, V. C. and B. Blong. 1978. A Magnificent Frigatebird in San Bernadino County, California. West. Birds 9: 129.

Condamin, M. 1978. Nidifications d'oiseaux de Mer en Guyane. [Nesting of the birds of the Sea of Guiana.] Oiseau R.F.O. 48: 115-121. [In French with English summary.]

Robertson, W. B., Jr. 1978. Rothchild's Magnificent Frigate-bird. Pp. 25-27 in H. W. Kale, II. (ed.) Rare and Endangered Biota of Florida. Vol. 2: Birds. Univ. Presses of Fla., Gainesville, FL. xix and 121 pp.

1977

Coello, F., C. Hernandez, M. L. Ortega and T. de Vries. 1977. Reproduccion y frecuencia alimenticia de Fregata minor en Genovesa y Fregata magnificens en Seymour, Galapagos. Rev. Univ. Catol. Quito 16: 71-110. [In Spanish.]

de Visscher, M. N. 1977. A mixed colony of egrets and Magnificent Frigatebirds in Venezuela. Gerfaut 67: 203-223.

Vaughn, C. R. 1977. First Virginia specimen of the Magnificent Frigatebird. Raven 48: 78.

1976

McCabe, T. R. 1976. First record of a Magnificent Frigatebird in inland Pacific Northwest. Murrelet 57: 43-44.

1975

Diamond, A. W. 1975. Biology and behaviour of frigatebirds Fregata spp. on Aldabra Atoll. Ibis 117: 302-323.

Husband, C. and D. N. Smith. 1975. Frigatebird, Fregata sp., Cape Clear Island, Co. Cork, 1973. Irish Nat. J. 18: 256-257.

Nelson, J. B. 1975. The breeding biology of frigatebirds--a comparative review. Living Bird 14: 113-155.

1974

Schnell, G. D. 1974. Flight speeds and wingbeat frequencies of the Magnificent Frigate-bird. Auk 91: 564-570.

1973

Diamond, A. W. 1973. Notes on the breeding biology and behavior of the Magnificent Frigatebird. Condor 75: 200-209.

Lawson, C. S. 1973. Notes on Pelecaniformes in Nevada. West. Birds 4: 23-30.

Varoujean, D. H. and L. J. V. Compagno. 1973. Magnificent Frigatebirds in Monterey, California. Auk 90: 192-193.

1972

Diamond, A. W. 1972. Sexual dimorphism in breeding cycles and unequal sex ratio in Magnificent Frigate-birds. Ibis 114: 395-398.

Harrington, B. A., R. W. Schreiber and G. E. Woolfenden. 1972. The distribution of male and female Magnificent Frigatebirds, Fregata magnificans, along the Gulf Coast of Florida. Am. Birds 26: 927-931.

1970

Buckley, P. A. 1970. Brown Booby, Magnificent Frigatebird and Sabine's Gull new to Virginia. Aud. Field Notes 24: 651-652.

Eisenmann, E. 1970. Frigatebird re-identified. Aud. Field Notes 24: 653.

McCaskie, G. 1970. The occurrences of four species of Pelecaniformes in the southwestern United States. Calif. Birds 1: 117-142.

van Swelm, N. D. 1970. Waarneming van een [male] Amerikaanse Fregatvogel (Fregata magnificens) in Nederland. [Magnificant Frigatebird observed in the Netherlands.] Limosa 43: 59-60. [In Dutch with English summary.]

1969

Salomonsen, F. 1969. Amerikansk Fregatfugl (Fregata magnificens Mathews) truffet i Danmark. [Magnificent Frigatebird (Fregata magnificens Mathews) encountered in Denmark.] Dan. Ornithol. Foren. Tidsskr. 63: 111-114. [In Danish with English summary.]

1968

de Bruijne, J. W. A. 1968. Frigate-bird (Fregata magnificens) in northeastern Atlantic Ocean. Ardea 56: 285.

Eyster, M. B. 1968. Birds of the Chandeleur Islands. La. Ornithol. Soc. News 49: 5-7.

Paterson, A. 1968. A Frigate-bird off Yorkshire. Bull. Br. Ornithol. Club 88: 109.

Trautman, M. B. and T. W. Nye. 1968. An Ohio record of the Magnificent Frigatebird (Fregata magnificens). Wilson Bull. 80: 487-488.

Zimmerman, D. A. 1968. Specimen of the Magnificent Frigatebird from New Mexico. Condor 70: 398.

1966

Fink, L. C. 1966. Sight record of Magnificent Frigatebird. Oriole 31: 47.

Kaestner, H. 1966. Magnificent Frigatebird at Ocean City. Md. Birdlife 22: 99.

Nelson, [J.] B. 1966. The Man-O'-War bird. Nat. Hist. 75: 32-39.

Post, P. W. and D. Puleston. 1966. Photographs of New York State rarities. 5. Magnificent Frigatebird. Kingbird 16: 66-67.

1965

Nieboer, E. 1965. Magnificent Frigate-bird (Fregata magnificens) in western Atlantic Ocean. Ardea 53: 236.

1964

Kramer, P. 1964. Kratz- und andere Putzbewegungen bie Fregattvogeln. Ergebnisse der Deutschen Galapagos-Expedition 1962/63 III. J. Ornithol. 105: 340-343. [In German with English summary.]

1963

Kielhorn, W. V., K. S. Norris and W. E. Evans. 1963. Bathing behavior of Frigate Birds. Condor 65: 240-241.

1962

Hailman, J. P. 1962. Frigate-bird off Gull Island, Dare County, North Carolina. Chat 26: 96.

1961

Cobey, F. 1961. Magnificent Frigate-bird on the upper South Carolina coast. Chat 25: 68.

1957

Bourne, W. R. P. 1957. Additional notes on the birds of the Cape Verde Islands, with particular reference to Bulweria mollis and Fregata magnificens. Ibis 99: 182-190.

Enger, P. S. 1957. Heat regulation and metabolism in some tropical mammals and birds. Acta Physiol. Scand. 40: 161-166.

1954

Anon. 1954. Magnificent Frigate-bird in Tiree, Inner Hebrides: a new British bird. Brit. Birds 47: 58-59.

del Toro, M. A. 1954. Frigate birds crossing the Isthmus of Tehuantepec. Condor 57: 62.

Ferguson-Lees, I. J. 1954. Some photographic studies of the Magnificent and Great Frigate-birds. Brit. Birds 47: 59.

1953

Adams, D. A. 1953. Frigate-bird on the North Carolina coast. Chat 17: 70.

Stephen, A. C. 1953. Magnificent Frigate-bird in Scotland. Scott. Nat. 65: 193-194.

1951

Chandler, A. C. 1951. Trematodes from the Man-O-War Bird, Fregata magnificens Rothschildi, on the Texas coast, with the description of a new species, Schwartzitrema seamsteri. Tex. J. Sci. 3: 186-189.

1950

Appleberry, E. L. 1950. Wilmington, N.C. Migration reports, Aug. 1, 1949-Nov. 30, 1949. Chat 14: 31.

Haverschmidt, F. 1950. The Man-O'-War-bird, Fregata magnificens, on the coast of Surinam, Dutch Guiana. Auk 67: 509.

Loftin, H. G., Jr. 1950. Man-O'-War bird seen at Southport, N.C. Chat 14: 57.

1948

Packard, F. 1948. Sight record of the Man-O'-War-bird in Massachusetts. Auk 65: 307.

1947

Baldwin, G. C. 1947. New records for the Boulder Dam area, Nevada. Condor 49: 85.

1946

Borden, R. W. 1946. Man-O-War Bird at Morehead City, N.C. Chat 10: 71.

Shaftesbury, A. D. 1946. Man-O'-War Bird at Southport, N.C. Chat 10: 71.

1944

Coffey, J., Jr. 1944. Man O' War Birds at Wrightsville Beach. Chat 8: 60.

Grey, J. H., Jr. and L. Mackenzie. 1944. Pea Island [Man O'War Bird]. Chat 8: 63.

1941

Bond, R. M. 1941. Man-O'-War-bird in Santa Barbara County, California. Condor 43: 249.

1939

Beard, D. B. 1939. Man-O'-War birds prey on Eastern Sooty Terns. Auk 56: 327-329.

Murphy, R. C. 1939. Man-O'-War Bird. Nat. Hist. 44: 133-143.

1936

Sutton, G. M. 1936. Man-O'-War bird in Oklahoma. Auk 53: 438.

Tatum, J. W. 1936. Notes from Brigantine Beach, N.J. Auk 53: 95.

1935

Jewett, S. G. 1935. The Man-O'-War bird off the Oregon coast. Condor 37: 212-213.

1934

Dickens, E. 1934. Rare birds on Block Island, Rhode Island. Auk 51: 247.

DuMont, P. A. 1934. On the specimens of Fregata magnificens in the University of Iowa museum. Wilson Bull. 46: 120-122.

1933

Swarth, H. S. 1933. Frigate-birds of the west American coast. Condor 35: 148-150.

1931

Pike, E. P. 1931. Notes on bird life in southern Florida. Auk 48: 595-596.

1928

Stone, W. 1928. The Man-O'-War-bird (Fregata magnificens) at Cape May, N.J. Auk 45: 367-368.

1927

Abbott, C. G. 1927. Another Man-O'-War-bird wanders into California waters. Condor 29: 272.

Bannerman, D. A. 1927. Fregata magnificens lowei subsp. nov. Bull. Br. Ornithol. Club 48: 12-13.

Nicholson, D. J. 1927. Florida notes. Auk 44: 115.

1926

Hoffman, R. 1926. Man-O'-War bird in Ventura County, California. Condor 28: 102.

1925

Sprunt, A., Jr. 1925. The Man-O'-War-bird in South Carolina. Auk 42: 578-579.

1924

Lowe, P. R. 1924. Some notes on the Fregatidae. Novit. Zool. 31: 299-313.

1922

Bartsch, P. 1922. An inland record for the Man-O'-War-bird. Auk 39: 249-250.

1915

Rothschild, W. 1915. On the genus Fregata. Novit. Zool. 22: 145-146.

1914

Mathews, G. M. 1914. On the species and subspecies of the genus Fregata. Austr. Avian Rec. 2: 117-121.

1912

Palmer, T. S. 1912. The Man-O'-War bird (Fregata aquila) on the coast of Georgia. Auk 29: 531-532.

1911

Linton, C. B. 1911. Man-O'-War Birds in southern California. Condor 13: 168.

Ramsden, C. T. 1911. Nesting of Man-O'-War-bird (Fregata aquila) in Cuba. Auk 28: 254.

Wayne, A. T. 1911. A third South Carolina record for the Man-O'-War-bird (Fregata aquila). Auk 28: 107.

1910

Coale, H. K. 1910. A new bird for Illinois. Auk 27: 75.

1908

Chapman, F. M. 1908. A contribution to the life histories of the booby (*Sula leucogastra*) and Man-O'-War-bird (*Fregata aquila*). Pap. Mar. Biol. Lab. Tortugas, Carnegie Instit. Wash. Publ. 103: 139-151.

Reynolds, [A. G.] 1908. Man-O'-War. Oologist 25: 121.

1905

Gifford, E. W. 1905. *Fregata aguila* at San Pablo Bay, California. Auk 22: 408.

1894

Shufeldt, R. W. 1894. Note on the shoulder girdle of the Man-O'-War Bird. Science 23: 50.

1893

Lawrence, R. H. 1893. *Fregata aguila* in California. Auk 10: 362.

1886

Lancaster, I. 1886. The torture of the Fish-hawk. Am. Naturalist 20: 223-230.

1874

Holder, J. B. 1874. The Frigate-bird--its remarkable powers of soaring. Am. Sportsman 3: 276.

1859

Taylor, G. C. 1859. Account of a visit to a nesting place of the frigate-bird. Ibis 1: 150-152.

1824

Anon. 1824. [Man-O'-War Bird.] Charleston Courier, September 24, 1824.

GREAT CORMORANT

(*Phalacrocorax carbo*)

[DA: Alekrage, DU: Aalscholver, EN: Cormorant, Black Cormorant; FI: Merimetso, FR: Grand Cormoran, GE: Kormoran, IC: Dilaskarfur, IT: Marangone, JA: Kawa-u, NW: Storskarv, PO: Kormoran czarny, PR: Corvo-marinjo, RU: (Large Cormorant), SP: Cormoran grande, SW: Storskarv]

GENERAL DISTRIBUTION

North America Great Cormorants breed locally in eastern Canada in Newfoundland, Quebec, Prince Edward Island, and Nova Scotia (Godfrey 1966). Most winter in the breeding range, but some winter regularly south along the Maine coast to Long Island and others occur irregularly in small numbers southward (Palmer 1962). These cormorants often straggle inland and there are now records from Ontario (Godfrey 1966), Maine, Vermont, West Virginia (AOU 1957), Pennsylvania (Palmer 1962), New York (Rusk 1974), and all of the southeastern coastal states except Texas (see citations below).

World Distribution The Great Cormorant is a nearly cosmopolitan species with a very extensive breeding range, primarily in the Old World. In Europe and Asia it breeds locally and discontinuously on coasts and inland waters from Iceland, the Faeroes, Great Britain, France, and Scandinavia south to Sardinia and Turkey, thence east to Sakhalin and Japan and south into southern India and China (BOU 1971, Cramp et al. 1977). It also breeds in northwestern, eastern, and South Africa, west Greenland, throughout much of Australia, in New Zealand, and in New Guinea (AOU 1957, BOU 1971, Serventy et al. 1971). Old World populations may be migratory, partially migratory, or dispersive, depending on the population (Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina The Great Cormorant was unrecorded in North Carolina until 1970, when a wintering bird was seen at Pea Island (Teulings 1971b). We now have 13 records for the state that indicate it is a rare winter resident.

1970	30 Dec.	1 imm. seen	Oregon Inlet, Pea Island	Teulings 1971b, Sykes 1971
1971	30 Dec.	1 imm. seen	Pea Island CBC	Sykes 1972
1973	6 Apr.	1 imm. seen	Croatan Sound, near Manteo	Potter and Potter 1974
1973	15 Dec.	1 seen	in Cape Fear River	Needham 1974

1973	1,31 Dec.	1 imm. seen	Pea Island NWR, off Oregon Inlet	Grant and Grant 1975, Sykes 1974
1974	15 Nov.	1 seen	near Southport	Teulings 1975a
1974	29 Nov.	1 seen	Pea Island	Teulings 1975a
1975	27 Dec.	1 imm. seen	Banks Channel at Wrightsville Beach (Wilmington CBC)	Needham 1976
1976	12 Mar.	1 ad. seen	Hatteras Inlet	Teulings 1976d
1976	25 Mar.	1 ad. seen	Cape Lookout	Teulings 1976d
1976	30 Dec.	1 imm. seen	Pea Island	Sykes 1977
1977	20 Nov.	1 seen	Fort Fisher	Teulings 1978b
1978-79	early Sep.-18 Dec., 10-17 Mar. 21 Apr.	2 imm. seen winter, 1 imm., spring	Wrightsville Beach	LeGrand 1979a, 1979b, 1979c

South Carolina We have found only three records for the Great Cormorant in South Carolina.

ca. 1880's	------	2 coll.	near Charleston	Sprunt and Chamberlain 1949
1946	27 Mar.	1 seen	Charleston jetties	Sprunt and Chamberlain 1949
1976	3 Jan.	1 ad., 1 imm. seen	Charleston shipyards	Teulings 1976b

Georgia Denton et al. (1977) considered Great Cormorants rare winter visitors on the coast. They probably occur more frequently than the three records we have found indicate, but have been overlooked because of the difficulty in distinguishing them from the much more abundant Double-crested Cormorant.

1930	19 Oct.	1 male coll. (1) (CM 30.238)	mouth of Savannah River	Tompkins [sic= Tomkins] 1931, Burleigh 1958

(1) Sprunt and Chamberlain (1949) also recorded this specimen as the second record from South Carolina. The specimen was taken along the state border and was counted as part of the avifauna of both states. We list it here with Georgia following Tomkins (1931), who first reported the bird.

1932	14 Feb.	1 seen	Tybee Island	Tomkins 1941
1941	20 Apr.	1 seen	N end Blackbeard Island	Tomkins 1941, Burleigh 1958

Florida - Atlantic Coast The Great Cormorant was regarded by Sprunt (1954) as accidental in Florida on the basis of two records (1). We have 14 records since then, but some of these may be replicate sightings of the same bird. This could mean that Great Cormorants are becoming more common in this area or simply that increasing numbers of observers are making more effort to look for these birds. In any event, Great Cormorants are rare on the Florida Atlantic coast but possibly not as uncommon as the few records suggest.

1947	17 Dec.	6 seen	Fernandina Beach	Hebard 1948
1961	4 Feb.	1 coll.	off Virginia Key	Stevenson 1961
1973	19 May-end of May	1 subad. seen	inlet to Port Everglades	Kale 1973
1974	31 Mar.	1 seen	Jacksonville Beach	Stevenson 1974
1976	19 Dec.	2 seen	Port Everglades	Stevenson 1977
1977	20-22 Feb.	2 seen (1 photogr.)	New Smyrna Beach	Stevenson 1977
1977	27 Feb.	1 seen	Old Rhodes Key, Biscayne Bay	Stevenson 1977
1977	7 Apr.-1 May- 16 Jun.-13 Aug.	1 seen, 2 seen 1 seen	Port Canaveral	Kale 1977, Ogden 1977, Edscorn 1978
1977	10-28 May	1 seen	Indian River, Fort Pierce	Kale 1977
1977	30 Oct.-24 Nov.	1 seen	Mayport	Edscorn 1978

(1) One of these records was stated to have been an immature specimen taken at Vista, 5 December 1930, that had been banded by H. F. Lewis at Lake Island, Saguenay County, Quebec, on 25 July 1930. When Lewis (1937) wrote up the results obtained from banding Great Cormorants, the southernmost recovery given was from Rhode Island. No mention is made of the Florida record, which would have been considered remarkable. It seems possible, if unlikely, that he never learned of the recovery. Lacking further information, we wonder about the validity of this record, and do not include it in our list of records.

1977	30 Oct.- 6 Nov., 4 Dec.	1 seen 1 seen	Ponce de Leon Inlet	Edscorn 1978, Stevenson 1978
1977	5 Nov.	1 seen	Sebastian Inlet	Edscorn 1978
1977	11 Nov.	1 seen	Blowing Rocks	Edscorn 1978
1977- 78	winter	1 seen	Port Canaveral	Stevenson 1978
1978- 79	30 Dec.- mid-Jan.	1 seen	Boynton Beach	Stevenson 1979

Florida - Gulf Coast There are now 12 records for the Florida Gulf Coast, Coast, almost all within the last decade. As on the Atlantic coast, this may indicate either increased abundance or increased observation. We suspect that it is the latter, because there are fewer records for all southeastern coastal states to the north than there are for Florida alone, and because the Florida birds presumably migrate both north and south along the coastlines of these states.

1968	6 Apr.	1 ad. seen	Old Tampa Bay, Pinellas Co.	Woolfenden and Lohrer 1968, Robertson 1968
1969- 70	early Dec.- late Jan.	1 seen	Wakulla Springs (inland)	Stevenson 1970
1970	10 Nov.	1 imm. coll. (FSU)	Lake Talquin, Leon Co.	Robertson 1971
1970	30 Dec.	2 seen	Panacea CBC	Dodd and Stev- enson 1971
1971	6 Feb.	1 imm. seen	St. George Island	Stevenson 1971
1971	18 Feb.	1 imm. seen	Lake Talquin, Leon Co.	Stevenson 1971
1972	29,31 Oct.	1 imm. seen	Pensacola Bay	Duncan 1973
1974	8 Dec.	1 seen	Alligator Point	Stevenson 1975
1974- 75	winter	1 seen	Gulf Breeze	Hamilton 1975
1976	4-5 Nov.	1 seen	Lake Jackson	Edscorn 1977
1976	6 Jan.	1 seen	Naples	Stevenson 1976
1977	17 Mar.- 16 Apr., 3-31 May	1 imm. seen	St. Petersburg	Kale 1977

Alabama We know of only one record for Alabama. Imhof and Peavy (1972) suggested that this bird was the one seen by Duncan in late October only 20 miles away in Florida.

1972	21 Nov.	1 imm. seen	mouth of Perdido Bay, Alabama Point	Imhof 1976b

Mississippi Great Cormorants have only once been recorded from Mississippi (Purrington 1979). The only one seen was found with Double-crested Cormorants.

1978	1 Nov.	1 imm. seen	Bellefontaine Point	Purrington 1979

Louisiana We know of only one record for Louisiana:

1978	5 Feb. (1)	2 imm. seen	Grand Island	Hamilton 1978

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding The Great Cormorant is a widespread largely coastal species that mainly occurs in the Old World between 72° N and 47° S latitude (BOU 1971). In North America it is restricted to the northeastern Atlantic coast where it breeds in Newfoundland, Quebec, Prince Edward Island, and Nova Scotia. There is no current information on the total North American breeding population. Lewis (1941) estimated that there were 1,086 pairs in North America in 1940, but the population has increased since then. Erskine (1972) estimated that there were 2,100 pairs of Great Cormorants in Nova Scotia in the late 1960's; a survey in 1971 revealed a breeding population of about 2,050 pairs (Lock and Ross 1973).

Old World populations are also incompletely known. Some of the larger populations known are as follows: an estimated 12,000 breeding pairs on Norwegian coasts, 1970-1974 (Brun 1979); 8,100 pairs in Britain and Ireland in 1969-1970; 2,000-2,500 pairs in Iceland in 1975; and 1,500 pairs in the Netherlands in 1971 (Cramp et al. 1977).

Winter and Migration Following the nesting season, most North American Great Cormorants disperse only relatively short distances from the breeding areas; many apparently never leave the Gulf of St. Lawrence. Most of the rest are found south along the Atlantic coast to Long Island. In spring, the primary period of movement is in March and the first three weeks of April. In fall, it is from mid-September to late October, occasionally into November (Palmer 1962). Palmer suggested that most of the longer movements (which would involve all birds in southeastern coastal waters) are made by younger birds that disperse earlier.

Old World birds may be migratory, partially migratory, or dispersive depending on the area. British and Irish populations show extensive dispersal

(1) First reported about a week earlier (Hamilton 1978).

but do not migrate; those from the Caspian and North Baltic are mostly migratory and, unlike populations along the Atlantic coasts, regularly migrate overland (Cramp et al. 1977).

Great Cormorants have now been found in all the coastal southeastern states except Texas (Tables 40, 41, Map 8). They have been recorded very seldom in five of these but are undoubtedly more common in South Carolina and Georgia than the number of records indicate. Great Cormorants have been recorded only very recently from Alabama, Mississippi, and Louisiana, and are surely genuinely rare there. This species seems to be wintering gradually farther and farther southeast and it is probably only a matter of time before one is recorded from the Texas coast.

Table 40. Approximate number of Great Cormorants recorded by month for the coastal southeastern United States (a).

State/Region	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	-	4	2	-	-	-	-	2	2	5	8
South Carolina	2	-	1	-	-	-	-	-	-	-	-	-
Georgia	-	1	-	1	-	-	-	-	-	1	-	-
Florida-Atlantic Coast	1	4	1	1	4	2	1	1	-	2	4	10
Subtotal-ATLANTIC COAST	3	5	6	4	4	2	1	1	2	5	9	18
Florida-Gulf Coast	2	2	1	2	1	-	-	-	-	1	2	4
Alabama	-	-	-	-	-	-	-	-	-	-	1	-
Mississippi	-	-	-	-	-	-	-	-	-	-	1	-
Louisiana	2	2	-	-	-	-	-	-	-	-	-	-
Texas	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal-GULF COAST	4	4	1	2	1	-	-	-	-	1	4	4
Total-ALL AREAS	7	9	7	6	5	2	1	1	2	6	13	22

(a) Birds seen over a period of several months are listed once for each month they were believed to be present.

HABITAT

Nesting Preferred nesting habitats of the Great Cormorant vary with area. The race inhabiting North America (*P. c. carbo*) is largely confined to coastal salt water where it breeds colonially, rarely alone, on fairly remote islands and cliffs (Palmer 1962, Godfrey 1966). The species is also mostly coastal in western Europe, but in eastern Europe and the Netherlands it breeds on extensive inland waters (Cramp et al. 1977).

Great Cormorants build bulky nests of seaweed and sticks. In North America, the great majority of nests are placed on the ground on bare, rocky

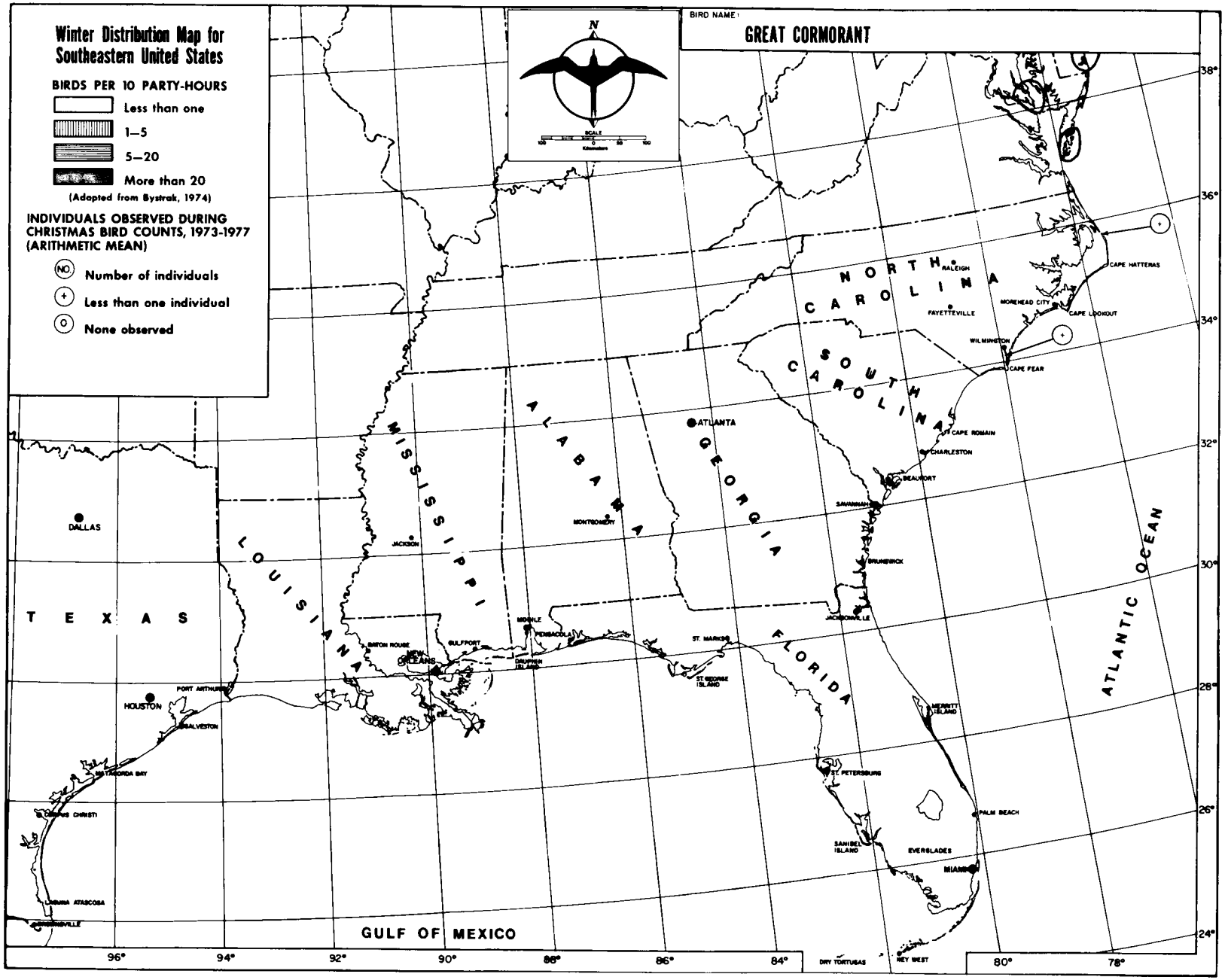

Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than one
1–5
5–20
More than 20
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
BIRD NAME:
GREAT CORMORANT
N
SCALE
Kilometers
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
TEXAS
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
RALEIGH
FAYETTEVILLE
MOREHEAD CITY
CAPE HATTERAS
CAPE LOOKOUT
WILMINGTON
CAPE FEAR
CAPE ROMAIN
CHARLESTON
BEAUFORT
SAVANNAH
BRUNSWICK
JACKSONVILLE
ATLANTA
MONTGOMERY
JACKSON
MOBILE
PENSACOLA
GULFPORT
BATON ROUGE
NEW ORLEANS
DAUPHIN ISLAND
ST. MARKS
ST GEORGE ISLAND
MERRITT ISLAND
ST. PETERSBURG
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
DRY TORTUGAS
KEY WEST
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
38°
36°
34°
32°
30°
28°
26°
24°
96°
94°
92°
90°
88°
86°
84°
80°
78°

Table 41. Dates of occurrence for Great Cormorants in the coastal southeastern United States (a).

State/region	Approximate number of occurrences	Dates of occurrence
North Carolina	13	early September - 21 April
South Carolina	3	3 January - 27 March
Georgia	3	19 October - 20 April
Florida-Atlantic Coast	15	30 October - 13 August
Florida-Gulf Coast	12	29 October - 31 May
Alabama	1	21 November
Mississippi	1	1 November
Louisiana	1	ca. 30 January - 5 February
Texas	unrecorded	

(a) Sightings after late April are probably anomalous.

islands and on ledges and tops of cliffs. Very rarely low trees are used as sites (Palmer 1962, Godfrey 1966, Ross 1977). In Old World areas, however, these cormorants also nest in tall forest trees to as much as 10 m above ground or water. Nests are also found in dense reedbeds and bare patches in swamps (Cramp et al. 1977). Nests may be found from near water level to elevations up to 100 m. Most colonies in Britain and Ireland are below 150 ft (Cramp et al. 1974, Cramp et al. 1977).

Colonies are usually small; few contain more than 200 pairs (Palmer 1962) but some exceptionally hold as many as 2,000 pairs (Cramp et al. 1977).

In North America this species frequently nests in mixed colonies with Double-crested Cormorants (Godfrey 1966). At two colonies in Nova Scotia these birds nested together on flat-topped islands with rapidly shelving boulder-strewn sides. Double-crested Cormorants nested on the exposed tops while the Great Cormorants were found around the edges, often sheltered behind rocks (Ross 1977).

Feeding Great Cormorants feed predominantly in marine waters in North America (Palmer 1962); Ross (1977) reported that it was strictly marine in Nova Scotia. Nova Scotian birds seldom fished close to the shoreline but instead flew to more open waters to forage (Ross 1977). Breeding birds may have foraging ranges of as much as 20 mi (Palmer 1962). Wintering Great Cormorants in Nova Scotia foraged up to 37 km from the nearest roost but the majority fed within 16 km (Ross 1974).

Nonbreeding and Offshore In coastal areas Great Cormorants prefer relatively shallow inshore waters and are seldom found far offshore. A wide variety of aquatic habitats are used, however. Cramp et al. (1977) listed habitats used as "lakes, reservoirs, lagoons, floodlands, open water in swamps and other wetlands, deltas, estuaries, saltpans, and broad rivers, usually

sluggish but some times on torrents." There, these cormorants roost by day on floating logs, pilings, buoys, dead trees, wave-swept rocks, mudflats, sandbars, breakwaters, and so on; nocturnal roosts are usually on islands, cliffs, or groups of trees (Palmer 1962, Cramp et al. 1977).

FOOD AND FEEDING BEHAVIOR

Information on the food habits of the Great Cormorant in North America is scant. Palmer (1962) could find specific mention of only one fish (sculpin) that had been reported eaten in Labrador, Greenland, and Iceland. At least some of these sculpin were of the genus Myoxocephalus. More recently, Ross (1974) reported on a sample of pellets collected in late March at a roost in Mahone Bay, Nova Scotia. Among 309 fish, most (57.8%) were sculpin (Myoxocephalus octodecemspinosus, M. scorpius) but Atlantic cod (Gadus morhua) (21.7%) and winter flounder (Pseudopleuronectes americanus)(14.9%) were also important.

Ross (1977) also reported the results of a more extensive survey based on pellets and regurgitations from breeding colonies in Nova Scotia. All four of the species listed above were among the six species most frequently eaten, but the relative frequency was quite different. The sculpin accounted for 16.1%, the winter flounder for 11.1%, and the cod for 5.5% of the diet. More important yet were cunner (Tautogolabrus adspersus)(41.4%) and pollock (Pollachius virens)(23.8%).

Cramp et al. (1977) presented a detailed summary of food habits in the Old World, and much of what follows is taken from that source. There (and elsewhere) Great Cormorants feed nearly exclusively on fish, of which 425-700 g are taken daily (an average of 15-17% of body weight). In marine and brackish waters, Great Cormorants feed mostly on bottom-feeding fish. The particular species of fish eaten varies from area to area. In a study of 243 stomachs obtained from birds in estuaries in Britain, particularly important food items included flounder (Platichthys flesus), saithe (Pollachius virens), cod (Gadus morhua), and whiting (Merlangius merlangus); a study based on regurgitations and pellets obtained in summer in Scotland revealed that dab (Limanda limanda) was a particularly important food. Further information on food habits at other areas and inland in the Old World is summarized by Cramp et al. (1977). Madsen and Sparck (1950) presented a detailed summary of earlier literature. More recent information is given by Whitfield and Blaber (1979).

Crustaceans, molluscs, and polychaetes have also been reported in the diet but it is uncertain to what degree these are actively sought, or to what extent they represent the remains of food consumed by the fish that the cormorants swallowed (Cramp et al. 1977, Ross 1977). Other kinds of food are taken rarely. Cramp et al. (1977) listed some of the more exotic food items. Birds that have been eaten include waterfowl, Moorhen (Gallinula chloropus), Shelduck (Tadorna tadorna) ducklings, and Barn Swallows (Hirundo rustica) that were seized from the air as they flew near the cormorant. Frogs (Rana temporaria) and mammals (water vole [Arvicola arvicola] and a kitten) have also been consumed.

Great Cormorants feed by pursuit diving, using their feet for propulsion as they follow their prey. According to Palmer (1962) they generally feed in 5 fathoms or less of water, usually diving for 20-30 seconds. They have been recorded remaining under as long as 71 seconds. Ross (1977) reported that Nova Scotian birds fed at a range of depths of from 4.6 to 19.8 m (mean = 10.7, n = 22) and exhibited a mean diving time of 51.0 seconds (n = 34). In a study conducted in South Africa, Whitfield and Blaber (1979) pointed out that diving times are related to water depth. They reported that birds feeding inland in water less than 2 m deep at Lake St. Lucia, Natal, made dives ranging between 4 and 30 seconds (mean = 14, n = 26) and cited Junor (1969), who reported a mean diving time of 21 seconds in water 2.4 to 5.5 m at Lake Kyle, Rhodesia.

Birds in Natal fed throughout the day, with peak activity 0600 to 0800 hours (Whitfield and Blaber 1979). The size of fish taken in Natal ranged from 1 to 24 g, with a peak in the 10-20 g class.

These cormorants may associate with other waterbirds and use the behavior of the latter to increase their own catch. Nightingale (1975 in Whitfield and Blaber 1979) reported an association of these cormorants with White Pelicans (*Pelecanus onocrotalus*) in which the cormorants dove beneath the pelican flotilla to catch the fish driven by the pelicans.

Most fishing is done solitarily, but birds frequently fish in loose scattered flocks that may contain hundreds of individuals that have aggregated to feed on shoaling fish or on fish stranded by tidal recession (Palmer 1962, Cramp et al. 1977).

SUSCEPTIBILITY TO OIL POLLUTION

Cormorants are frequently reported victims of oiling incidents due to their swimming and diving feeding habits and their adherence to coastal areas. Many of these reports do not distinguish which species of cormorant was affected; consequently, our knowledge of intrageneric differences in susceptibility to oiling is speculative at best. Although Great Cormorants are often oiled, only small numbers are found relative to all birds found oiled (Table 42). In Great Britain it has had a history of local population damage, but the total population was nonetheless increasing (Bourne 1968a). Great Cormorants are relatively rare in southeastern waters; consequently, the effects of oil development in that area on the species will be scant.

BIBLIOGRAPHY

1981

Kummer, J. 1981. Kormorane, *Phalacrocorax carbo*, im Raum Halle-Leipzig. [Great Cormorant, *Phalacrocorax carbo*, in Raum Halle-Leipzig.] Beitr. Vogelkd. 27: 52. [In German.]

Table 42. Number of dead birds and number and percentage of dead Great Cormorants found after major oiling incidents.

Area	Dates	Number of oiled dead birds	Number of dead Great Cormorants	Percentage of Great Cormorants	Source
Poole Harbour, Dorset, England	Jan. 1961	433 (a,b)	4	0.92	Bourne 1968a
Southeast Kent, England	winters of 1963-64 to 1965-66	509 (a)	3	0.59	Gibson 1966
Northeast England	Jan. 1966	805	10	1.24	Parrack 1967
Medway Estuary, Kent, England	Sep. 1966	2,748	31	1.13	Bourne 1968a
Pagham Harbour area, W. Sussex, England	Jan.-Feb. 1967	91 (a,b)	1	1.10	Phillips 1967
TORREY CANYON (c) oil spill, southwest Britain	Mar. 1967	1,223	1	0.08	Bourne et al. 1967
Tay Estuary, Scotland	Mar.-Apr. 1968	1,168	2	0.17	Greenwood and Keddie 1968
Northeast Britain	Jan.-Feb. 1970	10,992 (a)	69	0.63	Greenwood et al. 1971
S. Kattegat, Denmark	Dec. 1970-Jan. 1971	2,311 (a)	20	0.88	Joensen 1972a
Firth of Clyde, Ayrshire, Scotland	Jan. 1974	279 (a)	5	1.79	Lloyd et al. 1974
Firth of Forth, southern Scotland	Feb. 1978	740	1	0.13	Campbell et al. 1978

(a) Total includes only those birds identified to species.
(b) Total includes both live and dead oiled birds.
(c) This sample is from an oil spill that was believed to have killed more than 30,000 seabirds.

1980

Larsson, L. 1980. Flockfiske hos Storskarv. [Fishing in flock by cormorants Phalacrocorax carbo.] Var Fagelvarld 39: 43. [In Swedish with English summary.]

Skead, D. M. 1980a. Dispersal, life expectancy, and annual mortality of Whitebreasted Cormorants Phalacrocorax carbo ringed as nestlings at Barberspan. Cormorant 8: 73-80.

Skead, D. M. 1980b. Whitebreasted Cormorant Phalacrocorax carbo chokes on fish. Cormorant 8: 27.

Trout, N. 1980. Cormorant perching on electricity cable. Brit. Birds 73: 310.

1979

Harrison, C. J. O. and C. A. Walker. 1979. A recent and extinct cormorant species from the middle Pleistocene of Tanzania. Ostrich 50: 182-183.

McNicholl, M. K. and G. C. Hogan. 1979. Wind-caused death of Great Cormorant. Can. Field Nat. 93: 175.

Siefke, A. and W. Berger. 1979. Zug und Winterquartier der Rugen-Stralsund-Population des Kormorans, Phalocrocorax carbo sinesis. [The migration and wintering quarters of the Rugen-Stralsund population of the Great Cormorant Phalacrocorax carbo sinensis.] Beitr. Vogelk. 25: 65-74. [In German with English summary.]

Urban, E. K. 1979. Observations of the nesting biology of the Great Cormorant in Ethiopa. Wilson Bull. 91: 461-463.

Whitfield, A. K. and S. J. M. Blaber. 1979. Feeding ecology of piscivorous birds at Lake St. Lucia, Part 3: swimming birds. Ostrich 50: 10-20.

1978

Hammer, U. 1978. Kormoran (Phalacrocorax carbo sinensis) zieht Lachmowe (Larus ridibundus) unter Wasser. [Cormorant (Phalacrocorax carbo sinensis) pulls Black-Headed Gull (Larus ridibundus) under water.] Ornithol. Mitt. 30: 74. [In German.]

Hansen, H. B. 1978. Storskarvens vartrekk i Oslofjord. [Spring migration of Cormorants.] Var Fuglefauna 1: 91-93. [In Norwegian with English summary.]

Kruger, S. 1978. Der Kormoran (Phalacrocorax carbo) brutet in der Oberlausitz. [The Cormorant (Phalacrocorax carbo) breeding in Oberlausitz.] Beitr. Vogelkd. 24: 367-368.

Olver, M. D. and M. A. Kuyper. 1978. Breeding biology of the Whitebreasted Cormorant in Natal. Ostrich 49: 25-30.

Schwan, T. G. and L. Sileo. 1978. Neottialges (Pelecanectes) evansi (Sarcoptiformes: Hypoderidae) parasitizing a White-Necked Cormorant in Kenya. J. Med. Entomol. 14: 522.

Stanton, B. R. 1978. Trans Tasman Shags. Notornis 25: 247-248.

van Tets, J. 1978. Transmarine dispersal of Black Cormorants. Australas. Seabird Group Newsl. 10: 21-24.

von Wicht, U. 1978. Erspaht der Kormoran Beute im Fluge? [Do cormorants detect their prey in flight?] Ornithol. Beob. 75: 95-96. [In German.]

Underhill, L. G. 1978. Whitebreasted Cormorants breeding in the Tsitsikamma Coastal National Park. Cormorant 5: 34.

1977

Chapdelaine, G. 1977. Le Grand Cormoran (Phalacrocorax carbo) en Hiver, le Long des Cotes de la Peninsule de Gaspesie, Quebec. [The Great Cormorant (Phalacrocorax carbo) during winter along the coasts of the Gaspe Peninsula, Quebec.] Can. Field Nat. 91: 184. [In French.]

Mikuska, J. and J. Lakatos. 1977. Podaci o rasprostranjenju i ekologiji vranca velikog, (Phalacrocorax carbo (L. 1758)), u Jugoslaviji. [Data on the distribution and ecology of the cormorant, (Phalacrocorax carbo (L. 1758)), in Yugoslavia.] Larus 29-30: 141-151. [In Serbo-Croatian with English summary.]

Ouweneel, G. L. 1977. De toename van de Aalscholver Phalacrocorax carbo op het Hollandsch Diep Haringvliet. [The increase of the Cormorant Phalacorcorax carbo on the Holland Diep Haringvliet.] Limosa 50: 1-5. [In Dutch with English summary.]

Ross, R. K. 1977. A comparison of the feeding and nesting requirements of the Great Cormorant (Phalacrocorax carbo L.) and the Double-crested Cormorant (P. auritus Lesson) in Nova Scotia. Proc. Nova Scotia Instit. Sci. (1974-1976) 27: 114-132.

1976

Abdulali, H. 1976. Occurrence of Russian-ringed large cormorants [Phalacrocorax carbo sinensis (Shaw)] in India. J. Bombay Nat. Hist. Soc. 73: 212-213.

Ross, R. K. 1976. Notes on the behavior of captive Great Cormorants. Wilson Bull. 88: 143-145.

1975

De Jonckheere, T. and Y. De Jonckheere. 1975. Aalschover - Phalacorocorax carbo. Wielewaal 41: 24.

Dittberner, H. and W. Dittberner. 1975. Ein Brutversuch des Kormorans Phalacrocorax carbo im unteren Odertal. Beitr. Vogelkd. 21: 111-114.

Fog, M. 1975. Skarver "skydes" mod gaskanon. Feltornithologen 16: 166.

Grant, G. S. and S. S. Grant. 1975. Great Cormorant photographed at Pea Island National Wildlife Refuge, N.C. Chat 39: 39-40.

Hughes, S. W. M. 1975. Cormorants roosting on spire. Brit. Birds 68: 429.

Przybysz, A. and J. Przybysz. 1975. Kormoran czarny, Phalacrocorax carbo L. w Polsce. [Great Cormorant, Phalacrocorax carbo L. in Poland.] Przeglad Zool. 19: 341-354. [In Polish with English summary.]

Siegfried, W. R., A. J. Williams, P. G. H. Frost and J. B. Kinehan. 1975. Plumage and ecology of cormorants. Zool. Afr. 10: 183-192.

Urban, E. K. and T. G. Jefford. 1975. Seasonal and opportunistic nesting of the cormorant in Ethiopia. Emu 74: 294.

West, B., D. Cabot and M. Greer-Walker. 1975. The food of the cormorant Phalacrocorax carbo at some feeding colonies in Ireland. Proc. R. Irish Acad. 75B: 285-304.

1974

Engan, H. J. 1974. Skarvetrekk over Osterdalen. Sterna 13: 252. [In Norwegian.]

Harms, W. 1974. Der Kormoran (Phalacrocorax carbo) in Hamburg. Hamb. Avifaun. Beitr. 12: 63-68. [In German with English summary.]

Molchanova, T. V. 1974. [Pelicans and cormorants in western Siberia.] Ornitologiya 11: 393-395. [In Russian.]

Potter, J. and E. F. Potter. 1974. Third sight record of Great Cormorant from North Carolina. Chat 38: 22-23.

Ross, R. K. 1974. Notes on wintering Great Cormorant in Nova Scotia. Can. Field Nat. 88: 493-494.

Rusk, M. S. 1974. Great Cormorant at Oswego Harbor, New York. Kingbird 24: 12-13.

Urban, E. K. and T. G. Jefford. 1974. The status of the cormorants Phalacrocorax carbo lucidus and Phalacrocorax carbo patricki. Bull. Br. Ornithol. Club 94: 104-107.

1973

Bub, H. and W. Sturmer. 1973. Zur Fluggeschwindigkeit von Kormoranen (Phalacrocorax carbo). Ornithol. Mitt. 25: 99. [In German.]

Duncan, R. 1973. A Great Cormorant in west Florida. Fla. Field Nat. 1: 13.

Lock, A. R. and R. K. Ross. 1973. The nesting of the Great Cormorant (Phalacrocorax carbo) and the Double-crested Cormorant (Phalacrocorax auritus) in Nova Scotia in 1971. Can. Field Nat. 87: 43-49.

Petrescu-Raianu, A. 1973. Modificari sezoniere in tesutul cromafin din glanda suptarenala la Phalacrocorax carbo L. Studii Cerc. Biol. (Ser. Zool.) 18: 419-425.

Koeman, J. H., H. C. W. van Velzen-Blod, R. d. Vries and J. G. Vos. 1973. Effects of PCB and DDE in cormorants and evaluation of PCB residues from an experimental study. J. Reprod. Fertil. 19: 353-364.

1972

Erskine, A. J. 1972. The Great Cormorant of eastern Canada. Can. Wildl. Serv. Occas. Pap. 14. 23 pp.

Imhof, T. A. and J. V. Peavy. 1972. The Great (or European) Cormorant, a new bird species for Alabama. Ala. Birdlife 20: 17-18.

Iversen, J. A. and J. Krog. 1972. Body temperatures and resting metabolic rates in small petrels. Norw. J. Zool. 20: 141-144.

Jefford, T. G. and E. K. Urban. 1972. Behavioural responses to temperature in the cormorant (Phalacrocorax carbo lucidus) from Lake Shala, Ethiopia. Proc. Internatl. Ornithol. Congr. 15: 656-657.

Spillner, W. 1972. Zum Baltz- und Paarungsverhalten des Kormorans. Falke 19: 86-101. [In German.]

Strubell, A. 1972. Mas sobre Larus minutus y Phalacrocorax carbo en Santillana (Madrid). Ardeola 16: 261-262. [In Spanish.]

1971

Anon. 1971. Cormorant rookery in the midst of Tokyo. Game Bird Breeders Gaz. 20: 18.

Petrescu-Raianu, A. 1971a. Changes in some morphological indices of the adrenal gland during the different stages of the sexual cycle in Phalacrocorax carbo L. Revue Roum. Biol. (Ser. Zool.) 16: 175-183.

Petrescu-Raianu, A. 1971b. Changes in the ratio of interrenal and chromaffin tissue volumes in the adrenal gland during the different stages of the sexual cycle of Phalacrocorax carbo L. Revue Roum. Biol. (Ser. Zool.) 16: 375-381.

Schell, E. H., S. H. Mudd and M. H. Mudd. 1971. Great Cormorant added to the Maryland list. Md. Birdlife 27: 67.

Schmidt, E. 1971. Mantelmowen, Larus marinus, als Kommensalen beim Kormoran, Phalacrocorax carbo. Vogelwelt 92: 24-25.

Swahn, B.-E. 1971. Fran skarvarnas o i Kalmarsund. Var Fagelvarld 30: 163-167.

1970

Applyby, R. H., C. R. Clark and A. J. Wallis. 1970. Pure-white Cormorant at Ravenscar. Naturalist, Hull No. 912: 4.

Berger, W. 1970. Die Kormorankolonie Niederhof als Objekt des Naturschutzes und der angewandten Ornithologie. Naturschutzarbeit in Mecklenb. 13: 15-22.

Houwen, P. and A. Timmerman. 1970. Vestiging van een aalscholverkolonie. Limosa 43: 156.

Houwen, P. and A. Timmerman. 1970. Vestiging aalscholverkolonie. Levende Nat. 73: 238-239.

Jarvis, M. J. F. 1970. The White-breasted Cormorant in South Africa. Ostrich 41: 118-119.

Macdonald, J. W. and G. R. Potts. 1970. New species of subcutaneous mites in Shags and Cormorants. Brit. Birds 63: 80-81.

Petrescu-Raianu, A. 1970. Investigations of the differentiation in zones of the adrenal gland in Phalacrocorax carbo L. Revue Roum. Biol. (Zool. Ser.) 15: 159-163.

Stevenson, H. M. 1970. An inland record of the Great Cormorant in Florida. Fla. Nat. 43: 178.

Treacy, E. D. 1970. Great Cormorant at Cornwall-on-Hudson. Kingbird 20: 70.

Urban, E. K. and T. G. Jefford. 1970. Behavioural patterns of Phalacrocorax carbo lucidus from Ethiopia compared with those of P. carbo carbo and P. c. sinensis. (Abstract). Proc. XVth Internatl. Ornithol. Congr.: 699.

Wares, I. 1970. Unusual food of Cormorant. Scott. Birds 6: 196.

1969

Bernis, F. 1969. Sobre la presencia de Phalacrocorax carbo en aguas interiores. Ardeola 13: 236-237.

Mills, D. 1969. The food of the cormorant at two breeding colonies on the east coast of Scotland. Scott. Birds 5: 268-276.

Rae, B. B. 1969. The food of cormorants and shags in Scottish estuaries and coastal waters. Mar. Res. Dept. Agric. Fish., Scotl. 1: 16 pp.

Sharland, R. E. 1969. Variation in cormorants near Nguru. Bull. Niger. Ornithol. Soc. 6: 32.

Smith, R. W. J. 1969. Scottish cormorant colonies. Scott. Birds 5: 363-378.

Terrasse, J.-F., M. Terrasse and C. Chappuis. 1969. Essai de recensement de la population francaise du Grand Cormoran (Phalacrocorax carbo) en 1968 et 1969.

Zierz, K. 1969. Kormorane (Phalacrocorax carbo) bei Northeim/Han. Ornithol. Mitt. 21: 129-130.

1968

Coulson, J. C. and M. G. Brazendale. 1968. Movements of cormorants ringed in the British Isles and evidence of colony-specific dispersal. Brit. Birds 61: 1-21.

Dick, W. 1968. Sager- und Kormorandurchzug im oberen Erzegebirge. Beitr. Vogelkd. 14: 90-91.

Duncan, K. W. 1968. The food of the Black Shag (Phalacrocorax carbo novaehollandiae) in Otago inland waters. Trans. R. Soc. N. Z. Biol. Sci. 11: 9-23.

Gentz, K. [On some types of nesting behavior of Phalacrocorax carbo sinensis.] Ornitologiya 9: 282-288. [In Russian.]

Hirons, M. J. D. 1968. British seabirds. 3. The Cormorant. Animals 10: 428-429.

Schoennagel, E. 1968. Der Kormoran (Phalacrocorax carbo) aud der Mittel-- und Oberweser. Ornithol. Mitt. 20: 46.

Sheldon, J. 1968. Cormorants rolling over in flight. Brit. Birds 61: 227.

van Tets, G. F. 1968. White-breasted Cormorant swallows pebbles on land. Emu 67: 224.

Woolfenden, G. E. and F. E. Lohrer. 1968. Great Cormorant seen on Old Tampa Bay, Florida. Fla. Field Nat. 41: 169.

1967

Balfour, E., Anderson, A. and G. M. Dunnet. 1967. Orkney cormorants--their breeding distribution and dispersal. Scott. Birds 4: 481-493.

Dennis, R. H. 1967. The status of the Cormorant at Fair Isle. Fair Isle Bird Observ. Bull. 5: 247-250.

Ponting, E. D. 1967. Cormorant eating frog. Brit. Birds 60: 482.

Wright, R. M. 1967. Cormorants rolling over in flight. Brit. Birds 60: 522.

Stonehouse, B. 1967. Feeding behaviour and diving rhythms of some New Zealand Shags, Phalacrocoracidae. Ibis 109: 600-605.

1966

Coomans de Ruiter, L. 1966. De Aascholver Phalacrocorax carbo sinensis als Broedvogel in Nederland, in Vergelijkins met Andere Westeuropese Landen. [The cormorant Phalacrocorax carbo sinesis as a breeding bird in Holland compared with other western European countries.] Limosa 39: 187-212. [In Dutch with English summary.]

Rutschke, E. 1966. Wiederansiedlung des Kormarans (Phalacrocorax carbo) im deutschen Binnenland. Beitr. Vogelkd. 11: 318-321.

Williams, J. G. 1966. A new cormorant from Uganda. Bull. Br. Ornithol. Club 86: 48-50.

1965

Mills, D. H. 1965. The distribution and food of the of the cormorant in Scottish inland waters. Freshwater Salmon Fish. Res. Dept. Agric. Fish. Scotl. 35: 3-16.

Skokova, N. N. 1965. [Economic significance and characteristic effects of Great Cormorant and Gressores on the fauna of water reservoirs of the Delta of the Volga.] Pp. 65-89 in E. N. Pavlovskij (ed.) 1976 transl.

1964

Black, J. A. 1964. A further look at cormorants. Salmon Trout Mag. 172: 166-180.

1963

Fisher, A. 1963. The Black Cormorant as a predator. Austr. Bird Watcher 2: 24-25.

1962

Jehl, J. R., Jr. 1962. Remarks on the Great Cormorant in New Jersey. Urner Field Observ. 9: 1-14.

1961

Coulson, J. C. 1961. Movements and seasonal variation in mortality of shags and cormorants ringed on the Farne Islands, Northumberland. Brit. Birds 54: 225-235.

Dragesco, J. 1961. Observations ethologiques les oiseaux du Banc d'Arguin. Alauda 29: 81-98. [In French.]

1959

de Naurois, R. 1959. Premieres recherches sur l'avifaune des iles du Banc d'Arguin (Mauritanie). Alauda 27: 241-308. [In French.]

Marshall, A. J. and J. D. Roberts. 1959. The breeding biology of equatorial vertebrates: Reproduction of cormorants (Phalacrocoracidae) at Latitude 0° 25' N. Proc. Zool. Soc. Lond. 13: 617-625.

van Tets, G. F. 1959. A comparative study of the reproductive behaviour and natural history of three sympatric species of cormorants, (Phalacrocorax auritus, P. penicillatus, and P. pelagicus) at Mandarte Island, B.C. M. A. thesis, Univ. Brit. Columbia. 86 pp.

1958

Stokoe, R. 1958. The spring plumage of the cormorant. Brit. Birds 51: 165-179.

1957

Du Plessis, S. S. 1957. Growth and daily food intake of Whitebreasted Cormorant in captivity. Ostrich 28: 197-201.

Gladkov, N. A. 1957. [Nest disposition and migration of the Common Cormorant on the Caspian and Aral seas.] Izd. Akad. Nauk SSSR. Moscow: 90-99. [D. Nichols (transl.) 1960 'Translations from Russian Biology' No. 3, Washington, D.C.]

1952

King, B. 1952. Defensive behaviour of cormorant. Brit. Birds 45: 34-35.

Merwald, F. 1952. Eine Kormorankolonie bei Linz. Natur Land 38: 69-70. [In German.]

van Dobben, W. H. 1952. The food of the cormorant in the Netherlands. Ardea 40: 1-63.

Whalley, P. E. S. and M. J. Wooton. 1952. Cormorant perching on a cable. Brit. Birds 45: 35.

Winterbottom, R. H. 1952. Unusual perches of cormorants. Brit. Birds 45: 419-420.

1951

Buckalew, J. H. 1951. European Cormorant observed at Ocean City, Maryland. Md. Birdlife 7: 17.

1950

Madsen, F. J. and R. Sparck. 1950. On the feeding habits of the Southern Cormorant (Phalacrocorax carbo sinensis Shaw) in Denmark. Dan. Rev. Game Biol. 1: 45-75.

1949

Richards, E. G. 1949. Cormorant drying wings on water. Brit. Birds 42: 250.

1948

Hebard, F. W. 1948. European Cormorants seen at Fernandina. Fla. Nat. 28: 59.

1947

Cornish, A. V. 1947. Cormorant's method of eating eels. Brit. Birds 40: 314-315.

1945

Lack, D. 1945. The ecology of closely related species with reference to cormorant (Phalacrocorax carbo) and Shag (P. aristotelis). J. Anim. Ecol. 14: 12-16.

1942

Kortlandt, A. 1942. Levensloop, samenstelling en structuur der Netherlandse aalscholverbevolking. [A population study of the European Cormorant in Holland, based on counting and banding data.] Ardea 31: 173-280. [In Dutch with English summary.]

Peters, H. S. 1942. Cormorants found breeding on Prince Edward Island, Canada. Auk 59: 100.

Tucker, B. W. 1942. Aerial evolutions and soaring of Cormorants. Brit. Birds 36: 114-115.

1941

Lewis, H. F. 1941. Breeding European Cormorants of North America. Auk 58: 360-363.

Mack, G. 1941. Cormorant and the Gippsland Lakes fishery. Mem. Natl. Mus. Victoria 12: 95-117.

Tomkins, I. R. 1941. Sight record of European Cormorant in Georgia. Oriole 6: 516.

1940

Kortlandt, A. 1940. Eine Ubersicht der angeboren Verhaltungsweisen des Mittel-Europaischen Kormorans (Phalacrocorax carbo sinensis). Arch Neerl. Zool. 4: 401-442. [In German.]

Peters, H. S. 1940. European Cormorants nesting in Nova Scotia. Can. Field Nat. 54: 59-60.

1939

Serventy, D. L. 1939. Notes on cormorants. Emu 38: 357-371.

1938

Kortlandt, A. 1938. De uitdrukkingsbewingen en -geluiden van Phalacrocorax carbo sinensis (Shaw & Nodder). Ardea 27: 1-40. [In Dutch.]

Serventy, D. L. 1938. The feeding habits of cormorants in south-western Australia. Emu 38: 293-316.

1937

Kortlandt, A. 1937. Een albinistische Aalscholver (Phalacrocorax carbo sinensis Shaw & Nodder). Ardea 26: 217-218. [In Dutch.]

Lewis, H. F. 1937. Results from banding European Cormorants. Bird-Banding 8: 11-15.

1934

Lewis, H. F. 1934. Return of banded adult European Cormorant (Phalacrocorax carbo carbo) to its native colony. Bird-Banding 5: 132-133.

Roberts, B. B. 1932. On the normal flight-speed of birds. Brit. Birds 25: 220-222.

1933

Friedmann, H. 1933. The Chinese Cormorant on Kodiak Island, Alaska. Condor 35: 30-31.

Steven, G. A. 1933. The food consumed by shags and cormorants around the shores of Cornwall (England). J. Mar. Biol. Assoc. U.K. 19: 277-292.

1931

Lewis, H. F. 1931a. A banded adult Common Cormorant. Bird-Banding 2: 33.

Lewis, H. F. 1931b. Common Cormorant return to natal colony. Bird-Banding 2: 128.

1930

Brouwer, G. A. 1930. De sterkte der broedkolonies van Phalacrocorax carbo sinensis (Shaw & Nodder) in 1930. Ardea 19: 74-75. [In Dutch.]

Haverschmidt, F. 1930a. Jonge Aalscholver [Phalacrocorax carbo sinensis (Shaw & Nodder)] met 4 pooten. Ardea 19: 75-76. [In Dutch.]

Haverschmidt, F. 1930b. Over het broeden van Phalacrocorax carbo sinensis (Shaw & Nodder) in onvolkomen kleed. Ardea 19: 79-82. [In Dutch.]

1928

Haverschmidt, F. 1928. Broeden van Phalacrocorax carbo subcormoranus (Brehm) op den grond. Ardea 17: 159-160. [In Dutch.]

Patterson, A. H. 1928. Cormorant drowned by an eel. Brit. Birds 22: 162-164.

Tekke, M. J. 1928. Phalacrocorax carbo (L.) in een stadsgracht te Den Haag. Ardea 17: 72. [In Dutch.]

1927

Brouwer, G. A. 1927. De bedreigde broedplaatsen van den Aalscholver [Phalacrocorax carbo subcormoranus (Brehm)] in Nederland. II. Gegevens over de sterkle der kolonies in 1926. Ardea 16: 23-31. [In Dutch.]

Munro, J. A. 1927. Cormorants nesting on Bare Island, British Columbia. Condor 30: 327-328.

Portielje, A. F. J. 1927. Zur Ethologie bezw. Psychologie von Phalacrocorax carbo subcormoranus (Brehm). Ardea 16: 107-123. [In Dutch.]

1926

Brouwer, G. A. 1926. De bedreigde broedplaatsen van den Aalscholver (Phalacrocarbo subcormoranus (Brehm) in Nederland. Gegevens over sterkle van eenige kolonies in 1925. Ardea 15: 20-28. [In Dutch.]

1925

Lewis, H. F. 1925. Common Cormorants nesting in the Magdalen Islands. Can. Field Nat. 39: 113.

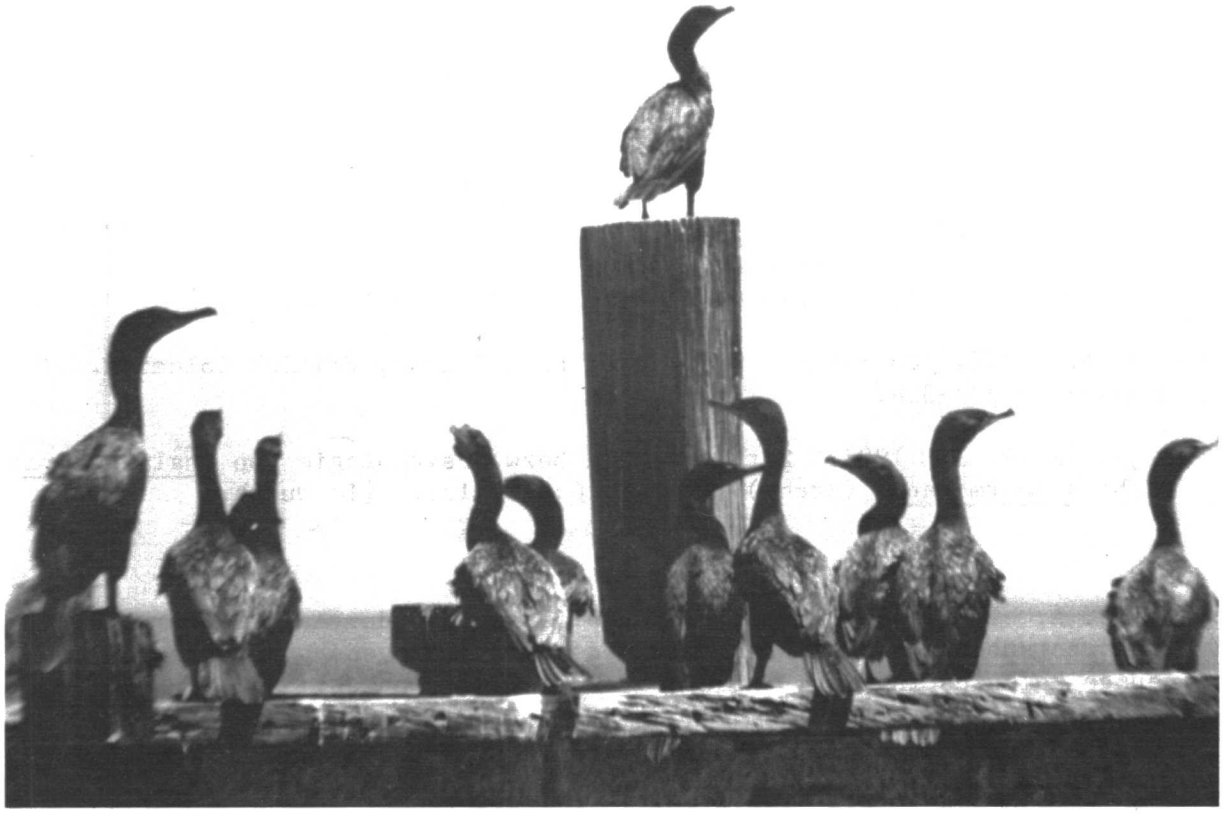
1924

Tufts, R. W. and C. W. Townsend. 1924. Notes on the cormorant (Phalacrocorax carbo). Auk 41: 150.

1910

Frohawk, F. W. 1910. On a white-breasted variety of the Common Cormorant. Brit. Birds 3: 385-390.

Jourdain, F. R. C. 1910. White-breasted variety of the Common Cormorant. Brit. Birds 4: 25-26.



Double-crested Cormorants roosting on pier, Flamingo, Florida, September 1978.
Photograph by Roger B. Clapp.

DOUBLE-CRESTED CORMORANT

(*Phalacrocorax auritus*)

[SP: Cuervo marino, US: Florida Cormorant]

GENERAL DISTRIBUTION

North America In central and eastern Canada, Double-crested Cormorants breed from central and southeastern Alberta east through southern Saskatchewan to southern Ontario, thence north along the Gulf of St. Lawrence to Newfoundland. Isolated breeding areas are found to the north in Ontario and Quebec (Godfrey 1966).

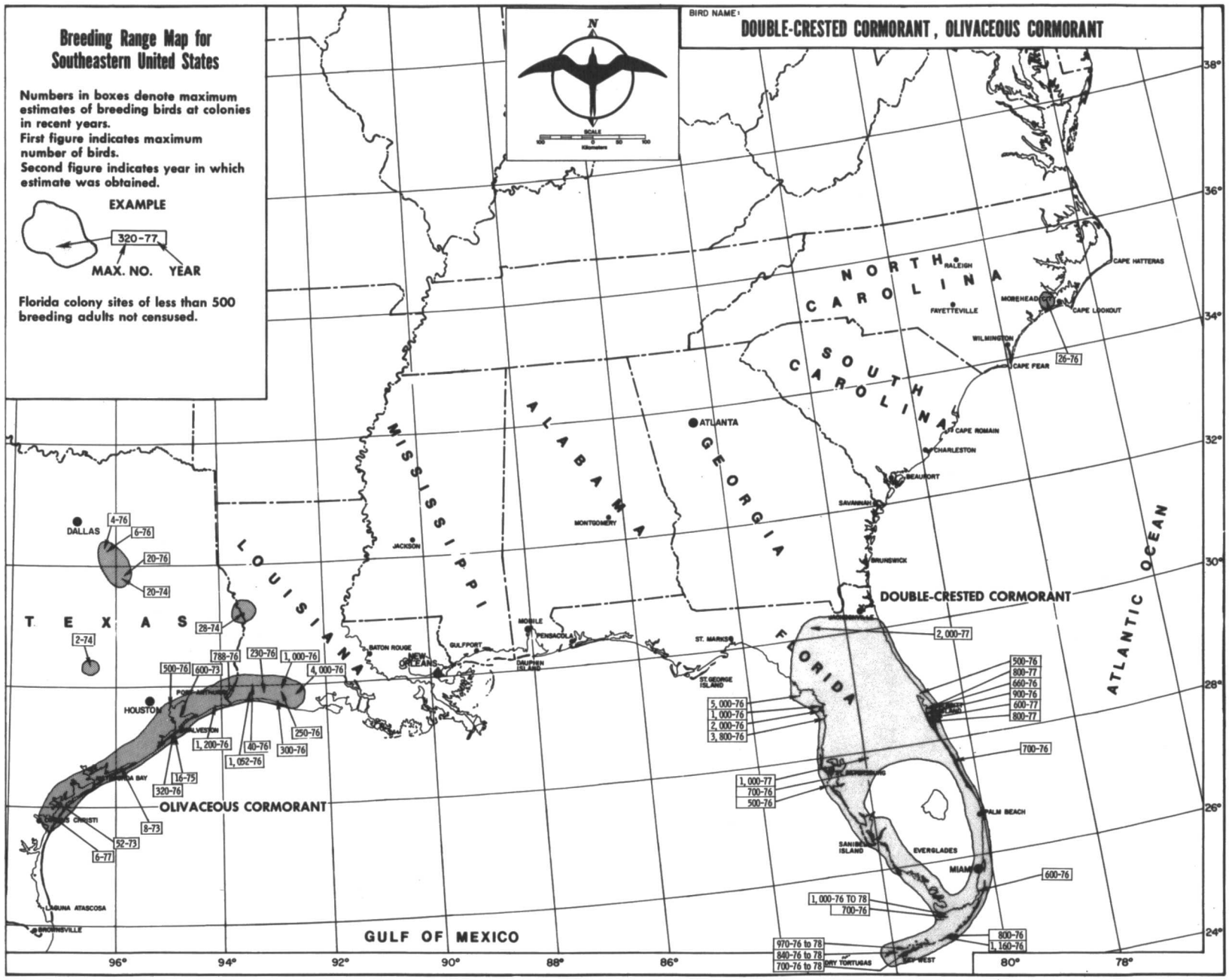
In western North America they breed in southern Alaska from the eastern Aleutians to the Kenai Peninsula (AOU 1957), on the coast of southern British Columbia, and south along the coast and in the interior from Washington to western Arizona and southern Baja California (Palmer 1962). These cormorants also breed in the Revilla Gigedo Islands, on islands in the Gulf of California, and south along the west coast of Mexico to at least Sonora (Palmer 1962, Jouanin and Mougin 1979). An isolated colony has recently been found breeding in central Durango on the Mexican Plateau (S. Williams 1978). Isolated breeding localities in the northwestern United States are found in Nevada, northern Utah, and southeastern Idaho (Palmer 1962).

The species nests regularly in the central United States from northwestern Montana east to northwestern Michigan, south to southern Wisconsin and northwestern Nebraska. Other colonies occur locally south to Tennessee (Palmer 1962). In the northeast, Double-crested Cormorants breed from the coast of Maine to Long Island, New York (Palmer 1962, Erwin 1979).

In the southeast (Map 9), these cormorants breed inland and on the east and Gulf coasts of Florida (Palmer 1962) and at Lake Ellis in North Carolina (Grant 1970); they were recently found breeding in Charles City County, Virginia (Blem et al. 1980). These cormorants formerly bred at several localities in Louisiana (Lowery 1974), but they have bred in Texas only very rarely. The few breeding records in Texas have been from both the coast and inland (Oberholser 1974, Holm et al. 1978).

Pacific coast birds tend to move southward in the winter but many also remain in the vicinity of the breeding areas; those from north-central populations winter along the Gulf Coast and along the Mississippi River to Tennessee. Birds from northeastern populations winter primarily in Florida, with smaller numbers wintering along the Gulf Coast and along the Atlantic coast as far north as New York (Palmer 1962, Kury and Cadbury 1970, Houston 1971). Still others winter in the Caribbean south to Belize (Jouanin and Mougin 1979).

Birds wander casually or accidentally north to the southern Yukon, southern Baffin Island, northern Ontario, and northeastern Labrador (Palmer 1962, Godfrey 1966), and east to Bermuda and Guadeloupe (AOU 1957). Double-crested


Breeding Range Map for Southeastern United States
Numbers in boxes denote maximum estimates of breeding birds at colonies in recent years.
First figure indicates maximum number of birds.
Second figure indicates year in which estimate was obtained.
EXAMPLE
320-77
MAX. NO.
YEAR
Florida colony sites of less than 500 breeding adults not censused.
BIRD NAME:
DOUBLE-CRESTED CORMORANT, OLIVACEOUS CORMORANT
N
SCALE
Kilometers
DOUBLE-CRESTED CORMORANT
OLIVACEOUS CORMORANT
GULF OF MEXICO
ATLANTIC OCEAN
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
DALLAS
HOUSTON
GALVESTON
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
PENSACOLA
DAUPHIN ISLAND
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
JACKSONVILLE
SAVANNAH
BRUNSWICK
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD
CAPE LOOKOUT
CAPE HATTERAS
PALM BEACH
EVERGLADES
MIAMI
SANIBEL ISLAND
DRY TORTUGAS
KEY WEST
4-76
6-76
20-76
20-74
2-74
28-74
788-76
230-76
1,000-76
4,000-76
500-76
600-73
1,200-76
40-76
1,052-76
250-76
300-76
16-75
320-76
8-73
52-73
6-77
5,000-76
1,000-76
2,000-76
3,800-76
1,000-77
700-76
500-76
2,000-77
500-76
800-77
660-76
900-76
600-77
800-77
700-76
600-76
1,000-76 TO 78
700-76
970-76 to 78
840-76 to 78
700-76 to 78
800-76
1,160-76
26-76
38°
36°
34°
32°
30°
28°
26°
24°
96°
94°
92°
90°
88°
86°
80°
78°

Cormorants also breed in the northern Bahamas, Cuba, and Isle of Pines (southwest of Cuba)(Jouanin and Mougin 1979).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina In North Carolina, these cormorants occur chiefly as migrants and winter residents along the coast (Pearson et al. 1942). Large numbers are present from at least mid-October through late April (Table 43, Map 10); Palmer (1962) considered the first week of April to be the peak of spring migration in North Carolina.

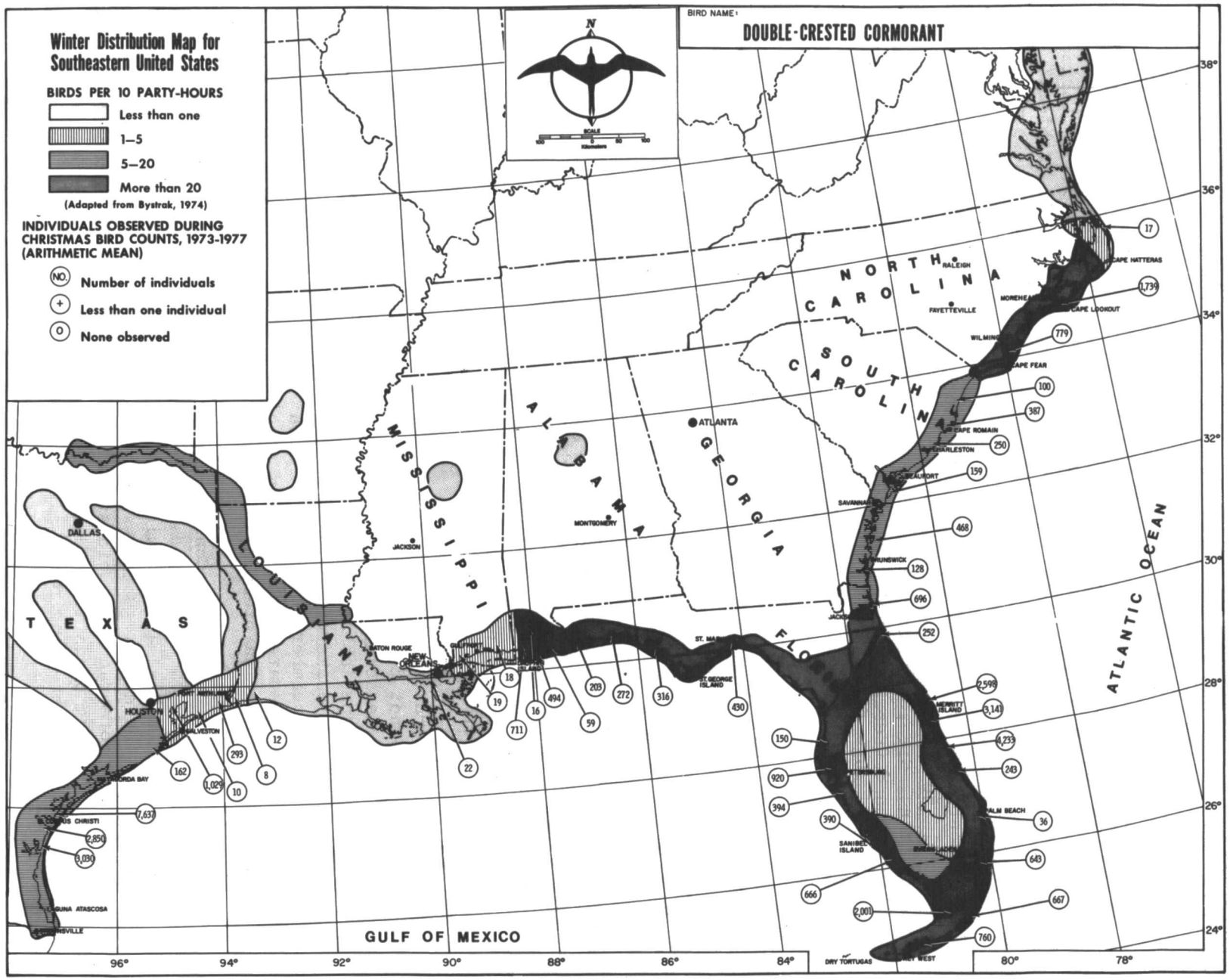
The southern race of the Double-crested Cormorant (the Florida Cormorant, *P. a. floridanus*) has bred sporadically within the borders of the state at two localities, Great Lake and Ellis Lake in Craven County, both about 10 mi from Bogue Sound (Pearson et al. 1942, Grant 1970). The breeding population evidently was never large. Our most recent information is that 13 nests with feathered young were present at Lake Ellis (Map 9) in early June 1976 (Colonial Bird Register).

South Carolina Sprunt and Chamberlain (1949) regarded Double-crested Cormorants primarily as winter residents, abundant in tidal rivers, bays, and the ocean, less common inland on larger bodies of water. Summer populations along the coast are much smaller; Sprunt and Chamberlain (1949) believed that any bird seen after 1 May was likely to be a Florida Cormorant.

Information on seasonal chronology and the size of wintering and migrant populations is scanty. The species is most abundant from November to May (Sprunt and Chamberlain 1949) but may reach peak abundance during the migrations, judging from concentrations seen on migration (Table 43) and on Christmas Counts (Map 10). Migrants have been seen moving south as early as 25 September (Parnell 1968a) and Burton (1970) reported two observations that suggest that the northward migration may begin as early as late February.

Georgia Double-crested Cormorants occur along the Georgia coast throughout the year but do not breed there. As in South Carolina, they are most abundant in winter, least abundant in summer (Burleigh 1958). Denton et al. (1977) regarded the species as uncommon in the interior in winter. Tomkins (1958) indicated that peaks of spring and fall migration in the Savannah River Delta area were in September-October and March-April, respectively. Most cormorants seen in Georgia are probably from populations breeding to the north. The proportion from Florida breeding populations is as yet unknown.

Florida - Atlantic and Gulf Coasts Florida is the only coastal southeastern state in which there are substantial numbers of breeding Double-crested Cormorants (Table 44). In winter, populations increase as wintering birds arrive from the north. Data assembled by Kale (1979 ms a, 1979 ms b) show that nesting cormorants are widespread on both coasts, but information on numbers of breeding birds is inadequate. Available data indicate that there are over 20,000 breeding birds along the coast (Map 9). The total number breeding in Florida may be much larger; other birds breed on lakes in the interior.


BIRD NAME:
DOUBLE-CRESTED CORMORANT
Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than one
1–5
5–20
More than 20
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
(NO.) Number of individuals
(+) Less than one individual
(O) None observed
N
SCALE
KILOMETERS
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
MISSISSIPPI
LOUISIANA
TEXAS
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
RALEIGH
FAYETTEVILLE
ATLANTA
MONTGOMERY
JACKSON
DALLAS
HOUSTON
GALVESTON
BATON ROUGE
NEW ORLEANS
SAVANNAH
BRUNSWICK
JACKSONVILLE
ST. MARYS
ST. GEORGE ISLAND
MERRITT ISLAND
PALM BEACH
SANIBEL ISLAND
DRY TORTUGAS
KEY WEST
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
CAPE HATTERAS
CAPE LOOKOUT
CAPE FEAR
CAPE ROMAIN
CHARLESTON
BEAUFORT
17
1,739
779
100
387
250
159
468
128
696
252
2,598
3,141
4,233
243
36
643
667
760
2,001
666
390
394
920
150
430
316
272
209
59
494
16
711
18
19
22
12
8
10
293
1,029
162
7,637
2,850
3,030

Nesting usually occurs from early December through late September, with most nesting activity occurring from April through June (Schreiber and Schreiber 1978). Individual colonies exhibit considerable variation in nesting chronology.

Wintering birds are common to abundant along the entire coastline, perhaps somewhat more so to the northeast (Map 10). There is little recent information on concentrations of migrant and wintering birds because the species is so common that it is seldom mentioned in American Birds. A few early records of such concentrations are given in Table 43.

Alabama Double-crested Cormorants are abundant migrants and winter visitors (Map 10) on the Alabama Gulf Coast and are occasional there in summer; inland it was formerly common but is now rare. Peak numbers (Table 43) are present from October to May (Imhof 1976b).

Band recoveries obtained in Alabama (Imhof 1976b) suggest that these Double-crested Cormorants originate from both mid-continental (Saskatchewan to Ontario) and northeastern (Quebec to Massachusetts) breeding populations. Cormorants found inland in Alabama are more likely to have come from interior colonies, whereas those along the coast come from both the interior and the northeast.

Mississippi Burleigh (1944) considered this species one of the most common wintering waterbirds in Mississippi Sound, but saw none during the summer months. It is present from late September through early May but is more common from early October through late March (Table 43).

Louisiana These cormorants are present in Louisiana throughout the year, and are common in winter and early spring. The species is most common from early September through late April, but is apparently less common now than formerly (Lowery 1974). Recent Louisiana Christmas Counts (Map 10) indicate that these cormorants are considerably less common in winter than to either the east or west. It should be remembered, however, that no Christmas Counts are available for much of the Louisiana coastline; consequently, the low levels of abundance indicated for this area on Map 10 should be regarded primarily as a demonstration of ignorance rather than as an indication of a lack of birds.

Oberholser (1938) stated that Double-crested Cormorants occurred in both coastal and inland areas but were particularly abundant along the Gulf Coast and on large bodies of water in southern parts of the state. The species once bred at Bird Island in Cameron Parish (Oberholser 1938), at Devil's Swamp north of Baton Rouge, and perhaps elsewhere. These colonies evidently were small and there is no recent record of breeding in the state (Lowery 1974).

Texas Oberholser (1974) considered this species locally very common to uncommon in winter along the entire coast and less common inland. He reported its status was similar during migration (mid-August to mid-November and early March to late May), and pointed out that Double-crested Cormorants were uncommon to rare during the summer months. Blacklock (1978 ms) believed that the periods of maximum density are in October-November and February-March (Table

Table 43. Peak concentrations of wintering and migrant Double-crested Cormorants in the coastal southeastern United States (a).

Date seen		Number seen	Locality	Source
			NORTH CAROLINA	
1974	27 Oct.	ca. 14,000	moving S off Ocracoke Island	Teulings 1975a
1979	24 Nov.	ca. 3,500	crossing from ocean to sound over Pea Island NWR	C. Wilds, pers. comm.
1975	30 Nov.	20,000+	moving S off Ocracoke Island	Teulings 1976a
1976	10 Jan.	ca. 10,000	from Hatteras-Ocracoke Island ferry	Teulings 1976b
1967	24 Jan.	ca. 5,000	Hatteras Inlet	Parnell 1967b
1972-73	winter	2,000	wintering, Morehead City	Teulings 1973b
1971	22 Apr.	ca. 4,000	moving S at Rodanthe	Teulings 1971c
1975	22 Apr.	2,500+	Oregon Inlet	Teulings 1975c
			SOUTH CAROLINA	
1970	24 Oct.	575	moving S by Isle of Palms near Charleston	Teulings 1971a
1964	22 Mar.	5,000	moving N off Murrell's Inlet	Chamberlain 1964
1977	2 Apr.	600+	single flock at Lake Marion	Teulings 1977b
			GEORGIA	
1957	1 Apr.	500+	in 3 flocks flying N, St. Marys	Chamberlain 1957
			FLORIDA	
1910	4 Dec.	ca. 10,000	Passage Key	Howell 1932
1919	21 Jan.	5,000+	in one flock, Terra Ceia Bay	Howell 1932
1924	Feb.	2,000+	roosting, reefs S of Pass-a-Grille	Howell 1932
			ALABAMA	
1958	28 Dec.	1,100+	Mississippi Sound	Imhof 1976b
1972	23 Jan.	550	Fort Morgan	F. James 1972
1971	23 Feb.	1,000's	off Dauphin Island	Hamilton 1971
1959	28 Feb.	1,200+	Dauphin Island	Imhof 1976b
1971	Feb.-Mar.	1,500+	Mississippi Sound	Imhof 1976b
			MISSISSIPPI	
1977	30 Oct.	200+	off Horn Island	Weber and Jackson 1978

Table 43. Continued.

			MISSISSIPPI (continued)	
1977	3 Dec.	100	in one flock at Ross Barnett Reservoir	Jackson and Cooley 1978a
1962	17 Mar.	2,000	Gulf near Horn and Petit Bois Islands	Gandy and Turcotte 1970
			TEXAS	
1978	21 Oct.	ca. 1,500	Braunig Lake, San Antonio	Webster 1979a
1969	15 Nov.	500	Laguna Atascosa NWR	Webster 1970a
1971	1 Jan.	ca. 2,500	Cove, Chambers Co.	Webster 1971b
1975	1 Jan.	2,000+	Cove, Chambers Co.	Webster 1975b
1975	14 Jan	3,500	Texas City Dike	Webster 1975b
1978	21 Jan	2,000+	Braunig Lake, San Antonio	Webster 1978a
1963	8 Feb.	820	counted, Laguna Atascosa NWR	Webster 1963b
1961	19 Feb.	2,000+	Texas City Dike	Webster 1961b
1978	19 Mar.	3,000+	leaving NW from Aransas Bay	Webster 1978c

(a) Within states, records are arranged by season.

43). Data from Christmas Counts (Map 10) indicate that Double-crested Cormorants are abundant in winter along the south Texas coast, perhaps more so than so than anywhere else in the southeastern United States.

These cormorants once nested in Texas in small numbers, but none are known to have bred there since 1939 (Oberholser 1974) through at least the mid-1970's.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Double-crested Cormorants breed solely in the New World, mostly within the confines of Canada, the United States, and Mexico. A few colonies are found in the Caribbean. Presently they breed, often locally, from the eastern Aleutians and southern Alaska south to southern Baja California and the Mexican west coast. Other populations breed from southern and eastern Alberta east to Newfoundland thence south to Massachusetts, New York (Long Island), Tennessee, and Texas. Breeding localities are few and scattered in the southern portion of this area. The only other major breeding area is in Florida and a few islands in the eastern Caribbean. Very small numbers breed or have bred at one or two localities in North Carolina and Virginia.

The quality of information available for breeding populations of Double-crested Cormorants is highly variable. Some Canadian data are relatively recent and complete, but information from other areas is incomplete or is entirely lacking. Some breeding populations have declined drastically in recent years (Mitchell 1975), but others are evidently increasing (Markham and Brechtel 1979). Palmer (1962) suggested that Florida populations were probably

Table 44. Breeding population estimates for the Double-crested Cormorant (a).

Area	Number of breeding birds	Number of colonies	When data obtained	Source
CANADA				
British Columbia	2,120	?	?	Manuwal and Campbell 1979
Alberta	3,800	17	1978	Markham and Brechtel 1979
Saskatchewan	5,480	11	1976	Roney 1978
Manitoba	ca. 9,650	40	1969	Vermeer 1969c, 1973
Newfoundland	ca. 310	9	1963/64-73	Brown et al. 1975
Nova Scotia	ca. 8,300	30	1971	Lock and Ross 1973
UNITED STATES				
Alaska-Coast	7,000	82	1970's	Sowls et al. 1978
Washington	910	10	1970's ?	Manuwal and Campbell 1979
Utah	410	3	1974	Mitchell 1975
Great Lakes	310	?	1977	Scharf 1978
Maine	30,670	103	1977	Korschgren 1979
New Hampshire	50	1	1977	Erwin 1979
Massachusetts	3,520	11	1977	Erwin 1979
New York (Long Island)	130	1	1977	Erwin 1979
Virginia	10	1	1978	Blem et al. 1980
North Carolina	30	1	1976	cf. Map 9, this paper
Florida-Atlantic Coast	ca. 8,630	?	1976-79	Kale 1979 ms a
Florida-Gulf Coast	ca. 15,060	?	1976-79	Kale 1979 ms b

Table 44. Continued.

Area	Number of breeding birds	Number of colonies	When data obtained	Source
MEXICO				
Durango	10	1	1977	S. Williams 1978

(a) Figures rounded to the nearest 10; those for Florida are rough and do not include inland breeding populations.

decreasing, but the species has never been well enough censused to document this. Recent estimates for some breeding populations are given in Table 44. This list is far from complete, but it suggests that Maine and Florida hold a large proportion of the breeding Double-crested Cormorants of eastern North America.

In the southeast, Double-crested Cormorants are among the least studied colonial waterbirds and warrant considerably more study. Information on populations and racial composition for migrant and wintering populations of cormorants in the southeast is largely lacking, and our knowledge of the size of breeding populations is considerably less adequate than for many other marine birds nesting there.

Winter and Migration Some populations of the Double-crested Cormorant are strongly migratory; others, particularly western populations, move only short distances after breeding is completed. The Florida Cormorant is apparently resident, but no one has conducted a study with marked birds that would show the degree and extent of post-breeding movement. Birds migrating from the north to southeastern wintering grounds use two routes. One follows the Atlantic coast south, the other is overland to the Gulf of Mexico. For the most part, these cormorants follow coastlines and watercourses closely. Birds usually migrate in flocks of 200 or less (Palmer 1962), but occasionally occur in very large aggregations (Table 43); they migrate either by day or by night.

A few banding studies provide information on the origins of Double-crested Cormorants wintering in the southeastern states. Kury and Cadbury (1970) analyzed recoveries of 248 nestlings banded in Maine. Among the birds recovered from December to February, 72% (n = 169) were taken in Florida and 13% were in other Atlantic coastal states; the other 15% were found along the Gulf Coast from Alabama to Texas. Houston (1971) reported results obtained from birds banded in Saskatchewan. Although there were some differences in dispersion that evidently were related to differences in where the birds were banded, most wintered along the coasts of Louisiana and Texas.

Examination of recent Christmas Counts (Map 10) suggests that major wintering concentrations are found near Cape Lookout, North Carolina, on the central Florida Atlantic coast, in Florida Bay, and along the Texas coast.

HABITAT

Nesting Double-crested Cormorants nest either on the ground or on elevated sites such as cliffs or trees, but nest sites most used vary from area to area. Vermeer (1973) suggested that Double-crested Cormorants prefer to nest on the ground throughout their range and only nest in trees in areas where they are frequently disturbed by people or may be affected by terrestrial predators.

In Nova Scotia, these cormorants prefer to nest in spruce trees on islands, but also nest on the ground, either by themselves or with Great Cormorants. In one study (Lock and Ross 1973), they were found nesting with Great Blue Herons in 10 of 12 sites that provided suitable nesting habitat for both species. At Mandarte Island, British Columbia, in contrast, they nest on cliff shoulders and almost never nest on the narrow ledges on cliff faces that are preferred by Pelagic Cormorants (*Phalacrocorax pelagicus*) (van Tets 1959). Vermeer (1973) reported that 52 of 56 colonies (92.9%) in the Canadian Prairie Provinces (Alberta, Saskatchewan, and Manitoba) from 1967 to 1972 were on islands in lakes, with the remainder near lakes and ponds. Most colonies (87.5%) were on the ground, the remainder in trees. At three of the six arboreal colonies in the Prairie Provinces, the cormorants had Great Blue Herons as nesting associates. At all the island colonies, the cormorants nested with one or more species of gulls (California, Herring, or Ring-billed), and were frequently found nesting with White Pelicans, Common Terns, or Caspian Terns (Vermeer 1973).

Birds breeding in Florida nest in a variety of situations, but mainly in elevated sites. Nests on dredge-spoil islands are usually found high in mature mangrove (*Avicennia germinans*) and Australian pine (*Casuarina equisetifolia*). In older, long established colonies, nests may be low, often no more than 1 m above ground. The cormorants nest in both single-species and mixed species colonies; in the latter their nesting associates are frequently Brown Pelicans, Anhingas, and Great Blue Herons (Schreiber and Schreiber 1978).

Palmer (1962) reported that colony size ranged from a single pair (rarely) to 3,500 pairs or more. More detailed information is provided by several recent papers. Vermeer (1973) reported that 56 colonies in the Canadian Prairie Provinces in 1967-72 ranged from 2 to 1,010 pairs (mean = 114). Slightly over two-thirds of 30 colonies examined in Nova Scotia in 1971 held 200 pairs or less (Lock and Ross 1973); the smallest contained 8 pairs, the largest 470 to 500 pairs. Maine colonies contained an average of 149 pairs (n = 103) in 1977 (Korschgren 1979). The smallest contained only one pair, the largest about 650 pairs.

Feeding According to Palmer (1962), Double-crested Cormorants prefer to feed in moderately shallow water (usually less than 5 fathoms) in areas of shoal water over rocks or gravel; they sometimes fish in deeper water to perhaps as much as 12 fathoms. Those at Mandarte Island, British Columbia, chose to feed either alone or in flocks in muddy bays and estuaries. They occasionally fed in open water with gulls and Brandt's Cormorants (*Phalacrocorax penicillatus*) (van Tets 1959). Birds on the Atlantic coast of Florida feed in intracoastal waterways and inshore waters. Only rarely are they encounted far offshore (Kale 1979 ms a).

Nonbreeding and Offshore Along south Atlantic and Gulf shores, Double-crested Cormorants are found in rivers and sounds, coastal bays and lagoons, lakes, ponds, and estuaries (Pearson et al. 1942, Sprunt 1954, Blacklock 1978 ms, Kale 1979 ms a). These cormorants are seldom seen far offshore. Indeed, their adherence to the coastline is so pronounced that Brown et. al. (1975) did not map their occurrence in waters offshore of eastern Canada because so few had been seen. Buhrman and Hopkins (1978) noted exceptional instances in which birds were seen from 23 to 51 mi out in the Gulf of Mexico.

FOOD AND FEEDING BEHAVIOR

Double-crested Cormorants feed primarily on fish, but also eat small amounts of crustaceans, amphibians, aquatic insects, and plants, as well as a few other items (Palmer 1962). Palmer (1962) presented an exhaustive summary of foods eaten based on the literature and on the files of the U.S. Fish and Wildlife Service; a brief abstract of his summary is given in the following paragraph.

Along the southern Atlantic and Gulf coasts, Double-crested Cormorants fed on sea catfish (*Galeichthys felis*), gizzard shad (*Dorosoma cepedianum*), herring (*Clupea*), toadfish (*Opsanus tau*), skipjack, and eels. Frogs and shrimp (*Palemonetes vulgaris*) were also eaten in South Carolina. Birds of the Florida race also fed largely on fish, including those listed above and sunfish (*Lepomis*), black bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), pigfish (*Orthopristes* [*chrysoptera*]), spot (*Leiostomus xanthurus*), filefish, and mullet (*Mugil cephalus*). Young in North Carolina were largely fed eels and in one instance were fed a water snake (*Natrix taxispilota*).

Palmer (1962) should be consulted for a detailed summary of early reports on food habits in other areas. A brief summary of information on the diet is given by area below:

Mandarte Island, British Columbia Van Tets (1959) briefly listed species of fish regurgitated by young in 1957 and 1958. These included three-spined sticklebacks (*Gasterosteus aculeatus*), saddled blenny (*Pholis ornatus*), crescent blenny or gunnel (*Pholis laeta*), pen-point gunnel (*Apodichthys flavidus*), eel blenny (*Lumpenus anguillaris*), and cabezon (*Leptocottus armatus*). A later (1969-71), more elaborate study by Robertson (1974) revealed that the primary food of the young consisted of five species that together accounted for 94.1% of the individual food items and 86.9% of the diet by weight. These species were penpoint gunnel (35.7% by weight), shiner seaperch (*Cymatogaster aggregata*, 20.5%), crescent gunnel (15.9%), snake prickleback (*Lumpenus sagitta*, 10.2%), and Pacific sandlance (*Ammodytes hexapterus*, 4.6%).

Lake Newell, Alberta Examination of regurgitations collected in 1968 showed that the diet consisted mostly of northern pike (*Esox lucius*) and common whitefish (*Coregonus clupeaformis*) (Vermeer 1969b).

Lake Winnepegosis, Manitoba McLeod and Bondar (1953) examined regurgitations left by adults at breeding colonies and determined that the three

most important food fish were tullibee (Leucichthys), that composed 55.7% of the material by weight, yellow perch (31.3%), and pickerel (Stizostedion vitreum, 6.5%). Smaller amounts of darters (Boleosoma nigrum), suckers (Catastomus commersoni), marias (Lota lota), stickleback (Eucalia inconstans), goldeyes (Amphiodon alosoides), minnows, and crayfish (Cambarus) were also eaten.

Utah Lake, Utah During studies conducted in 1973, Mitchell (1977) found that young were fed on food items ranging in size from 3-22 cm. According to Mitchell, three of the species eaten, goldfish (Carassius auratus), white bass (Roccus chrysops), and Utah chub (Gila atraria), had not previously recorded as prey of the Double-crested Cormorant.

Halifax County, Nova Scotia In 1971, Ross (1977) investigated food habits of young cormorants in Nova Scotia; he based his study largely on an examination of regurgitated pellets and to a lesser extent on regurgitated fish. Examination of pellets revealed that four species of fish, pollock (Pollachius virens, 30.5%), wrymouth (Cryptacanthodes maculatus, 23.3%), short-horned sculpin (Myoxocephalus scorpius, 17.5%), and cunner (Tautogolabrus adspersus, 14.7%) were most frequently eaten; these figures exclude "small gadoids" that could not be identified to species because of their size, but which were thought to be gadid fry; they made up a large proportion of all fish eaten. Examination of regurgitated fish revealed that the data derived from pellets were underestimating the quantity of rock gunnel (Pholis gunnellus) taken; these made up 48.4% of the regurgitated fish and led Ross to conclude that this item of prey represented from 25-50% of the diet.

Muscongus Bay, Maine Observations made in 1966 and 1967 indicated that the primary fish eaten were cunner, rock gunnel, and American eel (Anguilla rostrata). Some sculpin (Myoxocephalus) and flatfish also were taken (Kury 1969).

Isle of Shoals, New Hampshire Dunn (1975a) examined regurgitated fish fed to young at Duck Rock in 1972. She found that many of the fish that were important in Nova Scotia were also important in New Hampshire, but that the frequency with which various species were taken was different. Species taken were cunner (47%), winter flounder (Pseudopleuronectes americanus, 29%), American eel (Anguilla rostrata, 12%), mummichog (Fundulus heteroclitus, 12%), grubby (Myoxocephalus aenaeus, 6%), rock gunnel (6%), and pollock (6%). The first two species listed accounted for 75.2% of the diet by weight.

South Florida Owre (1967) reported that cormorants in South Florida fed almost exclusively on fish. He examined three stomachs collected in fresh water and nine from marine waters. The former contained the partly digested remains of centrarchids, a large catfish (Ameiurus ?), and a large spotted gar (Lepisosteus platyrhincus); the latter mostly contained toadfish (Opsansus beta), a few ariids (Bagre marina), scarids (Sparisoma), and some eel-like fishes thought to be Myrichthys acuminatus. Three crabs (Pitho anisodon) were also found; Owre noted that they could have been digested out from fish stomachs but suggested that their condition indicated they had been intentionally ingested.

Double-crested Cormorants feed primarily by diving from the surface and

pursuing their prey underwater, using their feet for propulsion. At other times, particularly in marine waters, they search along the bottom for prey (Owre 1967, Ross 1977). Prey is seized in the mandibles and then brought to the surface where it is swallowed (Owre 1967). Dives usually last about 30 seconds but have lasted as long as 70 seconds (Palmer 1962). Some recent observations of Nova Scotian birds agree closely with Palmer's remark. Ross (1977) reported that 86 dives lasted a mean of 25.1 seconds and that 25 dives averaged 4.7 m (range = 1.5-7.9). These cormorants usually feed in groups ranging from a few birds to concentrations of as many as 1,900. Small flocks are more common. Feeding in large colonies may occur throughout the day, but most occurs in early forenoon and early afternoon (Palmer 1962). Details regarding cooperative feeding behavior may be found in Palmer (1962).

According to Palmer (1962), one of the nesting requirements for this species is an adequate food supply within a fairly short (ca. 5-10 mi) foraging range from the colony. Wehle (1978) noted that breeding birds at Ugaiushak Island, Alaska, foraged within 3 km of the colony.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Throughout its range, the Double-crested Cormorant may lay from as early as late December to as late as late October. Most egg laying occurs from April through June, with the bulk laid within 2 weeks of the laying of the first egg in a colony (Palmer 1962). Laying period may vary within and between colonies, may differ from year to year, can change as a result of annual differences in weather conditions, and may vary in relation to the age of the colony and the age of the birds breeding in it (Palmer 1962). An examination of egg dates summarized by Palmer (1962) indicates that the southernmost populations lay earlier. Birds in Baja California may lay in mid-January, and those in Florida are known to have laid as early as late December; those in California and Oregon apparently typically begin laying in early April (Palmer 1962), while those at Utah Lake laid from late March to late May in 1973 (Mitchell 1977). Laying was initiated in late April in 1969 at Cypress Lake, Saskatchewan (Vermeer 1970c), and in both 1968 and 1969 at Lake Newell, Alberta (Vermeer 1970a). Two studies at Mandarte Island, British Columbia, reported peak laying in late May in 1957 and 1958 (van Tets 1959) and in late April and mid-May in 1959 (Drent et al. 1964). First clutches were laid in late May and early June at Ugaiushak Island, Alaska, in 1977 (Wehle 1978).

Mean Clutch Size Palmer (1962), who summarized reports by earlier authors, stated that Double-crested Cormorants usually lay clutches of three or four eggs but noted that as few as two and as many as nine had been recorded. More recent studies list mean clutch sizes ranging from 2.7 (n = 21) in 1977 at Ugaiushak Island, Alaska (Wehle 1978), to 4.21 (n = 19) in 1972 at Utah Lake, Utah (Mitchell 1977). For a combined sample of 308 clutches, clutch size ranged from one in Alaska (Wehle 1978) and Alberta (Vermeer 1969b) to six at Utah Lake. The modal clutch size was two in Alaska but four in Utah and Alberta.

Incubation Period Incubation usually begins with the third egg of a

clutch but may begin earlier (Palmer 1962); consequently, the incubation period may vary with the position of the egg in the clutch. In a study conducted at Mandarte Island, British Columbia, Drent et al. (1964) found that 15 first eggs had a mean incubation period of 29.9 days (range = 28-32) and 19 second eggs had a mean incubation period of 28.4 days (range = 27-33). Sixteen third eggs required an average of 27.9 days (range = 25-31). For an overall sample of 55 eggs, the mean was 28.7 days. Van Tets (in Palmer 1962) also reported a mean of about 28 days (mean = 27.7, n = 27, range = 25-29) for birds at Mandarte Island, as did Mitchell (1977) for birds at Utah Lake (n = 16, range = 26-30). Birds in Maine reportedly had a shorter incubation period (24.5-25 days) (Mendall 1936b), but these figures were based on a very small sample (n = 3) and may not adequately reflect incubation periods in that area.

Hatching Success Expressed as a proportion of eggs laid, hatching success at Mandarte Island ranged from 54.4% (n = 147) in 1957 to 67.5% (n = 126) in 1958 (Drent et al. 1964). Similar results were obtained at Utah Lake, Utah, by Mitchell (1977). There, hatching success ranged from 54.0% (n = 215) in 1973 to 55.0% (n = 80) in 1972. A considerably lower figure, 35.7% (n = 42), was obtained at Ugaiushak Island in 1977 (Wehle 1978).

Fledging Success Double-crested Cormorants fledged 1.9 young per nest (n = 148) at Newell Lake, Alberta, in 1967 (Vermeer 1969a). This would be about 59% if expressed as percent of eggs laid. The number of eggs laid (calculated as 473 from Table 3 in Vermeer 1969a) probably underestimated the true number laid because Vermeer indicated that some may have been lost to predation; consequently, the percentage figure calculated above is probably an overestimate.

For Double-crested Cormorants, as for White Pelicans, fledging success is often expressed as the number of young fledged per nest begun or the number of young fledged per nest with eggs. Van Tets (1959) reported a figure of 2.4 birds for 34 nests observed, 1957-58, at Mandarte Island, and Wehle (1978) gave a figure of 1.43 young fledged per nest with eggs for Ugaiushak Island.

Age at Fledging Young leave the nest at 3 to 4 weeks and shortly thereafter form into small groups. Age of first flight is about 5 to 6 weeks and young can fly from the water at 7 weeks. Full independence from the parents is not reached until 10 weeks (Palmer 1962). Mitchell (1977) recently gave more detailed information on the age at which young leave the nest. At a colony at Geneva, Utah, the mean age of departure from the nest was 29 days, the range 21-37 days.

Age at First Breeding Double-crested Cormorants usually breed at 3 years of age but occasionally breed successfully a year earlier; some may breed before full adult plumage is attained (van Tets in Palmer 1962).

Mortality of Eggs and Young Avian predation of eggs and young is often a major cause of nest failure in Double-crested Cormorant colonies either by itself or in relation to disturbance of nesting birds. In 1958-59 at Mandarte Island, most nest failure was attributed to egg predation by the Northwestern Crow (*Corvus caurinus*); loss of eggs to gulls was nil (Drent et al. 1964).

In contrast, chicks up to 1 week old suffered severe predation from gulls (van Tets 1959). Mitchell (1977) summarized earlier accounts of predation and listed reports of predation on eggs and young by Great Black-backed, Ring-billed, Herring, and California gulls; American Crows (Corvus brachyrhynchos) and Northern Ravens (Corvus corax) have also been recorded taking eggs and young, but Mitchell found no record of any instances of documented mammalian predation.

Human disturbance and its effects may often be a major cause of nest loss. Schreiber and Schreiber (1978) reported that Florida birds were highly susceptible to disturbance. Eggs were lost when fleeing adults dislodged them from their nests or when Fish Crows (Corvus ossifragus) took eggs from the temporarily unprotected nests. Grant (1970) suggested that Fish Crow predation was the primary factor in the decline in the North Carolina breeding population; judging from his account, this predation resulted from human disturbance of the colony. Kury and Gochfeld (1975) and Ellison and Cleary (1978), among others, have commented at length on the adverse affects of human disturbance on Double-crested Cormorant colonies.

Renesting Replacement of lost clutches is fairly common in this species. An example of the extent to which Double-crested Cormorants may replace lost nests is provided by McLeod and Bondar (1953) from studies conducted in Manitoba. At one colony in which 1,617 nests with eggs, young, or both were all destroyed, a subsequent visit revealed the presence of 643 (40%) rebuilt nests with eggs. Double-crested Cormorants may exhibit considerable persistence in their renesting attempts. At Mandarte Island, British Columbia, renesting attempts were made at 29 of 33 (87.8%) nests where there was repeated loss of eggs because of predation and human disturbance (van Tets 1959). More remarkably, renesting attempts were made five or more times at nearly a third (10) of these nests. One bird even tried to replace a clutch eight times. At this locality, the interval between loss of eggs and beginning of a new clutch averaged 13 days, with extremes of 7-8 days and 19-21 days (Drent et al. 1964).

Although Palmer (1962) indicated that this species is single-brooded, Drent et al. (1964) noted an instance in which a pair at Mandarte Island produced a second clutch after successfully fledging young in an earlier nesting attempt; they concluded that in British Columbia the Double-crested Cormorant is at least potentially double-brooded. The species usually lays only one clutch, however, and apparently does not replace the clutch unless all eggs are lost (Mitchell 1977).

After loss of a colony either to deterioration of the environment or to various forms of human disturbance, these cormorants may subsequently re-establish themselves elsewhere but alternatively may vanish for good. Vermeer (1973) noted that many such replacement colonies were often located within 10 mi of the original site.

Maximum Natural Longevity Although Double-crested Cormorants have reportedly lived to 23 years of age (Cadbury 1966), an examination of the data on which this record is based at the Bird-Banding Laboratory led Clapp et al. (1979 ms) to regard it as probably invalid. Although the record is as yet not fully validated, the oldest Double-crested Cormorant is apparently a bird

that attained an estimated minimum age of 17 years, 3 months (Clapp et al. 1979 ms).

Average annual mortality after the first year has been estimated at about 22-25% (Hickey 1952 in Palmer 1962).

Weight (in grams) Our data on the weights of Double-crested Cormorants are given in Table 45.

Table 45. Weights of Double-crested Cormorants (in grams).

Mean Weight	Range	N	Sample and season	Area	Source
2,415	1,986-2,807	12	males, May	Minnesota	Marshall and Erickson 1945
2,553	----------	2	males	Utah	Mitchell 1977
1,758	1,327-2,079	6	males	S. Florida	Owre 1967
2,233	2,072-2,566	10	adult males, July	Maine	Kury 1968
2,287	1,758-2,948	3	females, May	Minnesota	Marshall and Erickson 1945
2,247	----------	2	females	Utah	Mitchell 1977
1,535	1,391-1,665	5	females	S. Florida	Owre 1967
1,861	1,732-2,026	12	adult females, July	Maine	Kury 1968
36	----------	16	just hatched young	Utah	Mitchell 1977
32.2	30.1-37.5	15	just hatched young	Maine	Mendall 1936b
34.1	27.1-41.1	52 (a)	just hatched young	New Hampshire	Dunn 1975b
46.9	----------	12	fresh eggs	Gulf of St. Lawrence	Lewis 1929

(a) Figures listed are the mean ± 2 SD.

SUSCEPTIBILITY TO OIL POLLUTION

These cormorants have been victims of oil pollution both in the southeastern United States and elsewhere. Oiled Double-crested Cormorants were found following the Santa Barbara spill in March 1969; how many were affected is not known, but fewer than 5% of those cleansed survived (Holmes and Cronshaw 1977). Ten died from oiling following the Chesapeake Bay, Virginia, spill in February 1976, but this represented only 0.1% of all birds killed (Roland et al. 1977). Within the southeastern United States, some were killed following the spill in Tampa Bay in early 1970; the number that died is not precisely known but was evidently small compared with numbers of other species killed (Sims 1970, Stevenson 1970).

Nonetheless, we suggest that its abundance in coastal waters as a breeder, migrant, and winter resident, its surface-swimming and diving feeding habits and preference for inshore feeding, and its documented high susceptibility to human disturbance (Ellison and Cleary 1978) will make it more likely to sustain major population losses as a result of oil development activities than most other marine birds occurring in the southeast. We suspect that adverse affects that may occur will be greater from ancillary aspects of oil development than from direct mortality as a result of exposure to oil.

BIBLIOGRAPHY

1981

Bull, J. 1981. Double-crested Cormorants breeding at Fishers Island. Kingbird 31: 83.

Couzens, D. 1981. Cormorants perching on overhead cable. Brit. Birds 74: 181.

1980

Blem, C. R., W. H. N. Gutzke and C. Filemyr. 1980. First breeding record of the Double-crested Cormorant in Virginia. Wilson Bull. 92: 127-128.

Mahoney, S. 1980. Thermal energetics of Double-crested Cormorants and Anhingas. (Abstract only). Am. Zool. 20: 734.

Siegel-Causey, D. 1980a. Progenicide in Double-crested Cormorants. Condor 82: 101.

Siegel-Causey, D. 1980b. Ethology of the defensive behaviors in five cormorants. (Abstract only). Pac. Seabird Group Bull. 7: 53.

Trout, N. 1980. Cormorant perching on electricity cable. Brit. Birds 73: 310.

1979

Morrison, M. L. 1979. The cormorants of Texas. Bull. Texas Ornithol. Soc. 12: 35-36.

Raffaele, H. A. 1979. Status of the genus Phalacrocorax in Puerto Rico including the first records of P. auritus. Auk 96: 204-206.

Roney, K. [N.]. 1979a. Saskatchewan's pelicans and cormorants in 1978. Blue Jay 37: 216-218.

1978

Benz, C. and R. Garrett. 1978. Colony development and nesting behavior of Double-crested and Pelagic cormorants. (Abstract only). Pac. Seabird Group Bull. 5: 82.

Ellison, L. N. and L. Cleary. 1978. Effects of human disturbance on breeding of Double-crested Cormorants. Auk 95: 510-517.

Holm, S. F., H. D. Irby and J. M. Inglis. 1978. First nesting record of Double-crested Cormorant in Texas since 1939. Bull. Texas Ornithol. Soc. 11: 50-51.

Roney, K. 1978. Pelicans, cormorants and Great Blue Herons in Saskatchewan in 1976. Blue Jay 36: 28-35.

Siegel-Causey, D. 1978. Seasonal colony growth in cormorants. (Abstract only). Pac. Seabird Group Bull. 5: 83.

Thompson, D. H. 1978. Declines in populations of colonial waterbirds nesting within the floodplain of the upper Mississippi River. Pp. 26-37 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, DeKalb, IL, 20-23 October 1977. viii and 205 pp.

Weseloh, D. V., S. Brechtel and R. D. Burns. 1978. Recent population changes in Double-crested Cormorants and California and Ring-billed gulls in Alberta, Canada, with a note on White Pelicans. Pp. 10-18 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, DeKalb, IL, 20-23 October 1977. viii and 205 pp.

1977

Mitchell, R. M. 1977. Breeding biology of the Double-crested Cormorant on Utah Lake. Great Basin Nat. 37: 1-23.

Onuf, C. P., J. M. Teal and I. Valiela. 1977. Interactions of nutrients, plant growth and herbivory in a mangrove ecosystem. Ecology 58: 514-526.

Ross, R. K. 1977. A comparison of the feeding and nesting requirements of the Great Cormorant (Phalacrocorax carbo L.) and the Double-crested Cormorant (P. auritus Lesson) in Nova Scotia. Proc. Nova Scotia Instit. Sci. 1974-1976, Vol. 27: 114-132.

Vermeer, K. and D. B. Peakall. 1977. Toxic chemicals in Canadian fish-eating birds. Mar. Pollut. Bull. 8: 205-210.

1976

Dunn, E. H. 1976. Development of endothermy and existence energy expenditure of nestling Double-crested Cormorants. Condor 78: 350-356.

Zitko, V. 1976. Levels of chlorinated hydrocarbons in eggs of Double-crested Cormorants from 1971 to 1975. Bull. Contam. Toxicol. 16: 399-405.

1975

Dunn, E. H. 1975a. Caloric intake of nestling Double-crested Cormorants. Auk 92: 553-565.

Dunn, E. H. 1975b. Growth, body components and energy content of nestling Double-crested Cormorants. Condor 77: 431-438.

Kury, C. R. and M. Gochfeld. 1975. Human interference and gull predation in cormorant colonies. Biol. Conserv. 8: 23-34.

Mitchell, R. M. 1975. The current status of the Double-crested Cormorant in Utah: a plea for protection. Am. Birds 29: 927-930.

1974

Maxwell, G. R., II and H. W. Kale, II. 1974. Population estimate of breeding birds on a spoil island in the Indian River, Indian River County, Florida. Fla. Field Nat. 2: 32-39.

Potter, J. and E. F. Potter. 1974. Third sight record of Great Cormorant from North Carolina. Chat 38: 22-23.

Robertson, I. 1974. Food of nesting Double-crested and Pelagic cormorants at Mandarte Island, British Columbia, with notes on feeding ecology. Condor 76: 346-348.

1973

Bicknell, E. J., A. Greichus, Y. A. Greichus, R. J. Bury and W. U. Knudtson. 1973. Diagnosis and treatment of aspergillosis in captive cormorants. Sabouraudia 9: 119-122.

Casler, C. L. 1973. The air-sac systems and buoyancy of the Anhinga and Double-crested Cormorant. Auk 90: 324-340.

Dunn, E. H. 1973. Energy allocation of nestling Double-crested Cormorants. Ph. D. thesis, Univ. Michigan/Ann Arbor, MI. 153 pp.

Greichus, A. and Y. A. Greichus. 1973. Some factors affecting the nesting success of pelicans and cormorants in South Dakota. Proc. S. Dak. Acad. Sci. 52: 241-247.

Gress, F., R. W. Risebrough, D. W. Anderson, L. F. Kiff and J. R. Jehl, Jr. 1973. Reproductive failures of Double-crested Cormorants in southern California and Baja California. Wilson Bull. 85: 197-208.

Lock, A. R. and R. K. Ross. 1973. The nesting of the Great Cormorant (Phalacrocorax carbo) and the Double-crested Cormorant (Phalacrocorax auritus) in Nova Scotia in 1971. Can. Field Nat. 87: 43-49.

Stunkard, H. W. and A. C. Olsen. 1973. The Double-crested Cormorant, Phalacrocorax auritus, natural host of Neogogatea kentuckiensis (Cable 1935) Hoffman and Dunbar 1963. J. Parasitol. 58: 634-635.

Vermeer, K. 1973. Great Blue Heron and Double-crested Cormorant colonies in the Prairie Provinces. Can. Field Nat. 87: 427-432.

1972

DeLaRonde, G. G., II and Y. A. Greichus. 1972. Care and behavior of penned Double-crested Cormorants. Auk 89: 644-650.

Erskine, A. J. 1972. The Great Cormorants of Eastern Canada. Can. Wildl. Serv. Occas. Pap. 14. 23 pp.

Hall, J. L. 1972. Double-crested Cormorant in western North Carolina. Chat 36: 106.

Pense, D. B. and G. E. Childs. 1972. Pathology of Amphimerus elongatus (Digenea: Opisthorchiidae) in the liver of the Double-crested Cormorant. J. Wildl. Dis. 8: 221-224.

Meyerriecks, A. J. 1972. Tool-using by a Double-crested Cormorant. Wilson Bull. 84: 482-483.

Rhan, H. 1972. Egg shell porosity and gas conductance differences in a precocial chicken and an altricial bird (Double-crested Cormorant Phalacrocorax auritus). Bull. Mt. Desert Isl. Biol. Lab. 12: 79-80.

1971

Houston, C. S. 1971. Recent Saskatchewan banding of the Double-crested Cormorant. Blue-Jay 29: 74-79.

1970

Grant, G. S. 1970. Decline of the Double-crested Cormorant as a breeding bird in North Carolina. Chat 34: 34-36.

Kury, C. P. and J. M. Cadbury. 1970. The winter distribution of Maine's Double-crested Cormorants. Auk 87: 815.

Vermeer, K. 1970a. Arrival and clutch initiation of Double-crested Cormorants at Lake Newell, Alberta. Blue Jay 28: 124-125.

Vermeer, K. 1970b. Colonies of Double-crested Cormorants and White Pelicans in Saskatchewan. Can. Field Nat. 84: 39-42.

Vermeer, K. 1970c. Some aspects of the nesting of Double-crested Cormorants at Cypress Lake, Saskatchewan, in 1969; a plea for protection. Blue Jay 28: 11-13.

1969

Anderson, D. W., R. W. Risebrough, D. F. Hughes and R. E. Christenson. 1969. Significance of chlorinated hydrocarbon residues to breeding pelicans and cormorants. Can. Field Nat. 83: 93-112.

Drewien, R. C. and L. F. Fredrickson. 1969. Band recovery distribution of Double-crested Cormorants from South Waubay Lake. S. Dak. Bird Notes 21: 28-32.

Kury, C. R. 1969. Pesticide residues in a marine population of Double-crested Cormorants. J. Wildl. Manage. 33: 91-95.

Lasiewski, R. C. and G. K. Snyder. 1969. Responses to high temperature in nestling Double-crested and Pelagic cormorants. Auk 86: 529-540.

Vermeer, K. 1969a. Colonies of Double-crested Cormorants and White Pelicans in Alberta. Can. Field Nat. 83: 365-369.

Vermeer, K. 1969b. Some aspects of the breeding chronology of Double-crested Cormorants at Lake Newell, Alberta, in 1968. Murrelet 50: 19-20.

Vermeer, K. 1969c. The present status of Double-crested Cormorant colonies in Manitoba. Blue Jay 27: 217-220.

1968

Bartholomew, G. A., R. C. Lasiewski and E. C. Crawford, Jr. 1968. Patterns of panting and gular flutter in cormorants, pelicans, owls, and doves. Condor 70: 31-34.

Cline, D. R. and E. Dornfeld. 1968. The Agassiz Refuge cormorant colony. Loon 40: 68-72.

Hanson, W. C. 1968. Recent history of Double-crested Cormorant colonies in southeastern Washington. Murrelet 49: 25-26.

Kury, C. R. 1968. Difference in weight of male and female cormorants. Auk 85: 513.

1967

Anderson, D. W. and F. Hamerstrom. 1967. The recent status of Wisconsin cormorants. Passenger Pigeon 29: 3-15.

Owre, O. T. 1967. Adaptations for locomotion and feeding in the Anhinga and the Double-crested Cormorant. A.O.U. Ornithol. Monogr. No. 6. 138 pp.

1966

Anderson, D. W. and J. W. Ellis. 1966. Cormorant nesting in northwestern Minnesota. Loon 38: 5-8.

Cadbury, J. M. 1966. 23-year-old cormorant. EBBA News 29: 18.

Carson, R. D. 1966. Destruction of colonial birds on an island on Suggi Lake. Blue Jay 24: 96-97.

1964

Drent, R., G. F. van Tets, F. Tompa and K. Vermeer. 1964. The breeding birds of Mandarte Island, British Columbia. Can. Field Nat. 78: 208-263.

Tomkins, I. R. 1964. A specimen of Florida Cormorant from Tybee Island. Oriole 29: 17-18.

1959

Nisbet, I. C. T. and J. Baird. 1959. The autumn migration of the Double-crested Cormorant through eastern New England. Mass. Audubon Bull. 43: 224-227.

van Tets, G. F. 1959. A comparative study of the reproductive behaviour and natural history of three sympatric species of cormorants, (*Phalacrocorax auritus*, *P. penicillatus*, and *P. pelagicus*) at Mandarte Island, B.C. M. S. thesis, Univ. Brit. Columbia/Vancouver, BC. vi and 86 pp.

Williamson, F. S. L. and L. J. Peyton. 1959. Breeding record of the Double-crested Cormorant in south-central Alaska. Condor 61: 154-155.

1953

McLeod, J. A. and G. F. Bondar. 1953. A brief study of the Double-crested Cormorant on Lake Winnepegosis. Can. Field Nat. 67: 1-11.

1951

Gross, A. O. 1951. The Herring Gull-cormorant control project. Proc. Xth Internatl. Ornithol. Congr.: 532-536.

Trautman, C. G. 1951. Food habits of the Double-crested Cormorant. S. Dak. Conserv. Digest 18: 3-5.

1950

Clark, C. F. and G. W. Reed. 1950. Nesting of the Double-crested Cormorant in Gogebic County, Michigan. Jack-Pine Warbler 28: 24-25.

Scattergood, L. W. 1950. Observations on the food habits of the Double-crested Cormorant, Phalacrocorax a. auritus. Auk 67: 506-508.

1949

Lundquist, A. R. 1949. The Waubay Lake colonies of Double-crested Cormorant. S. Dak. Bird Notes 1: 8-10.

1948

Collister, Ms. C. N. 1948. Nesting of the Double-crested Cormorant in Nebraska. Nebr. Bird Rev. 16: 22-26.

Johnston, D. W. 1948. First occurrence of the Florida Cormorant in Georgia. Oriole 13: 33.

Manville, R. H. 1948. The Huron Island rookery. Jack-Pine Warbler 26: 152-155.

1947

Baillie, J. L., Jr. 1947. The Double-crested Cormorant nesting in Ontario. Can. Field Nat. 61: 119-126.

Kutz, H. L. and D. G. Allen. 1947. Double-crested Cormorant nesting in New York. Auk 64: 137.

Omand, D. N. 1947. The cormorant in Ontario. Sylva 3: 18-23.

1946

Baldwin, W. P. 1946. An unusual bird fatality. Auk 63: 96.

Jones, F. M. 1946. Double-crested Cormorants caught in fykes. Auk 63: 592.

Russel, J. 1946. Flight speed of the Florida Cormorant. Fla. Nat. 19: 66.

1945

Burnett, F. L. 1945. Double-crested Cormorants nest off Manchester, Massachusetts. Bull. Mass. Audubon Soc. 29: 205-207.

1944

Buchheister, C. W. 1944. The comeback of the cormorants. Audubon Mag. 46: 15-25.

Gross, A. O. 1944. The present status of the Double-crested Cormorant on the coast of Maine. Auk 61: 513-537.

1943

Bartholomew, G. A., Jr. 1943a. The daily movements of cormorants on San Francisco Bay. Condor 45: 3-18.

Bartholomew, G. A., Jr. 1943b. Contests of Double-crested Cormorants for perching sites. Condor 45: 186-195.

Gross, A. O. 1943. The Double-crested Cormorant on the coast of Maine. Bull. Mass. Audubon Soc. 27: 227-231.

1942

Bartholomew, G. A., Jr. 1942. The fishing activities of Double-crested Cormorants on San Francisco Bay. Condor 44: 13-21.

Peters, H. S. 1942. Cormorants found breeding on Prince Edward Island, Canada. Auk 59: 100.

1941

Behle, W. H. 1941. Additional data concerning the subspecific status of the cormorants of Great Salt Lake. Condor 43: 286-289.

Hagar, J. A. 1941. Double-crested Cormorant breeding in Massachusetts. Auk 58: 567-568.

1940

Mendall, H. L. 1940. Observations of the Double-crested Cormorant (*Phalacrocorax auritus auritus*). Bull. Mass. Audubon Soc. 24: 47-50.

1937

Marshall, W. H. 1937. Double-crested Cormorant nesting on the Bear River Refuge in Utah. Condor 39: 36.

Stanford, J. S. 1937. Cormorant and heron colonies in Cache Valley, Utah. Proc. Utah Acad. Sci. Arts Lett. 14: 195.

1936

Behle, W. H. 1936. Status of the cormorants of Great Salt Lake. Condor 38: 76-79.

Mendall, H. L. 1936a. Nest-building instinct in an immature Double-crested Cormorant (Phalacrocorax auritus auritus). Auk 53: 202-203.

Mendall, H. L. 1936b. Home life and status of the Double-crested Cormorant (Phalacrocorax auritus auritus Lesson). Maine Bull. 39. v and 159 pp.

Munro, J. A. 1936. Nesting colonies of the Double-crested Cormorant in British Columbia. Brit. Col. Prov. Mus. Rept. 1936: 26-30.

1935

Barker, B. 1935. Second laying of cormorants. Oologist 52: 120.

Perkins, S. E. 1935. Double-crested Cormorants breeding in Posey County, Indiana. Auk 52: 74-75.

Wood, H. B. 1935. Double-crested Cormorants at Harrisburg, Penna. Auk 52: 300-301.

1934

DuMont, P. 1934. The Double-crested Cormorant nesting in southeastern Iowa. Auk 51: 509-510.

Marsh, V. L. 1934. The nesting of the Double-crested Cormorant at Lake Bowdoin, Montana. Condor 36: 219-220.

1932

Lundquist, A. 1932. The cormorants of South Dakota. Wilson Bull. 44: 227-230.

1931

Lewis, H. F. 1931. Additional information concerning the Double-crested Cormorant (Phalacrocorax auritus auritus [Lesson]). Auk 48: 207-214.

Norton, A. H. and R. P. Allen. 1931. Breeding of the Great Black-backed Gull and Double-crested Cormorant in Maine. Auk 48: 589-592.

1929

Fargo, W. G. 1929. The Florida Cormorant as observed in Pinellas County, Florida. Wilson Bull. 41: 228-235.

Lewis, H. F. 1929. The Natural History of the Double-crested Cormorant (Phalacrocorax auritus auritus (Lesson)). Ru-Mi-Lou Books, Ottawa. 94 pp.

Skinner, M. P. 1929. Double-crested Cormorant in Yellowstone National Park. Condor 31: 128.

1928

McCrimmon, A. R. 1928. Phalacrocorax a. albociliatus in Colorado. Auk 45: 368.

1927

Munro, J. A. 1927. Observations on the Double-crested Cormorant (Phalacrocorax auritus) on Lake Manitoba. Can. Field Nat. 41: 102-108.

1926

Bagg, A. C. 1926. Double-crested Cormorants in the Connecticut Valley in fall. Auk 43: 88-89.

1925

Bagg, A. C. 1925. Double-crested Cormorant in the Connecticut Valley. Auk 42: 578.

Uhler, F. M. 1925 ms. Report on the economic status of the Double-crested Cormorant (Phalacrocorax auritus auritus) and other fish-eating birds in Minnesota and North Dakota. Rept. to Chief, Bureau Biol. Survey, Washington, D.C.

1923

Bedell, E. 1923. Double-crested Cormorant at Waterford, N.Y. Auk 40: 317.

1921

Magee, M. J. 1921. Double-crested Cormorant (Phalacrocorax auritus auritus) in Ontario. Auk 38: 597.

1915

Taverner, P. A. 1915. The Double-crested Cormorant (Phalacrocorax auritus) and its relation to the salmon industries on the Gulf of St. Lawrence. Can. Geolog. Surv. Mus. Bull. 13: 1-24.

1913

McGrath, L. W. 1913. Contents of the stomach of Double-crested Cormorant. Bull. Charleston Mus. 9: 70-71.

1911

Smith, F. 1911. Double-crested Cormorants breeding in central Illinois. Auk 28: 16-19.

1901

Stone, W. K. 1901. Curious habit of a cormorant and removal of stones from stomach. Osprey 5: 63.

1894

MacKay, G. H. 1894. Habits of the Double-crested Cormorant (*Phalacrocorax dilophus*) in Rhode Island. Auk 11: 18-25.

1889

Goss, N. S. 1889. The Double-crested Cormorant. Trans. Kansas Acad. Sci. 11: 59-60.

OLIVACEOUS CORMORANT

(*Phalacrocorax olivaceus*)

[EN/US: Mexican Cormorant, Neotropic Cormorant, Brazilian Cormorant, Bigua Cormorant; SP: Corvejon, Cuervo de mar, Bigua]

GENERAL DISTRIBUTION

North America Olivaceous Cormorants breed and are largely resident along the Gulf Coast of the United States from southwestern Louisiana south through Texas to the lowlands of Tamaulipas, and from central Mexico south throughout southern Mexico and Central America. They also breed in the western lowlands of Mexico south from Sonora (Palmer 1962). Breeding has occurred recently in north-central Texas (Zinn 1977) and New Mexico (Hundertmark 1974). They have wandered accidentally to Colorado, central Texas, Kansas, southern Illinois (AOU 1957), and California (Jones 1971, Small 1974).

Olivaceous Cormorants also breed in the northwestern Caribbean on Cuba, the Isle of Pines, and San Salvador Island in the Bahamas (Blake 1977). They are known to wander to other islands in the Caribbean--Jamaica, Dominica (Bond 1971), and Puerto Rico (Raffaele 1979).

World Distribution Olivaceous Cormorants breed throughout South America, chiefly in the lowlands, but also to the temperate zone in the Andes. They breed on islands off northern South America (Aruba to Trinidad) as well (Blake 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

All major breeding colonies within the United States (Map 9, cf. p. 396) are found along the coasts of Texas and Louisiana, with more than three-quarters of these between Galveston Bay and Sabine Lake, Texas (Morrison 1977 ms).

Mississippi The only record for Mississippi is an immature seen and photographed by Toups and Hodges (1980) on 4 August 1979. The bird was found at Bellefontaine Beach, Jackson County, 100 mi east of the previous easternmost record in Louisiana. Olivaceous Cormorants are difficult to distinguish from Double-crested Cormorants and R. D. Slack (pers. comm.), who examined the photographs, believes this bird may have been the latter species.

Louisiana Lowery (1974) considered the Olivaceous Cormorant a fairly common permanent resident in southwestern Louisiana; breeding occurs in Cameron Parish. He knew of only two unquestionable records from elsewhere in the state, a bird seen 27 March and 4 April 1959 at New Orleans, and another seen at Baton Rouge on 20 January 1961.

Taxonomic note: Alternative names occurring in earlier scientific literature are *Phalacrocorax vigua* and *Phalacrocorax brasilianus*.

In 1976, Portnoy (1977) found seven breeding colonies in Louisiana with a total of 6,872 adult birds. Six of these colonies, containing a total of 2,872 birds, were in Cameron Parish; the remaining 4,000 birds were in a single colony in Vermillion Parish (Map 9, p. 396). All birds were nesting in freshwater habitats, with 84% in marsh and the remainder in cypress swamp.

Texas Oberholser (1974) reported that the Olivaceous Cormorant is a locally uncommon to scarce resident along the Texas coast and inland. This species was formerly much more common, with as many as 1,000 seen in one place at one time (Table 46). By 1969, however, only 409 birds could be found on the Texas coast, 400 of these on the upper coast. There were only three known breeding colonies: one on the Vingt'une Islands, Chambers County, another near Baytown, Harris County, and a third in Rosita Lake, Willacy County (Oberholser 1974). Since 1969, populations in southwestern Louisiana have been gradually increasing and those in Texas have been fluctuating at low levels (Morrison and Slack 1977a).

Most recently, breeding populations are apparently declining. Only 363 and 355 pairs were counted during the summers of 1977 and 1978 by the Texas Colonial Waterbird Census (Blacklock et al. 1979). The mean number of pairs breeding in Texas during the preceding 4 years was approximately 750; numbers varied from 380 pairs in 1974 to 1,270 pairs in 1976 (Blacklock et al. 1978 ms). From 1973 through 1976, most Olivaceous Cormorants in Texas bred along the coast, with only 0.87% (1973) to 7.41% (1974) breeding at inland localities; on the average, only 1.96% bred at inland localities during the 4 years (Blacklock et al. 1978 ms).

Olivaceous Cormorants formerly bred along most of the Texas coast (Oberholser 1974), but in recent years the breeding population was largely restricted to the upper coast (Map 9). From 1973 to 1976, an average of 99.1% of the coastal nesting birds were found in this area (Blacklock et al. 1978 ms). In 1976 there were eight known breeding localities for Olivaceous Cormorant in Texas. The four largest were: the Willie Slough Gully colony, Jefferson County, with 600 pairs; the Atkinson Island, Chambers County colony, with 250 pairs; the Sidney Island colony, Orange County, with 125 pairs; and the colony on the Vingt'une Islands, with 120 pairs (Blacklock et al. 1978 ms). Together these made up 86% of the known breeding population in Texas for that year.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Olivaceous Cormorants are widespread in neotropic areas, but within the United States they breed primarily along the coasts of Texas and Louisiana. A rough estimate of breeding birds in these states is given below:

Louisiana:	6,850 (1)	72.9%	(1976 census)
Texas	2,550	27.1%	(1976 census)
	9,400	100.0%	(Total for 1976 census)
Texas	1,500		(mean of censuses 1973-76)
Texas	1,250		(mean of censuses 1977-78)

(1) Totals rounded to nearest 50.

Winter During the winter, Olivaceous Cormorants apparently tend to congregate where conditions are particulary favorable for feeding (Table 46, Map 11). These are often areas of shallow water where many perches (e.g., dead trees, posts, pilings) are available.

Migration Olivaceous Cormorants are thought to be largely resident, but non-breeders are known to wander widely and the species may exhibit extensive post-breeding dispersal (Oberholser 1974). Young banded in Argentina tended to concentrate some 400 km from the hatching site (Olrog 1975). Virtually nothing is known about the nature and extent of this dispersal in populations breeding in the United States or elsewhere. Oberholser (1974) indicated that Olivaceous Cormorants tended to move southward in winter, but available information is largely anecdotal in nature.

Table 46. Winter concentrations of Olivaceous Cormorants recorded in Texas.

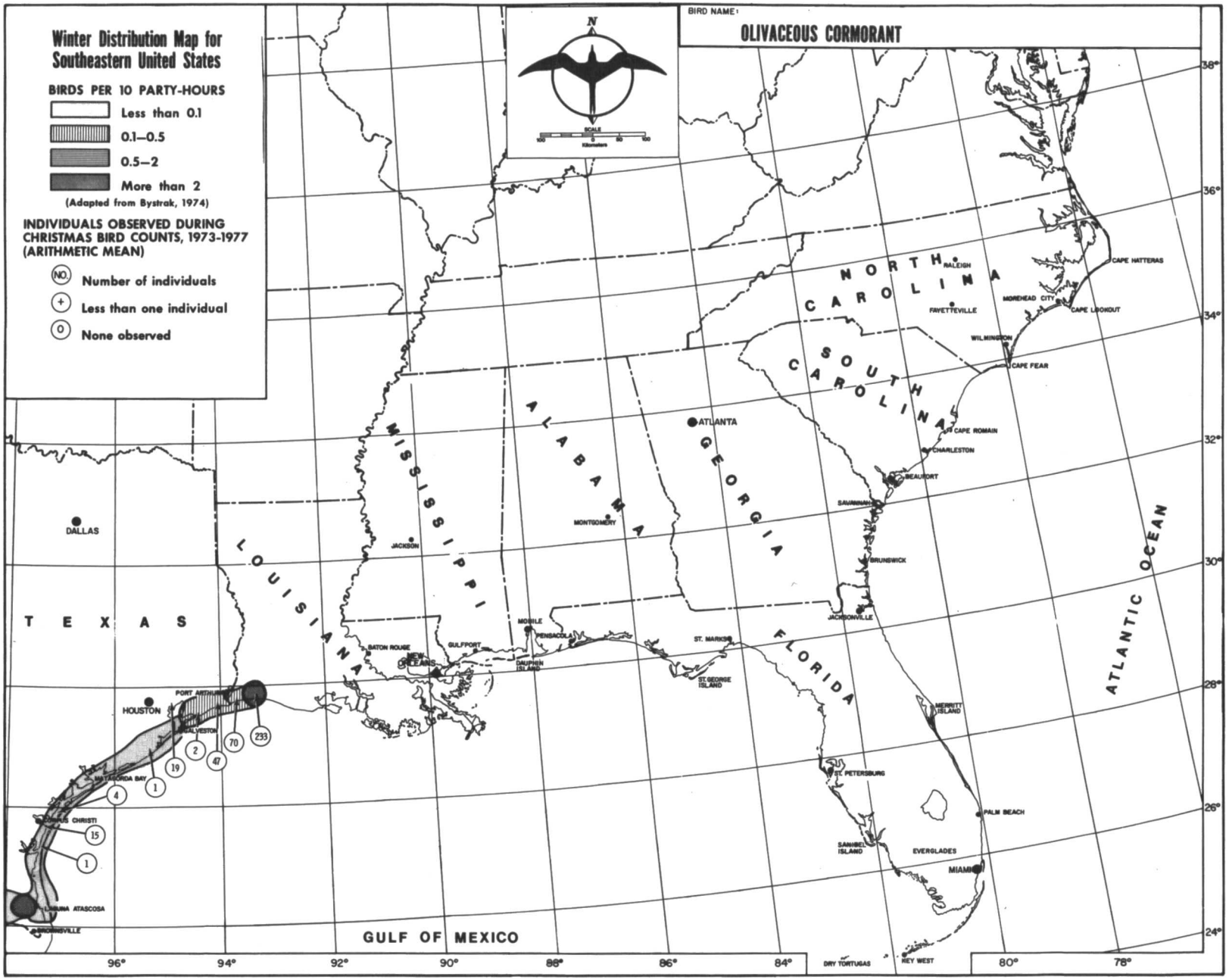
Date seen		Number seen	Locality	Source
1928	2 Feb.	123	San Antonio Bay	Oberholser 1963 ms
1932	5 Feb.	104	N shore, Matagorda Peninsula	"
1932	5 Feb.	206	E end of Matagorda Island	"
1932	6 Feb.	135	Aransas Bay	"
1933	22 Jan.	459	Laguna San Martin	"
1935	4 Jul.	300	Delta Orchards Lake	"
1936	2 Feb.	600	Laguna Atascosa	"
1936	14 Mar.	1,000	El Morro Island	"
1938	9 Jul.	135	Third Chain of Islands	"
1971	18 Dec.	ca. 150	Cove	Webster 1972b

HABITAT

Nesting Olivaceous Cormorants are colonial, predominantly tree-nesting birds that nest on freshwater lakes, ponds, and reservoirs and on coastal islands. The nest of twigs is placed on live or dead wood 3-20 ft above the water, but on the ground if tree sites are unavailable (Palmer 1962).

Feeding Coker (1919) indicated that Olivaceous Cormorants preferred fishes found inshore in shallow water rather than those from more pelagic areas. Morrison et al. (1977) reported that these cormorants at Sabine Lake fed mostly on fish that characteristically prefer protected inshore waters to open lake waters. The fishes obtained in this study were both bottom and surface feeders, but the latter predominated in terms of frequency with which they were taken and in proportion by weight of all fish taken.

In Texas, these birds feed in coastal and inland marshes, on ponds, bays, and lakes, and on power plant cooling ponds (Morrison and Slack 1977b). Oliv-


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1—0.5
0.5—2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
BIRD NAME:
OLIVACEOUS CORMORANT
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
PENSACOLA
DAUPHIN ISLAND
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
JACKSONVILLE
BRUNSWICK
SAVANNAH
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
MERRITT ISLAND
ST. PETERSBURG
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
DRY TORTUGAS
KEY WEST
233
70
47
2
19
1
4
15
1
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°

aceous Cormorants also may forage in strong surf (James in Palmer 1962), and have been reported feeding in rapids in mountain streams (Nelson 1903).

Migration, Winter and Offshore Few Olivaceous Cormorants have been banded and consequently little is known about migration and dispersal. Winter flocks usually remain on or adjacent to the feeding grounds (Morrison and Slack 1977a). As James (in Palmer 1962) pointed out, however, the presence of large aggregations of Olivaceous Cormorants at favorable localities during the nonbreeding season implies significant dispersal, and the species is known to wander considerably (Oberholser 1974). During nonbreeding periods a wide variety of habitats may be used, but areas of shallow water with large numbers of suitable perches are preferred.

FOOD AND FEEDING BEHAVIOR

From their study at Sabine Lake, Morrison et al. (1977) concluded that the Olivaceous Cormorant is a generalist in its feeding habits during the breeding season, taking the most readily available prey; that study was based on the regurgitations of young birds. They found that almost all of the food was fish, with five species (*Poecilia latapinna*, *Cyprinidon variegatus*, *Mugil cephalus*, *Micropogon undulatus*, *Gambusia affinis*) accounting for 94.3% of the diet by frequency and 82.8% by weight. Other species of fish taken were *Fundulus pulvereus*, *F. grandis*, *F. chrysotus*, *F.* sp., *Dorosoma cepedianum*, *Lepomis gulosus*, *L. macrochirus*, *L.* sp., *Lagodon rhomboides*, and *Menidia beryllina*. A few shrimp (*Penaeus* sp.)—2.2% by weight—were also taken.

James (in Palmer 1962) reported the contents of two stomachs from birds taken in August at Norias, Kenedy County, Texas. Both stomachs contained mostly fish (*Gambusia* sp.), comprising 78% and 86% of the stomachs' contents, respectively. Other food taken was frogs, tadpoles (*Rana* sp.), and dragonfly nymphs (Aeschnidae).

Olivaceous Cormorants forage by pursuit diving from the surface, using the feet for propulsion. In Texas they feed either solitarily or in small flocks, but are predominantly solitary feeders (Morrison and Slack 1977b). Flocks ranging in size from three to eight cormorants (mean = 6.1, n = 10) were seen only on shallow marsh ponds. These flocks formed only when solitary birds came upon concentrations of fish during low tide. Fish attempting to escape the single bird apparently attracted other cormorants to the scene by splashing at the surface. Morrison and Slack emphasized, however, that flock feeding is a feeding technique used relatively seldom by Olivacous Cormorants. During one 50-hour period of observation, flock feeding accounted for only 3% of total feeding time.

Morrison et al. (1978a) recorded diving times of adults and immatures at two different habitats in Texas. At a shallow (0.25-0.75 m), tidally influenced estuary on Galveston Island, diving times averaged 6.3 seconds (n = 1,348). At a deeper (0.75-2.0 m) power plant cooling pond near Baytown, diving times averaged 16.0 seconds (n = 773). The differences between the two areas was attributed to habitat differences. A significant correlation between rate of foraging success and water depth was found for both adults

and immatures; the shallower the water, the greater the foraging success. As in many other species of seabirds, immature cormorants are less successful in capturing prey than are adults (Morrison et al. 1978a).

Little information is available on foraging range, but Morrison et al. (1977) reported that most adults at the breeding colony on Sidney Island, Sabine Lake, Texas, flew 2 km to what was apparently a particularly favored foraging area.

The number of feeding periods during the day may vary from three to eight or more depending on the size of nestings and availability of food (James in Palmer 1962).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Egg laying may occur from early February to mid-October in Texas (Bent 1922, Oberholser 1974). At Sidney Island, Texas, the peak of laying in 1977 was early to mid-April (Morrison 1977 ms).

Mean Clutch Size In 75 nests at Sidney Island, Texas, clutches ranged from 1 to 5 eggs in 1976, with a mean of 2.99. At the same colony in 1977, 55 clutches ranged from 1 to 4 eggs, with a mean of 2.87; 53% of the nests held the modal clutch of 3 eggs (Morrison 1977 ms). Chaney et al. (1978) reported a mean clutch size of 3 eggs in eight nests on an island in the Trinity River Channel, Texas.

Incubation Period In the Sidney Island, Texas, colony in 1976-77, incubation at 15 nests ranged from 23 to 26 days; the mean was 24.6 days (Morrison et al. 1979).

Hatching Success In a sample of 55 nests with clutch sizes from 1 to 4 at Sidney Island, Texas, in 1977 (Morrison et al. 1979), 91 eggs (57.6% of those laid) hatched, yielding 1.65 chicks per nest. Hatching success was generally greater in nests with larger clutches. In ten 4-egg clutches, 25 eggs hatched, a success rate of 62.5%; twenty-nine 3-egg clutches yielded 51 hatchlings, a rate of 58.6%; and 14 eggs in fifteen 2-egg clutches hatched, a success rate of 46.7%. The hatching of a single egg in one clutch provided a 100% success rate for that clutch size. At another Texas colony in 1977, in the Trinity River, Chaney et al. (1978) reported the hatching of 5 of 24 eggs in 8 nests (21%).

Fledging Success From 55 nests at Sidney Island, Texas, in 1977, 0.95 cormorant per nest was fledged. This represented 0.57 per egg hatched, and 0.33 bird per egg laid (Morrison et al. 1979).

Age at Fledging Unknown (James in Palmer 1962).

Age at First Breeding Unknown.

Mortality of Eggs and Young Starvation and loss of nests to storms were the major causes of nest failure at Sidney Island, Texas (Morrison et al. 1979).

The only predation noted was loss of eggs to Boat-tailed Grackles (Cassidix mexicanus), which accounted for 8.3% of the egg mortality. The ultimate cause of this loss was human disturbance, because grackles apparently only took eggs when the presence of observers caused all setting cormorants to leave their nests. In another south Texas colony, loss to grackle predation was much more severe. James (in Palmer 1962) reported that only 3 of 30 nests fledged young because of grackles. She also mentioned that raccoons (Procyon lotor) prey on both eggs and young.

In the Sidney Island colony, 52.8% of the eggs and 53.8% of the nestlings either disappeared without trace or were found dead on the ground. Both human disturbance, causing departing birds to dislodge the nest contents, and storm winds were likely significant factors in this loss (Morrison et al. 1979).

Renesting Olivaceous Cormorants, indeterminate layers, readily replaced eggs from partially or entirely lost clutches, but raised only one brood per season at Sidney Island, Texas. After eggs were lost, renesting occurred 1-11 days later for partially lost clutches (mean = 5.5, n = 4), and 2 to 20 days later for clutches that were entirely lost (mean = 8.5, n = 8) (Morrison et al. 1979).

Maximum Natural Longevity A bird banded in Louisiana, probably when young, achieved the estimated minimum age of 11 years and 7 months (Clapp et al. 1979 ms).

Weight (in grams) The mean weight of 10 birds was 1,260, and the mean of a sample of 3 birds was 1,070; no data on age, sex, season, or origin of these samples were given by the reporter (Hartman 1961). Four males from Panama taken January-March ranged from 1,100 to 1,500, with a mean weight of 1,275. A female from the same time and place weighed 1,000 (Hartman 1955).

SUSCEPTIBILITY TO OIL POLLUTION

We have not found any records of oiling of Olivaceous Cormorants. As surface swimming, diving birds of a group known to be relatively highly susceptible to oil, we would expect that any major oil contamination near a concentration of these birds would result in some mortality. Information available to us indicates that this species tends to use fresh and brackish water to a considerable extent, perhaps decreasing its vulnerability somewhat relative to other, more marine, cormorants.

A very small proportion of the total species population occurs within the United States, and this is possibly declining. Known colonies are few, and as much as 40% of the entire U.S. population may be concentrated in one colony. This colony and several others accounting for a majority of the known U.S. breeding population are relatively well inland (Portnoy 1977, Map 9), and as a result breeding birds may not be very vulnerable to coastal oil spills. It seems most likely that wintering birds would be much more vulnerable. In any event, the status of this species should be given serious consideration in areas where oil development may occur.

BIBLIOGRAPHY

1980

Toups, J. A. and M. F. Hodges. 1980. Olivaceous Cormorant - first Mississippi record. Mississippi Kite 10: 2-3.

1979

Morrison, M. L. 1979. The cormorants of Texas. Bull. Texas Ornithol. Soc. 12: 35-36.

Morrison, M. L., E. Shanley, Jr. and R. D. Slack. 1979. Breeding biology and age-specific mortality of Olivaceous Cormorants. Southwest. Nat. 24: 259-266.

Raffaele, H. A. 1979. Status of the genus Phalacrocorax in Puerto Rico including the first records of P. auritus. Auk 96: 204-206.

1978

Morrison, M. L., R. D. Slack and E. Shanley, Jr. 1978a. Age and foraging ability relationships of Olivaceous Cormorants. Wilson Bull. 90: 414-422.

Morrison, M. L., R. D. Slack and E. Shanley, Jr. 1978b. Declines in environmental pollutants in Olivaceous Cormorant eggs from Texas, 1970-1977. Wilson Bull. 90: 640-642.

Morrison, M. L., R. D. Slack and E. Shanley, Jr. 1978c. Interspecific association of Olivaceous Cormorants and Roseate Spoonbills. Southwest. Nat. 23: 681-683.

Morrison, M. L., E. Shanley, Jr. and R. D. Slack. 1978. Reproductive success and nesting ecology of Olivaceous Cormorants in Texas. Abstract 7 in Abstracts - 48th Ann. Mtng. Cooper Ornithol. Soc., Arizona St. Univ., Tempe, AZ. May 11-14, 1978.

Smit, F. G. A. M. A new bird-flea from Peru. J. Linn. Soc. (Zool.) 62: 189-192.

1977

Morrison, M. L. 1977 ms. Life history and status of the Olivaceous Cormorant. M. S. thesis, Texas A&M Univ. 84 pp.

Morrison, M. L., E. Shanley, Jr. and R. D. Slack. 1977. The food of nestling Olivaceous Cormorants. Southwest. Nat. 22: 321-326.

Morrison, M. L. and R. D. Slack. 1977a. Population trends and status of the Olivaceous Cormorant. Am. Birds 31: 954-959.

Morrison, M. L. and R. D. Slack. 1977b. The role of flock feeding in Olivaceous Cormorants. Bird-Banding 48: 277-279.

Zinn, K. S. 1977. Olivaceous Cormorants nesting in north central Texas. Southwest. Nat. 21: 556-557.

1975

Olrog, C. C. 1975. Vagrancy of Neotropical Cormorant, egrets, and White Ibis. Bird-Banding 46: 207-212.

1974

Hundertmark, C. A. 1974. First record of Olivaceous Cormorants nesting in New Mexico. Wilson Bull. 86: 65.

1973

Ostrowski de Nunez, M. 1970. Estudios sobre la fauna parasititaria del bigua "Phalacrocorax b. brasilianus". 2. Trematodes pertencientes a la familia "Diplostomatidae" Poirier 1886. Revista Mus. Argent. Cienc. Nat. "Bernardino Rivadivia" Inst. Nac. Invest. Cienc. Nat. (Zool.) 10: 199-214.

1971

Jones, H. L. 1971. Olivaceous Cormorant record for California. Calif. Birds 2: 134.

1956

Bo, N. A. 1956. Observaciones morfologicas y etologicas sobre el Bigua. Hornero 10: 146-157. [In Spanish.]

1961

Aramburu, R. H. and N. A. Bo. 1961. Descripcion de colonias de nidification (Detta del Parana y Golfo San Jose, Chabut) y estudio juveniles de Phalacrocorax brasilianus brasilianus (Gmelin). Rev. Mus. la Plata (N.S.) Sec. Zool. 7: 107-121.

1960

Daneri, C. H. 1960. La nidification del Biua Phalacrocorax olivaceus olivaceus (Humboldt) en Puerto Descado. Physis 21: 273-277.

1955

Bahamonde, N. 1955. Alimentacion de cormoranes o cuervos marinos (Phalacrocorax atriceps, Ph. magellanicus y Ph. olivaceus olivaceus). Invest. Zool. Chil. 2: 132-133. [In Spanish.]

1952

Eisenmann, E. 1952. Olivaceous Cormorant. Wilson Bull. 64: 195-196.

1939

van Rossem, A. J. and the Marquess Hachisuka. 1939. A northwestern race of the Mexican Cormorant. Proc. Biol. Soc. Wash. 52: 9-10.

1903

Nelson, E. W. 1903. Notes on the Mexican Cormorant. Condor 5: 139-145.

NORTHERN GANNET

(*Sula bassana*)

[DA: Sule, DU: Jan van Gent, EN: Gannet, FI: Suula, FR: Fou de Bassan, GE: Basstolpel, IC: Sula, IT: Sula, NW: Havsule, PO: Gluptak, PR: Ganso-patola, SP: Bubia de Norte, Alcatraz pardo, Alcatraz comun; SW: Havssula]

GENERAL DISTRIBUTION

North America Northern Gannets breed in six areas in North America: Gullcliff Bay, Anticosti Island, and the Bird Rocks, Magdalen Islands, both in the Gulf of St. Lawrence; Bonaventure Island, Cape St. Mary's, Baccalieu Island, and Funk Island, Quebec (Nettleship 1976). They formerly bred in Nova Scotia and New Brunswick (Nelson 1978a). Wintering birds regularly disperse south along the Atlantic coast to Florida (AOU 1957), with smaller numbers occurring in the Gulf of Mexico. Gannets occasionally straggle inland in the continental United States and there are now records from Michigan, Pennsylvania, New York, Vermont (AOU 1957), Indiana, and Ohio (Kirkpatrick 1948).

World Distribution In the Old World the breeding range is confined to northwestern Europe, where there are breeding stations in Great Britain, Ireland, France, Iceland, and Norway (Cramp et al. 1977, Nelson 1978a). These gannets winter to Scandinavia, the Baltic, northern France, and the northwest coast of Africa as far south as Senegal; some enter the Mediterranean (Cramp et al. 1974). Most adults remain in waters near their nesting areas during the nonbreeding season, but some may on occasion wander widely (Cramp et al. 1974, Cramp et al. 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Northern Gannets are common to abundant migrants and winter residents off North Carolina (Table 47) where they often occur in small flocks (Pearson et al. 1942) but are occasionally seen in very large numbers.

South Carolina Sprunt and Chamberlain (1949) regarded the gannet as a fairly common winter resident on the South Carolina coast. Gannets may well be more common than the available information suggests, because other remarks by Sprunt and Chamberlain imply that they usually occur far off South Carolina shores and apparently are infrequently seen from land. Recorded concentrations (Table 48) are considerably smaller than those reported from North Carolina. This may mean no more than that this species more frequently occurs inshore off North Carolina.

Georgia The most recent Georgia check-list (Denton et al. 1977) lists the Northern Gannet as an erratic winter resident along the coast and sometimes common offshore. Earlier, Burleigh (1958) had remarked that this bird was "...probably commoner than the few records would indicate"; we concur with this statement. Until more extensive pelagic observations have been made off

Table 47. Peak concentrations of wintering and migrant Northern Gannets in North Carolina.

Date seen	Number seen	Locality	Source
1961 21 Oct.	over 100	inshore at Wrightsville Beach	Chamberlain 1962a
1974 28 Oct.	200	feeding off Cape Point (only one adult seen)	Teulings 1975a
1965 11 Nov.	ca. 500	off Oregon Inlet	Parnell 1966a
1965 20 Nov.	ca. 3,000	off Oregon Inlet	Parnell 1966a
1975 29 Nov.	ca. 1,500	off Bodie-Pea Island	Teulings 1976a
1953 4 Dec.	ca. 3,000	off Pea Island Refuge	Chamberlain 1954a
1977 18 Dec.	2,790	Morehead City CBC	Fussell 1978
1974 30 Dec.	2,100	Bodie-Pea Island CBC	Sykes 1975
1975 30 Dec.	2,273	Bodie-Pea Island CBC	Sykes 1976
1978 30 Dec.	1,065	Bodie-Pea Island CBC	Sykes 1979
1954 1 Jan.	ca. 3,000	in 1/2 mi off Cape Hatteras	Quay and Davis 1954
1967 24 Jan.	over 1,000	feeding close inshore off Hatteras Village	Parnell 1967b
1961 25 Feb.	ca. 1,500	feeding just inside Oregon Inlet	Chamberlain 1961b
1979 5 Mar.	ca. 5,000	Pea Island area	LeGrand 1979c
1938 21 Mar.	ca. 3,000	in 15 mi from Oregon Inlet to Sand Ridge	Pearson et al. 1942
1979 21 Mar.	ca. 1,275	migrating N along beach, near Corolla, Currituck Co.	LeGrand 1979c
1960 26 Mar.	ca. 1,500	near Oregon Inlet	Chamberlain 1960a
1954 25 Apr.	77	Long Beach	Chamberlain 1954b

this state (and South Carolina), we believe it best to regard the status of the Northern Gannet there as essentially unknown. Peak numbers would probably occur at a time of year (mid-winter) when the fewest offshore observations are likely to be made. Concentrations seen offshore (Table 49) are apparently little different from those seen in South Carolina.

Florida - Atlantic Coast According to Kale (1979 ms a), Northern Gannets are abundant off the Florida Atlantic coast. They are present from October to April, but peak numbers are present from November through February (Table 50).

Table 48. Peak concentrations of wintering and migrant Northern Gannets in South Carolina.

Date seen	Number seen	Locality	Source
1961 13 Oct.	ca. 50	3 mi off Murrell's Inlet	Chamberlain 1962a
1978 28 Dec.	153	Litchfield-Pawley's Island CBC	Probst 1979
1977 29 Dec.	234	Litchfield-Pawley's Island CBC	Probst 1978
1977 2 Jan.	65	Charleston CBC	Harrison 1977
1976 4 Jan.	171	Litchfield-Pawley's Island CBC	Probst 1976

Table 49. Peak concentrations of wintering and migrant Northern Gannets in Georgia.

Date seen	Number seen	Locality	Source
1970-71	102	seen on CBC, Jekyll Island	Teulings 1971b
1970-71	50	seen on CBC, Sapelo Island	Teulings 1971b
1979 11 Feb.	ca. 300	off Jekyll Island	LeGrand 1979b
1950 18 Mar.	ca. 40	a few mi off Sapelo Island	Johnston and Major *in* Burleigh 1958

Florida - Keys Northern Gannets have seldom been recorded from the Florida Keys. They are almost certainly more frequent there than our information indicates because migrants into the Gulf of Mexico are not known to fly overland, but instead come around the southern tip of Florida (Palmer 1962). The few records of concentrations in the Keys that we have found (Table 51) are similar to concentrations reported from the eastern Gulf of Mexico (Tables 51-54).

Florida - Gulf Coast This species is common in winter off the Florida Gulf Coast, but considerably less abundant (Table 52) than on the Atlantic coast (Sprunt 1954, Kale 1979 ms b). Most are present from November through April and early may (Kale 1979 ms b) but extreme occurrences have been recorded as early as late July and as late as June. Kale also noted that North-

Table 50. Peak concentrations of wintering and migrant Northern Gannets on the Florida Atlantic Coast.

Date seen	Number seen	Locality	Source
1978 2 Dec.	371	off Juno Beach	Stevenson 1979
1977 17 Dec.	268	W. Palm Beach CBC	Langridge 1978
1977 17 Dec.	325	Dade County CBC	King 1978
1974 27 Dec.	176	Merritt Island NWR CBC	Eichhorn 1975
1976 28 Dec.	333	Merritt Island NWR CBC	Brigham 1977
1973 30 Dec.	229	Jacksonville CBC	Markgraf 1974
1975 30 Dec.	320	Merritt Island NWR CBC	Eichhorn 1976
1937 4 Jan.	500	moving S at Fort Pierce	Kuerzi 1938
1961 10 Jan.	ca. 100	flying S at Miami	Stevenson 1961
1951 21 Jan.	ca. 50	at mouth of St. John's River	Brookfield 1951
1973 21 Jan.	108	off Mayport (highest count from shore in season, 10% ad.)	Woolfenden 1973
1979 26 Jan.	ca. 1,000	off Cocoa	Stevenson 1979
1978 4 Feb.	1,300	off Sebastian Inlet	Stevenson 1978
1977 19 Feb.	80	off Canaveral	Stevenson 1977
1958 3 Mar.	250	moving N in 1 hr off Cocoa	Stevenson 1958b
1970 9 Mar.	50	off mouth of St. Johns River	Stevenson 1970
1958 11 Mar.	56	34 ad. and 22 imm. off Titusville	Stevenson 1958b
1978 15 Apr.	123	mostly immatures off Boynton Inlet	Kale 1978

Table 51. Peak concentrations of wintering and migrant Northern Gannets in the Florida Keys.

Date seen	Number seen	Locality	Source
1959 22 Nov.	200	in flocks flying S off Islamorada	Stevenson 1960a
1971 28 Feb.	44	around Upper Keys	Stevenson 1971
1935 5 Apr.	ca. 75	20 ad. and 55 imm. flying NE off Ragged Keys	Nichols 1935

ern Gannets frequently occur inshore off the northern Gulf Coast, but are extremely rare inshore along the peninsula.

Table 52. Peak concentrations of wintering and migrant Northern Gannets on the Florida Gulf Coast.

Date seen	Number seen	Locality	Source
1959 27 Dec.	25	off Pensacola	F. James 1960
1950 8 Jan.	51	off Pensacola (4 ad., 47 imm. seen in 45 min)	Lowery 1950a
1959 20 Jan.	37	off Pensacola	Newman and Warter 1959a
1967 12 Feb.	139	off Pensacola	F. James 1967
1955 15 Mar.	ca. 100	fishing off Alligator Point	Stevenson 1955b
1979 24 Mar.	90	counted in 1/2 hour, flying W off Pensacola	Imhof 1979
1957 6 Apr.	40	flying S off Marco Island	Robertson and Stevenson 1957
1965 10 Apr.	44	flying W off Alligator Point	Cunningham 1965b
1979 21 Apr.	31	off St. George Island	Kale 1979

Alabama Northern Gannets are common winter visitors off Alabama (Table 53). Most birds have been recorded from November to May (Imhof 1976b), with a few sightings outside this period. During pelagic surveys conducted from 1974 through 1978, Havard (in Duncan and Havard 1979 ms) saw approximately 95% of the observed Northern Gannets from December through April. Peak numbers were present in January and February, when about 54% of the birds were seen. This peak of abundance agrees favorably with observations made from onshore (Table 53).

Mississippi The status of the Northern Gannet off Mississippi, like that of other pelagic birds, is poorly known; it is probably not much different than off Alabama. Only one relatively large concentration has been reported (Table 54) but few observations have been made.

Louisiana The status of the Northern Gannet in Louisiana waters is poorly known. Lowery (1974) pointed out that there was only one record of its occurrence in the state through 1960, but by the time his book was written there were at least 15 records. The only time that relatively large numbers have been recorded was on 15 March 1960 when 54 birds were counted between the north end of the Chandeleur Islands and Ship Island (Lowery 1974). All Louisiana records known to us have occurred in the period from late November to early May.

Table 53. Peak concentrations of wintering and migrant Northern Gannets in Alabama.

Date seen	Number seen	Locality	Source
1977 1 Jan.	70	Gulf Shores CBC	Chandler 1977
1979 1 Jan.	63	Gulf Shores CBC	Chandler and Duncan 1979
1979 4 Jan.	250	offshore	Hamilton 1979
1972 22 Jan.	85	Gulf Shores	F. James 1972
1970 30 Jan.	200	Gulf Shores	Imhof 1976b
1969 20 Feb.	ca. 50	off Dauphin Island	Able 1969
1968 26 Feb.	ca. 150	off Dauphin Island	F. James 1968
1960 15 Mar.	50	off Dauphin Island	Newman 1960b
1966 11 Apr.	60	off Dauphin Island	Imhof 1966
1960 15 Apr.	50	Dauphin Island	Newman 1960b
1956 21 Apr.	103	Gulf Shores, Fort Morgan, and Dauphin Island	Imhof 1976b

Table 54. Peak concentrations of wintering and migrant Northern Gannets in Mississippi.

Date seen	Number seen	Locality	Source
1950 2 Jan.	10	9 mi off Biloxi	Lowery 1950a
1961 16 Jan.	43	Mississippi Sound	Newman 1961b
1961 12 Feb.	"100's"	1-10 mi S Horn Island	Williams and Clawson 1963
1979 24 Feb.	50	West Ship Island	Hamilton 1979
1961 26 Feb.	ca. 50	1-10 mi S Horn Island	Williams and Clawson 1963

Texas Oberholser (1974) considered the Northern Gannet a rare and irregular winter visitor to the northern and central coasts, and casual farther south. More recently, Blacklock (1978 ms) considered it uncommon rather than rare, probably because at least a dozen more observations were made in the 4 years between the publication of Oberholser's book and the preparation of his manuscript. The largest numbers recorded are so small (Table 55) compared with observations made farther east that it seems safe to conclude that Northern Gannets are found in Texas waters in only relatively low numbers. With a few exceptions, their occurrence has been between early October and early May.

Table 55. Peak concentrations of wintering and migrant Northern Gannets in Texas.

Date seen	Number seen	Locality	Source
1975 19 Jan	9	off High Island	Webster 1975b
1972 26 Jan.	17	off San Luis Pass, Brazoria Co.	Oberholser 1974
1972 27 Jan.	25	off San Luis Pass, Brazoria Co.	Oberholser 1974
1977 1 Mar.	11	offshore between High Island and Sabine Pass	Webster 1977d

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Northern Gannets are marine birds of the temperate and subarctic waters of the North Atlantic that breed primarily on islands off the mainlands of Europe and Canada. Their total breeding population is among the best known, if not the best known, for any seabird in the world. The world breeding population in 1976 was approximately 213,000 pairs (Nelson 1978b). We abstract recent information on breeding populations in different areas from Nelson (1978b) in Table 56.

Winter and Migration Both Old and New World gannets perform a combination of migration and dispersal in which there is considerable difference between age classes, and in which the longest movements are made by juveniles. A brief summary based largely on Nelson (1978a, 1978b) is given below for east and west Atlantic populations.

East Atlantic First-year birds largely move south to winter off Morocco and Senegal, but a few penetrate into the Baltic and Mediterranean. Few of these birds return from tropical West Africa in their first year but a larger proportion of second-year birds does return to home waters. Dispersal southward apparently is less in succeeding years and by the fifth year, when full adult plumage is attained, these birds apparently remain mainly in European waters.

West Atlantic As is true in the Old World, juveniles undertake the longest movements. Band recoveries indicate that the principal wintering area is off the Florida Atlantic coast. Juveniles predominate in the Gulf of Mexico, but subadults occur there as well. Forty percent of January-March recoveries in the Gulf were juveniles, compared with 13% immatures and 8% adults. Subadult and adult Northern Gannets from Canada move farther south in greater numbers than do Old World birds of those age classes, but a much smaller proportion of these age-classes (and immatures) go as far south as the juveniles. In consequence, the wintering birds of southeastern waters are predominantly juveniles.

Table 56. Location and size of colonies of the Northern Gannet (a).

Area	Approximate number of pairs	Approximate proportion of world population	Major colonies and proportion of world population
OLD WORLD	185,790		
Wales	20,370	9.3%	Grassholm (20,370 - 9.3%)
Ireland	21,670	10.0	Little Skelling (20,000 - 9.2%)
Channel Islands	3,000	1.4	
France	4,400	2.0	
Scotland	111,070	51.2	St. Kilda (59,258 - 27.3%), Ailsa Craig (16,000 - 7.4%), Bass Rock (13,500 - 6.2%), Sula Sgeir (9,000 - 4.2%), Hermaness (6,012 - 2.8%)
England	170	0.1	
Iceland	22,100	10.2	Eldey (16,300 - 7.5%), Westmann Islands (5,315 - 2.5%)
Faeroe Islands	2,250	1.0	
Norway	760	0.4	
NEW WORLD	30,950		
Quebec	22,750	10.5	Bonaventure (17,280 - 8.0%), Bird Rocks, Magdalen Islands (5,330 - 2.5%)
Newfoundland	8,200	3.8	Cape St. Mary's (5,260 - 2.4%)

(a) These figures are drawn from the text in Nelson (1978b) and incorporate figures given there. Thus, they do not agree in some places with figures given in his Table 5 where other estimates were sometimes used, nor do they necessarily agree with stated totals therein.

The southward movement begins in late September, and by mid-October it is pronounced. By November most first-year birds are off southern New England and New Jersey, and birds reach Florida and the Gulf of Mexico in December and January, respectively. Adults begin the return north in February, subadults in early March, and juveniles in April (Moisan and Scherrer 1973). The adults arrive at the colonies by about mid-April, with later return by younger age-classes.

Recorded abundance in southeastern waters varies greatly from one region to another. Maximum abundances have been recorded off the Atlantic coast, where a large proportion of the North American population winters. Numbers occurring in the Gulf of Mexico are poorly known, but the species is clearly more common in the eastern portion. Table 57 lists periods when these birds have been recorded in different areas.

Table 57. Dates of occurrence for Northern Gannets in the coastal southeastern United States (a).

State/region	Dates of occurrence (b)
North Carolina	18 October - 3 June (24 June, 1, 28, 30 August)
South Carolina	2 October - 18 June (24 June)
Georgia	16 November - 7 May (23 May)
Florida-Atlantic Coast	10 October - 12 May (2 August, 19 May)
Florida-Keys	2 November - 10 May (27 June)
Florida-Gulf Coast	9 November - 14 May (8 September, 23 May, 19 June)
Alabama	6 November - 10 May (2 September, 27 June)
Mississippi	16 January - 22 April (10 August, 19 September)
Louisiana	29 November - 5 May
Texas	6 October - 1 May (8 August, 20 September, 5 June)

(a) Exceptional occurrences are listed in parentheses.
(b) Moisan and Scherrer (1973) listed band recoveries for some of these areas that are outside the extremes given above. These include subadults recovered in South Carolina and on the Florida east coast in July, another from the latter area in September, as well as two juveniles recovered in Alabama in July.

HABITAT

Nesting Northern Gannets nest in large dense colonies, usually on cliffs or precipitous slopes on small rocky islands, where they prefer to place their substantial nests on long, broad, fairly flat ledges (Nelson 1978a, 1978b), although extremely narrow ledges (to 10 cm) are sometimes used (Poulin 1968 in Nelson 1978a). Bases of cliffs are avoided because of sea-spray (Nelson 1978b), and most colonies are well above the sea. Nelson (1978a) indicated that a majority of the world's gannetries are on cliffs more than 30 m high, but that mid-cliff areas are preferred. Cramp et al. (1977) reported that these birds may nest up to about 200 m or more. In a few areas slopes are important nesting habitats, and in two colonies (Eldey, Iceland, and the Bird Rocks, Quebec) gannets nest extensively on flat ground (Nelson 1978a).

The nests are mounds about 30 cm across and 20 cm high and are built largely of seaweeds, grass, and vegetation. They also incorporate feathers, flotsam, and rubbish. In recent years synthetic fiber lines and nets have occurred in more than half the nests in some large colonies and have become a common source of mortality. Less common nest materials have included false teeth, a gold watch, golf balls, and even a plastic frog (Nelson 1978b).

Spacing between nests is extremely regular. Nelson (1978a) reported that they "...almost invariably nest about 80 cm apart...", and noted that 95% of a large sample (233) of nests at Bonaventure were from 64.3 to 96.3 cm apart. He further remarked that nesting density, regardless of colony size, was nearly constant at 2.3 pairs per square meter.

Feeding Northern Gannets feed at sea off their colonies and have large foraging ranges; Nelson (1978b) estimated a 200-300 mile range for breeding birds and considerably more for nonbreeders.

Nonbreeding and Offshore Gannets occur in both pelagic and coastal waters but are primarily birds of offshore waters over continental shelves (Cramp et al. 1977). They usually occur solitarily or in small numbers out of sight of land (Palmer 1962), but may occasionally be found inshore in large numbers when feeding or on migration.

FOOD AND FEEDING BEHAVIOR

Gannets feed mostly on fish but are also known to eat squid (*Loligo*), and readily feed on offal from fishing boats. A large variety of species is known to have been eaten (Nelson 1978a, q.v. for a detailed list). At least at breeding colonies, the main food fish are herring (*Clupea harengus*) and mackeral (*Scomber scomber*), but sprat (*Sprattus sprattus*), coalfish or saithe (*Gadus virens*), and sand-eel (*Ammodytes ammodytes*) are also important (Nelson 1978a). Nelson also reported seasonal change in food habits. At Bonaventure, herring was the most important food fish until June but was supplanted thereafter by mackerel and, to a lesser degree, squid.

Northern Gannets feed primarily by surface plunging but have also been recorded surface seizing and pursuit diving; they have even been seen fishing on foot in shallow sandy bays (Nelson 1978b). Plunges range from just above the surface to as much as 27 m above it. Most dives are made at heights of from 9 to 15 m, however, with the former height most prevalent (Nelson 1978b). Nelson added that most dives probably are no deeper than 3.5 m, but that gannets may sometimes descend to 12-15 m using their feet and wings for propulsion. Birds are usually underwater for very brief periods (5-7 seconds) but have been known to remain under for as long as 20 seconds.

These gannets may feed solitarily but typically feed in flocks. Over shoaling fish these flocks may contain 1,000 birds or more. Gannets readily scavenge fish and offal from fishing vessels and have been seen doing so in artificial lighting at night (Nelson 1978b).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Within colonies, the time of egg laying is highly consistent from year to year, but laying may vary considerably between colonies (Nelson 1978b). At Bass Rock, Scotland, egg laying occurs between mid-March and early July but most eggs are laid in late April and early May; the season at Ailsa Craig, Scotland, is 2 weeks or more later. Laying at the Bempton, England, colony is similar to that at Bass Rock. Birds at Bonaventure, Quebec, lay from late April or early May to late June, with peak laying in the second week of May.

Mean Clutch Size Northern Gannets invariably lay only one egg (Nelson 1978a). Nelson (1978b) stated that two eggs are found in less than one in a

thousand nests and believes that such "clutches" involve two females.

Incubation Period Northern Gannets at Bass Rock had a mean incubation period of 43.6 days (range = 42-46, mode = 44, n = 82). Those at Bonaventure Island had a very similar mean of 43.9 days (n = 220). Infertile eggs may be incubated for considerably longer periods. One bird on Bass Rock incubated such an egg for 102 days; another incubated at Bonaventure for 148 days (Nelson 1978a, Poulin in Nelson 1978a).

Hatching Success On Bass Rock, hatching success is usually around 85%. It was 82% (range = 74-87) in the 3 years for which the best data were available, and a maximum hatching success of 96% has been recorded. Data from other European colonies are similar, but a 2 year average at Bonaventure was only 38% (range = 36.5-39.9). The lower success was caused by greater egg loss, but chilling and toxic chemicals may have been contributing factors (Nelson 1978b).

Inexperienced birds at Bass Rock had much lower hatching success than did birds that had bred three times or more. The former hatched 62.5% of their eggs, the latter, 86% (Nelson 1978a).

Fledging Success Northern Gannets typically have a very high fledging success. Nelson (1978a) reported an average fledging success (in terms of eggs hatched that fledged young) of 92.3% for 500 nests over three seasons (1961-63) at Bass Rock. Figures for Ailsa Craig (1974-75) and Bempton (1973-75) have ranged from 91% to 93%, and a 78% fledging success was recorded in two seasons (1966-67) at Bonaventure (Nelson 1978a, 1978b).

Age at Fledging Nelson (1978a, 1978b) reported the mean fledging period for gannets at Bass Rock as 90 days (n = 111, mode = 89, range = 84-97), and pointed out that age at fledging is not significantly different from one gannetry to another (at Bonaventure, mean = 90.6 days, range = 82-99). Experienced parents do not fledge their young sooner than do novices. Young birds at Bass Rock fledged significantly younger in August (mean = 87.8 days) and October (mean = 86.4) than those in September (mean = ca. 90.8), a phenomenon that Nelson (1978a) attributed to better growth in early chicks and premature departure in late ones.

Age at First Breeding Northern Gannets of both sexes may breed successfully in their fourth year, but most do not breed until at least their fifth year. Females apparently tend to breed earlier than males (Nelson 1978b).

Mortality of Eggs and Young Nelson (1978b) suggested that most egg loss in the Northern Gannet is due to inadequate parental care by inexperienced birds. Unseasonal storms, chilling, and toxic chemicals are other sources of egg mortality.

Nelson (1978a) stated that "man is undoubtedly the main cause of chick mortality either directly or indirectly through disturbance." Other causes of chick loss include climatic disturbances, inept parental care, falling, accidents during fledging, and attack by neighbors. Although Nelson (1978a, 1978b) did not state so specifically, weather would probably be the most sig-

nificant single source of mortality in the absence of human-related mortality. Neither starvation, predation, nor disease is of importance in nestling mortality.

Renesting Gannets readily replace eggs lost up to about the 25th day of incubation. On Bonaventure Island, a mean of 27.3% of lost eggs was replaced in two breeding seasons, and birds have been known to replace lost eggs as many as three times (Poulin in Nelson 1978b). Most eggs are replaced within 14-18 days. Replacement eggs produce proportionately fewer young than first eggs in both Old and New World colonies. In one instance at Bass Rock, replacement eggs produced only about half as many young per nest as did first eggs (Nelson 1978b).

Maximum Natural Longevity The oldest known Northern Gannet from North American colonies is a chick banded at the Bonaventure Island colony that was found dead near Gabarouse, Nova Scotia, at an estimated minimum age of 20 years, 3 months (Clapp et al. 1979 ms). The oldest known individual from an Old World colony is a bird banded as a chick (Rydzewski 1978) that reached an estimated minimum age of 16 years, 10 months. Nelson (1978b) stated that average adult mortality was about 5%, from which he inferred an average life expectancy of at least 16.2 years.

Weight (in grams) A selection of pertinent data on the weight of Northern Gannets is given in Table 58.

SUSCEPTIBILITY TO OIL POLLUTION

Scattered references to oiled Northern Gannets in the southeastern United States are made in the distributional literature dealing with the avifauna of that area. We summarize some of these reports in Table 59.

There are also numerous reports of oiled Northern Gannets from the Old World. Brouwer (1953 in Vermeer and Vermeer 1974) reported that 7% of birds lost to oil pollution along Dutch coasts were gannets. During the winter of 1976-77, Northern Gannets composed 11% of the oiled birds found on Irish coasts (O'Keeffe 1978). Oiled gannets made up between 0.4% and 3.6% (mean = 1.8%) of the oiled seabirds found along British beaches for the seven winters from 1966-67 to 1973-74 (Croxall 1977). Although these reports do not indicate a level of susceptibility as great as in the very vulnerable loons, grebes, alcids, and sea ducks, they clearly show that this pelecaniform species is at least somewhat susceptible to oil pollution.

Possible secondary effects of oiling on nesting Northern Gannets have also been suggested. Following the "TORREY CANYON" oil spill, Jouanin (1967 in Nelson-Smith 1973) reported that gannets were oiling themselves and their eggs as a result of bringing oiled seaweed into the colony for nest-building material.

Although oiling is frequently reported for Northern Gannets, the actual number found oiled has usually been small. Nelson (1978a) commented that gannets suffer relatively slightly from oil compared with other sources of post-

Table 58. Weights of Northern Gannets (in grams).

Mean weight	Range	N	Sample and season	Area	Source
2,932	2,470-3,470	27	males	Bass Rock	Nelson 1978b
3,120	2,400-3,600	17	males	Ailsa Craig	Wanless in Nelson 1978b
3,153	----------	38	males	Bonaventure	Poulin 1968 in Nelson 1978b
3,067	2,570-3,610	27	females	Bass Rock	Nelson 1978b
2,941	2,300-3,600	18	females	Ailsa Craig	Wanless in Nelson 1978a
3,284	----------	24	females	Bonaventure	Poulin 1968 in Nelson 1978b
104.6	81-139	393	fresh eggs	Bass Rock	Nelson 1978b
----	70-80	--	newly hatched eggs	Bass Rock	Nelson 1978b
ca. 4,100	----------	--	maximum weight of chick (65-75 days)	Bass Rock	Nelson 1978a
ca. 3,900	----------	--	fledging chicks		Nelson 1978a
2,948	----------	1	imm. male, mid-March	Alabama	Stewart and Skinner 1967
3,062	----------	1	imm. female, mid-March	Alabama	Stewart and Skinner 1967

fledging mortality, such as shooting or fishing activities. He also suggested (1978b) that Northern Gannets are normally unaffected by floating oil because they dive only on prey that they can see, and noted that this species does not swim enough on or under the water to come up in an oil-slick as do some other, more severely affected, species.

A large proportion of North American gannets winter in southeastern waters and relatively close inshore. Consequently, we believe that these birds are at least moderately susceptible to oil development activities in this area, and should be taken into account when extensive operations are planned.

Table 59. Reports of oiled Northern Gannets from the southeastern United States.

State	Locality and date	Number of affected birds	Remarks	Source
NC	5 mi of beach N of Morehead City, 3rd week Feb. 1952	27	6 dead and 21 live oil-soaked birds	Chamberlain and Chamberlain 1952
LA	Grand Terre beach, Jefferson Par., 27 Jan. 1970	1	oil-covered bird found freshly dead	F. James 1970
TX	S. Padre Island beach, 16 Oct. 1975	1	slightly oiled adult caught	Webster 1976a
GA	North Jetty near Tybee Light, 16 Mar. 1944	1	bird sitting on jetty had an apparently oil-soaked breast	Tomkins 1944

BIBLIOGRAPHY

1981

Furness, R. W. 1981. Colonization of Foula by Gannets. Scott. Birds 11: 211-213.

Kirkham, I. R. 1981. Nesting Northern Gannets (Morus bassanus) killed by rock falls at Great Bird Rock, Quebec. Can. Field Nat. 95: 202-203.

Murray, S. 1981. A count of Gannets on Boreray, St. Kilda. Scott. Birds 11: 205-211.

1980

Montevecchi, W. A., I. R. Kirkham, R. Purchase and B. D. Harvey. 1980. Colonies of Northern Gannets in Newfoundland. Osprey 11: 2-8.

1979

Cooke, A. S. 1979. Egg shell characteristics of Gannets Sula bassana, Shags, Phalacrocorax aristotelis and Great Black-backed Gulls Larus marinus exposed to DDE and other environmental pollutants. Environ. Pollut. 19: 47-65.

Perkins, E. G. 1979. Aspects of the 1977 North Atlantic Gannet migration over Georges Bank and its adjacent shelf waters. (Abstract only). Pac. Seabird Group Bull 6: 42.

1978

Nelson, J. B. 1978a. The Sulidae. Gannets and Boobies. Oxford Univ. Pres, Oxford. x and 1012 pp.

Nelson, J. B. 1978b. The Gannet. Buteo Books, Vermillion, S. Dak. 336 pp.

Nelson, J. B. 1978c. Atlantic Gannets: "The state of the nation.' (Abstract only). Ibis 120: 132-133.

1977

Femreite, N., J. E. Bjerk, N. Kreseth and E. Brun. 1977. DDE and PCBs in eggs of Norwegian seabirds. Astarte 10: 15-20.

Gunter, G. and W. D. Burke. 1977. Notes on the status of the Gannet (Morus bassanus) in the Gulf of Mexico, with a record from Mississippi. Gulf Resch. Rept. 6: 83-86.

Nelson, J. B. 1977. Interchange between Gannet colonies. Brit. Birds 70: 127-128.

Parslow, J. L. F. and D. J. Jefferies. 1977. Gannets and toxic chemicals. Brit. Birds 70: 366-372.

Snook, R. F. 1977. Gannet swallowing brass welding rod. Brit. Birds 70: 35.

Taylor, I. R. 1977. Overland passage of Gannets from the Forth. Scott. Birds 9: 298-299.

1976

Cullen, M. S. and R. Pratt. 1976. A census of the Gannet nests on Grassholm in 1975. Brit. Birds 69: 88-90.

Fairhurst, J. 1976. Gannets brooding Guillemot chicks. Bird Study 23: 285-286.

Nettleship, D. N. 1976. Gannets in North America: present numbers and recent population changes. Wilson Bull. 88: 300-313.

Thomson, A. L. 1976. Migration of the Gannet into the Mediterranean. J. Bombay Nat. Hist. Soc. (1974) 71: 548-553.

1975

Birkhead, T. R. and R. E. Ashcroft. 1975. Auk numbers on Skomer Island. Nat. Wales 14: 222-223.

Nettleship, D. N. 1975. A recent decline of Gannets, Morus bassanus, on Bonaventure Island, Quebec. Can. Field Nat. 89: 125-133.

Neven, R. 1975. Jan-van-gent - Sula bassana. Wielewaal 41: 139.

Thomson, A. L. 1975. Dispersal of first-year Gannets from the Bass Rock. Scott. Birds. 8: 295-298.

1974

Brun, E. 1974. Breeding success of Gannets Sula bassana at Nordmjele, Andoya, North Norway. Astarte 7: 77-82.

Burchak-Abramqvich, N. and V. Tsalkin. 1974. [Traces of the Gannet Sula bassana bassana (L.) in the Black Sea area.] Communs. Baltic Commiss. Study Bird Migrat. 8: 206-213. [In Russian with English summary.]

Fimreite, N., E. Brun, A. Froslie, P. Frederichsen and N. Gundesen. 1974. Mercury in eggs of Norwegian seabirds. Astarte 7: 71-75.

Gould, M. 1974. Gannet on Kent Island, New Brunswick. Auk 91: 175.

Klapste, J. 1974. Terej bily (Sula bassana) v jiznich morich. Ziva 21: 155.

Meltofe, H. and E. Overlund. 1974. Forekomsten af Suler Sula bassana ved Blavanshuk, 1963-71.] [The occurrence of Gannets Sula bassana at Blavenshuk, 1963-71.] Dan. Ornithol. Foren. Tidsskr. 68: 43-48. [In Danish with English summary.]

Olsen, B. and M. Permin. 1974. Besta den af Sula bassana pa Mykinesholmur, 1972. [The population of Sula bassana on Mykinesholmur, 1972.] Dan. Ornithol. Foren. Tidsskr. 68: 39-42.

Rowe, P. 1974. Gannet nest with two chicks. Brit. Birds 67: 25.

Thomson, A. L. 1974. The migration of the Gannet: a reassessment of British and Irish ringing data. Brit. Birds 67: 89-103.

1973

Bomford, E. 1973. Gannets in action. Animals 15: 118-119.

Dixon, T. J. 1973. Estimates of the number of Gannets breeding on St. Kilda 1969-1973. Seabird Rept. 1971: 5-12.

Moisan, G. and B. Scherrer. 1973. Deplacements saisonniers des Fous de Bassan de l'Ile Bonaventure (Canada) (Sula bassana). [Seasonal displacements of Gannets Sula bassana from Bonaventure Island (Canada).] Terre Vie 27: 414-434. [In French with English summary.]

Parslow, J. L., D. F. Jefferies and H. M. Hanson. 1973. Gannet mortality incidents in 1972. Mar. Pollut. Bull. 4: 41-44.

Petrovic, C. A. and J. King, Jr. 1973. Bird records from the Dry Tortuguas. Fla. Field Nat. 1: 5-8.

Pickup, T. 1973. The Gannet that fostered a Guillemot. Birds RSPB Mag. 4: 243-244.

1972

Bourne, W. R. P. 1972. Mortality of Gannets and Shags in Great Britain. Mar. Pollut. Bull. 3: 117.

Brun, E. 1972. Establishment and population increase of the Gannet Sula bassana in Norway. Ornis Scand. 3: 27-38.

Calvert, D. E. 1972. Diving behaviour of Gannets and shearwater. Notornis 19: 366.

Maxwell, T. C. 1972. Spring migration of the Gannet in Florida waters. Wilson Bull. 84: 198-199.

Reinsch, H. H. 1972. Zwei neue Basstolpel-Kolonien bei Island. Beitr. Vogelkd. 18: 364-366.

1971

Brun, E. 1971. [Gannet, Sula bassana, from Bass Rock, Scotland breeding on Andoya]. Fauna, Oslo 24: 22-24. [In Norwegian with English summary.]

White, S. J. 1971. Selective responsiveness by the Gannet (Sula bassana) to played back calls. Anim. Behav. 19: 125-131.

1970

Brun, E. 1970. Havsulen, Sula bassana, etablert som hekkfugl i Lofoten. [Gannet Sula bassana established as breeding bird in Lofoten, North Norway.] Sterna 9: 141-147. [In Norwegian with English summary.]

Dathe, H. 1970. Basstolpel (Sula bassana) bei Berlin. Beitr. Vogelkd. 15: 455-456.

MacInnes, J. 1970. Gannet catching in the Hebrides. Frooskaparrit 18: 151-158.

White, S. J. and R. E. C. White. 1970. Individual voice production in Gannets. Behaviour 37: 40-54.

White, S. J., R. E. C. White and W. H. Thorpe. 1970. Acoustic basis for individual recognition by voice in the Gannet. Nature 225: 1156-1158.

1968

Hirons, M. J. D. 1968. British sea-birds. 6. The Gannet. Animals 10: 571-573.

Moisan, G. and J. M. Poulin. 1968. The Gannets (Sula bassana) of Bonaventure Island, Quebec. Trans N.E. Sec. Wildl. Soc., N.E. Fish Wildl. Conf. (14-17 Jan., 1967) 25: 135-142.

Poulin, J. M. 1968a. Reproduction du Fou de Bassan (Sula bassana). Ile Bonaventure (Quebec). M. Sc. thesis, L'Universitie Laval/Province de Quebec. 110 pp.

Poulin, J. M. 1968b. Croissance du jeune Fou de Bassan (Sula bassana) pendant sa periode pre-envol (Ile Bonaventure, Quebec). Naturaliste Can. 95: 1131-1143.

Russell, F. 1968. "Stange powerful birds, sir". Audubon Mag. 70: 74-81.

Young, J. G. 1968. Birds of the Scar Rocks--the Wigtownshire gannetry. Scott. Birds 5: 204-208.

1967

Brun, E. 1967. Hekking av havsule, Sula bassana, i nord-Norge. [Breeding of the Gannet, Sula bassana, in North Norway.] Sterna 7: 376-386. [In Norwegian with English summary.]

Maxwell, T. C. 1967. Gannet (Morus bassana) found on Texas coast. Bull. Texas Ornithol. Soc. 1: 10.

Nelson, J. B. 1967a. Das Verhalten der Tolpel und seine Anpassung an den Lebensraum. Umschau Wissensch. Techn. 19: 638-639. [In German.]

Nelson, J. B. 1967b. Das Verhalten der Tolpel: II. [The behavior of Gannets: II.[Nat. Mus. 97: 502-510. [In German.]

Nelson, J. B. 1967c. Colonial and cliff nesting in the Gannet compared with other Sulidae and the Kittiwake. Ardea 55: 60-90.

1966

Nelson, J. B. 1966a. Population dynamics of the Gannet (Sula bassana) at the Bass Rock, with comparative information from other Sulidae. J. Anim. Ecol. 35: 443-470.

Nelson, J. B. 1966b. The behaviour of the young Gannet. Brit. Birds 59: 393-419.

Nelson, J. B. 1966c. The breeding biology of the Gannet (Sula bassana) on the Bass Rock, Scotland. Ibis 108: 584-626.

1965

Barrett, J. H. and M. P. Harris. 1965. A count of the Gannets on Grassholm in 1964. Brit. Birds 58: 201-202.

Nelson, J. B. 1965. The behaviour of the Gannet. Brit. Birds 58: 233-288, 313-336.

Randazzo, G. R. 1965. Nuova cattura della Sula bassana (L.) in Sicilia. Atti. Soc. Pelorit. Sic. Fis. Mat. Nat. 10: 471-476. [In Italian with English summary.]

Sharrock, J. T. R. 1965. The status of immature Gannets off Cape Clear Island. Brit. Birds 58: 216-217.

Spano, S. 1965. La sula (Sula bassana bassana (L.)) in Italia. Riv. Ital. Ornitol. 35: 1-33.

1964

Adams, W. H. 1964. Unseasonable record of Gannet in North Carolina. Wilson Bull. 76: 187.

Barlee, J. 1964. The flight of the Gannet. Colo. Outdoors 13: 58-65.

Nelson, J. B. 1964a. Bass Rock Gannets: aggression seems dominant theme in behavior of these birds. Nat. Hist. 73: 32-41.

Nelson, J. B. 1964b. Factors influencing clutch-size and chick growth in the North Atlantic Gannet, Sula bassana. Ibis 106: 63-77.

Nelson, J. B. 1964c. Fledging in the Gannet. Scott. Nat. 71: 47-59.

Nelson, J. B. 1964d. Some aspects of breeding biology and behaviour of the North Atlantic Gannet on the Bass Rock. Scott. Birds 3: 99-137.

1963

Nelson, J. B. 1963a. Aggression in the Gannet (Sula bassana). Biol. J. Univ. St. Andrews 3: 28-35.

Nelson, J. B. 1963b. The breeding biology of the Gannet (Sula bassana) with particular reference to behaviour. Ph. D. thesis, Oxford Univ.

1962

Peakall, D. 1962. Gannet population of Bonaventure Island. Can. Field Nat. 76: 179-180.

1961

Boyd, J. M. 1961. The gannetry of St. Kilda. J. Anim. Ecol. 30: 117-136.

1959

Drury, W. H., Jr. 1959. Orientation of Gannets. Bird-Banding 30: 118-119.

1957

Barlee, J. 1957. The soaring of Gannets and other birds in standing waves. Ibis 99: 686-687.

1956

Barlee, J. 1956a. Flying for business. Soaring (Nov.-Dec.) 1956: 10-16.

Barlee, J. 1956b. Flying for business and pleasure. Shell Aviation News (Feb.) 1956: 4-9.

1955

Flanighan, M. 1955. Gannet with deformed mandible. Brit. Birds 48: 229-230.

1954

Lockley, R. M. and D. S. Dane. 1954. Congenital abnormalities in a Gannet. Brit. Birds 47: 23-24.

Quay, T. L. and P. H. Davis. 1954. Herring Gulls and Gannets along Hatteras Bank. Chat 18: 53.

Williams, G. G. 1954. A captive Gannet. Auk 71: 320-321.

1953

Gudmundsson, F. 1953. Islenzkir fuglar VII. Sula (Sula bassana (L.)). [Icelandic Birds. VII. The Gannet (Sula bassana (L.)).] Natturufraedingurinn 23: 170-177. [In Icelandic with English summary.]

1952

Bruce, A. J. 1952. Gannets associating with Basking Sharks and making shallow dives. Brit. Birds 45: 420-421.

Hunt, G. H. 1952. Gannets feeding on shore. Brit. Birds 45: 420.

Wallis, A. J. 1952. Gannets mating at sea. Brit. Birds 45: 369.

1951

Fisher, J. and H. G. Vevers. 1951. The present population of the North Atlantic Gannet (Sula bassana). Proc. 10th Internatl. Ornithol. Congr. 1950: 463-467.

1950

Gudmundsson, F. 1950. Nyjar suluvarpstovvar. [New Gannet colonies in Iceland.] Natturufraedingurinn 20: 49-567. [In Icelandic with English summary.]

Kay, G. T. 1950. Migratory movements of Gannets. Brit. Birds 43: 230-232.

MacIntyre, D. 1950. The young Gannet. Brit. Birds 43: 232.

Perry, R. 1950. The young Gannet. Brit. Birds 43: 343-344.

Wallis, A. J. 1950a. Migration of juvenile Gannets. Brit. Birds 43: 227.

Wallis, A. J. 1950b. Unusual flight behavior of Gannet. Brit. Birds 43: 227.

1949

Whitcombe, J. H. 1949. Gannets taking food thrown from ships. Brit. Birds 42: 25.

1948

Campbell, J. W. and S. Gordon. 1948. Gannet taking bread at sea. Brit. Birds 41: 123.

Davies, O. J. H. and R. D. Keynes. 1948. The Cape St. Mary Gannet colony, Newfoundland. Ibis 90: 538-546.

Kay, G. T. 1948. The Gannet in Shetland in winter. Brit. Birds 41: 268-270.

Kirkpatrick, C. M. 1948. Gannet in eastern Indiana. Wilson Bull. 60: 240.

Sprunt, A., Jr. 1948. Abnormally late occurrence of the Gannet in south Florida. Auk 65: 315.

Williamson, K. 1948. Gannet taking bread at sea. Brit. Birds 41: 26.

1947

Mayaud, N. 1947. Phalaropes and Gannets off the west coast of Africa. Bull. Br. Ornithol. Club 47: 54-55.

1946

Cornish, A. B. 1946. Gannet feeding on large fish. Brit. Birds 39: 345.

Dobson, R. and R. M. Lockley. 1946. Gannets breeding in the Channel Islands: two new colonies. Brit. Birds 39: 309-312.

Henderson, M. 1946. Gannets at some distance from the sea. Brit. Birds 39: 221.

1945

Gunter, G. 1945. A record of the Gannet from the Texas coast. Auk 62: 311-312.

1944

Anderson, J. A. 1944. Gannets fishing in fresh water. Brit. Birds 38: 17-18.

Fisher, J. and H. G. Vevers. 1944. The breeding distribution, history and population of the North Atlantic Gannet (Sula bassana). Part II. The changes in the world numbers of the Gannet in a century. J. Anim. Ecol. 13: 49-62.

Tomkins, I. R. 1944. Gannets at sea off the Georgia coast. Oriole 9: 9-10.

1943

Fisher, J. and H. G. Vevers. 1943. The breeding distribution, history and population of the North Atlantic Gannet (Sula bassana). Part I. A history of the Gannet's colonies, and the census in 1939. J. Anim. Ecol. 12: 173-213.

Weaving, J. and J. Barlee. 1943. Gannets and Manx Shearwaters nesting on Great Saltee, Co. Wexford. Brit. Birds 37: 98.

1942

Gordon, J. 1942. Feathered fishermen of Bonaventure. Nat. Hist. 49: 219-222.

Nickell, W. P. 1942. Third Gannet record for Michigan. Jack-Pine Warbler 21: 12.

Peters, H. S. 1942. A new Gannet colony in Newfoundland. Auk 59: 100.

1941

Cruickshank, A. D. 1941. Bonaventure's Gannets. Audubon Mag. 48: 537-542.

Griffin, W. W. 1941. A Gannet on St. Simons Island. Oriole 6: 49.

1940

Fisher, J. 1940a. The world distribution and numbers of breeding Gannets. Bull. Br. Ornithol. Club 60: 39-41.

Fisher, J. 1940b. The world's Gannets. Field 176: 276-278.

1939

Fisher, J. 1939. The history of the Irish Gannet colonies. Brit. Birds 32: 314-319.

Jourdain, F. C. R. 1939. The foundation of a Gannet colony. Oologists' Rec. 19: 55-56.

McWilliam, J. M. 1939. Breeding of the Gannet on the Scar Rocks, Wigtownshire. Brit. Birds 33: 105-107.

Marchant, S. 1939. The Irish Gannet colonies, 1938. Brit. Birds 32: 320-325.

Thomson, A. L. 1939. The migration of the Gannet: results of marking in the British Isles. Brit. Birds 32: 282-289.

1938

Fisher, J., M. Stewart and L. S. V. Venables. 1938. Gannet colonies of Shetland. Brit. Birds. 32: 162-169.

Fisher, J. and L. S. V. Venables. 1938. The Gannets (Sula bassana) on Noss, Shetland, with an analysis of the rate of increase of this species. J. Anim. Ecol. 7: 305-313.

Stewart, M. 1938. Notes on the gannetries of Sule Stack and Sula Sgeir. Brit. Birds 31: 282-294.

1937

Gilliard, E. T. 1937. The Gannets of Funk Island. Auk 54: 379-381.

Robinson, H. W. 1937a. Recoveries of Gannets from the Bass Rock. Scott. Nat. 1937: 133-134.

Robinson, H. W. 1937b. Young Gannets with malformed beaks. Scott. Nat. 1937: 172.

1936

Wynne-Edwards, V. C., R. M. Lockley and H. M. Salmon. 1936. The distribution and numbers of breeding Gannets (Sula bassana L.). Brit. Birds 29: 262-276.

1935

Harrisson, T. H. and D. B. Keith. 1935. The Gannet colony of Grimsey, north Iceland. Brit. Birds 28: 319-320.

Nichols, J. T. 1935. Spring migration of the Gannet in southeast Florida. Auk 52: 300.

Robinson, H. W. 1935. Gannets wintering on the Bass Rock. Scott. Nat. 1935: 78.

Wynne-Edwards, V. C. 1935. The Newfoundland Gannet colony: with recent information on the other North American gannetries. Ibis 13th Ser., vol. 5: 584-594.

1934

Kennedy, P. G. 1934. Gannets and Choughs on Great Sultee Island. Brit. Birds 27: 362.

Lockley, R. M. and H. M. Salmon. 1934. The Gannet colonies of Iceland. Brit. Birds 28: 183-184.

Roberts, B. 1934. The Gannet colonies of Iceland. Brit. Birds 28: 100-105.

1933

Gillespie, M. B. and J. A. Gillespie. 1933. A Gannet in Delaware Co., Penna. Auk 50: 205-206.

Harrisson, T. H. 1933. Counts of the Gannets (Sula bassana) in Scottish islands. J. Anim. Ecol. 1: 116.

MacPherson, A. H. 1933. Gannets in Shetland. Scott. Nat. 1933: 118.

Salmon, H. M. and R. M. Lockley. 1933. The Grassholm Gannets: a survey and census. Brit. Birds 27: 142-152.

1931

Kuerzi, J. F. 1931. On the status of the Gannet (Sula bassana) in the New York City region. Auk 48: 256.

Sprunt, A., Jr. 1931. Early occurrence of the Gannet on the South Carolina coast. Auk 48: 109.

1930

Corlett, G. 1930. The winter status of the Bass Rock Gannets. Brit. Birds 24: 54-55.

1929

Ritchie, J. 1929. A census of Bass Rock Gannets. Scott. Nat. 1929: 127-132.

1928

Wallis, H. M. 1928. Gannet diving from surface of water. Brit. Birds 21: 234.

1926

Green, H. T. 1926. Gannet in Bucks County, Pennsylvania. Auk 43: 363.

Hadeler, E. E. 1926. A Gannet at Painesville, Ohio. Auk 43: 89-90.

Lloyd, B. 1926. On the egg-laying of the Grassholm Gannets. Brit. Birds 29: 309-310.

1923

Hewitt, V. 1923. An account of the Gannets on Grassholm Island, off Pembrokeshire. Oologists' Rec. 3: 69-80.

1921

Balfour, H. 1921. Varieties of the Common Gannet. Brit. Birds 15: 82-84.

1920

Waldo, E. G. B. M. 1920. A new nesting-place of the Gannet. Brit. Birds 14: 93-94.

1918

English, A. 1918. Gannet colonies. Ottawa Nat. 32: 98.

Taverner, P. A. 1918. The Gannets of Bonaventure Island. Ottawa Nat. 32: 21-26.

1915

Tulloch, J. S. 1915. Nesting of the Gannet in Shetland: an extension of the breeding range. Scott. Nat. 1915: 251.

1914

Gurney, J. H. 1914. Are Gannets destructive birds? Irish Nat. 1914: 212-213.

BLUE-FOOTED BOOBY

(*Sula nebouxii*)

[SP: Bubia pies azules, Camanay]

GENERAL DISTRIBUTION

North America Blue-footed Boobies breed on islands in the Gulf of California, on islets off western Mexico (Revilla Gigedos, Tres Marias, Tres Marietas), and on islands in the Gulf of Panama (AOU 1957, Nelson 1978a). They range casually or accidentally north to northern California (Elliott 1976), Washington (Larrison 1945), Arizona (Phillips et al. 1964), and Nevada (Lawson 1973).

World Distribution Blue-footed Boobies also have a major breeding area in the Galapagos Islands. South of Panama along the Pacific coast they breed in the Gulf of Guayaquil, Ecuador, and on the Lobos Islands, Peru; only the latter area has a substantial concentration of breeding boobies. They may breed on other offshore islets or headlands between Panama and Peru but adequate documentation is lacking (Nelson 1978a).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

The Blue-footed Booby is accidental in the southeast and has only been recorded once.

Texas

1976	5 Oct.	1 seen, photogr.	South Padre Island beach	Webster 1977b

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Blue-footed Booby is a relatively abundant breeder in the Galapagos Islands and from northwestern Mexico to Peru, but data on the size of breeding populations are scattered and antiquated. As a rough guess, Nelson (1978a) suggested that there were perhaps 10 to 15 thousand pairs in the Galapagos, about the same in Peru, and perhaps 10,000 in the area around the Gulf of California. He thought the world population to be about 25 to 40 thousand pairs.

HABITAT

Nesting Blue-footed Boobies nest colonially on relatively level ground with little or no vegetation. The nesting substrate may range from bare sand to bushy shrubby areas, but this species always nests on the ground. It does

not build a nest and, perhaps as a consequence, tends to nest on softer areas such as pockets of earth between boulders (Nelson 1978a).

Feeding and Offshore The Blue-footed Booby feeds inshore, along coasts and bays, more than many other species of the genus. They usually feed within a few kilometers of land and seldom forage more than 160 km from shore. These boobies have been recorded diving into a 2-foot deep rock pool in the Galapagos Islands (Nelson 1978a).

FOOD AND FEEDING BEHAVIOR

Nelson (1978a) pointed out that exceptionally little is known of the diet of the Blue-footed Booby, and suggested that its preferred feeding habitat inshore and along coasts and bays will result in a more varied diet than found in other species of boobies. He reported that Blue-footed Boobies are known to eat "flying fish (*Exocoetus* spp.), sardines, several species of anchovies, and Pacific mackerel."

Blue-footed Boobies feed primarily in flocks, plunge diving from the air to varying depths in the water. Nelson (1978a) reported that one male interspersed about 100 dives from about 3-6 m with 15 dives from the surface of the water. Juveniles have also been seen making such surface dives. According to Nelson (1978a), there are no observations on surface diving in other boobies, so the importance of surface diving by Blue-footed Boobies is difficult to evaluate.

Deep plunging dives are usually accomplished by gravity alone, but Harris (1975) reported that the Blue-footed Booby also commonly power dives, i.e., uses its wings to gain added speed of entry into the water. He suggested that this greater speed allowed penetration deeper into the water or decreased the time in which the prey could recognize that it was in danger--particularly important in this species which dives in shallow water where fish can more easily detect the booby's approach. Blue-footed Boobies may also seize flying fish from the air while in flight (Gifford 1913 *in* Palmer 1962).

This booby exhibits a form of cooperative fishing not known in more pelagic species. Communal groups observed in the Galapagos ranged from 2 to 13 individuals (Parkin et al. 1970). One bird would dive and would be closely followed by the other(s). Often a single di-syllabic whistle was given by one of the birds at the beginning of a dive, apparently as a signal to the others. Parkin et al. (1970) suggested that this simultaneous diving enhances each individual's chance to obtain food from a rapidly dispersing school of fish.

Palmer (1962) reported two primary periods of daily feeding, early morning and late afternoon, but also noted that the Blue-footed Booby may feed actively on moonlit nights.

SUSCEPTIBILITY TO OIL POLLUTION

We have found no records of oiling in this species, but its pronounced

tendency to feed inshore, as well as its diving, would make it particularly liable to both direct and indirect effects of oil pollution. Due to its extreme rarity in the southeastern states, in that area the effect of oiling on Blue-footed Boobies can be considered nil.

BIBLIOGRAPHY

1979

Harris, M. P. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

1978

Nelson, J. B. 1978a. The Sulidae. Gannets and Boobies. Oxford Univ. Press, Oxford. x and 1012 pp.

1976

Elliott, B. G. 1976. Blue-footed Booby in northern California. West. Birds 7: 155-157.

1975

Harris, M. P. 1975. Unusual feeding by Blue-footed Booby. Auk 92: 601-602.

Ruppel, G. 1975. Die Stosstauchmanover des Blaufusstolpels (Sula nebouxii) und des Meerespelikans (Pelecanus occidentalis). [Diving-manoeuvres of the Brown Pelican (Pelecanus occidentallis and the Blue-footed Booby (Sula nebouxii).] J. Ornithol. 116: 168-180. [In German with English summary.]

1973

Lawson, C. S. 1973. Notes on Pelecaniformes in Nevada. West. Birds 4: 23-30.

1970

McCaskie, G. 1970. The occurrences of four species of Pelecaniformes in the southwestern United States. Calif. Birds 1: 117-142.

Parkin, D. T., A. W. Ewing and H. A. Ford. 1970. Group diving in the Blue-footed Booby Sula nebouxii. Ibis 112: 111-112.

1955

Stultz, A. 1955. Another Blue-footed Booby in southern California. Condor 57: 123.

1948

Todd, W. E. C. 1948. A new Booby and a new Ibis from South America. Proc. Biol. Soc. Wash. 61: 49-50.

1945

Larrison, E. J. 1945. Blue-footed Booby in the Pacific Northwest. Murrelet 26: 45.

1934

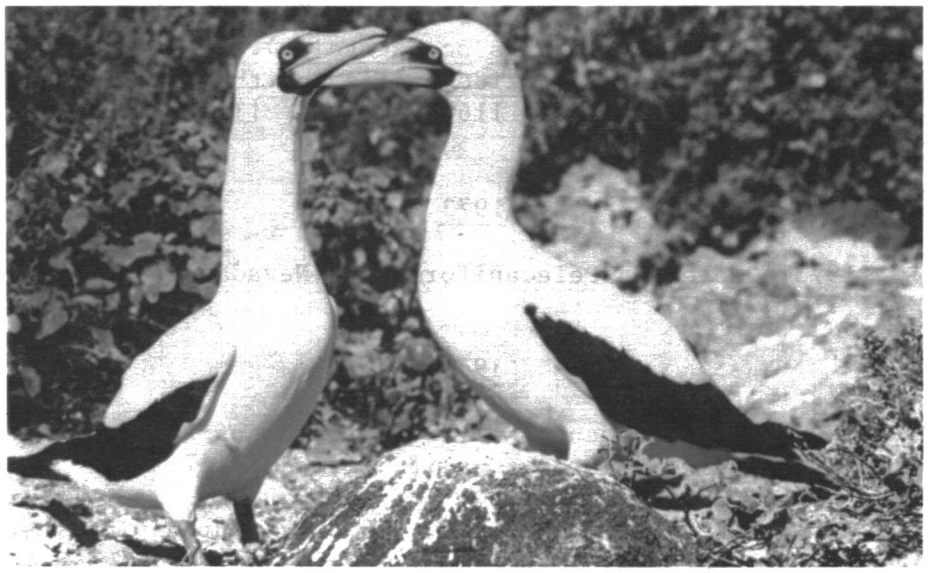
Edge, E. R. 1934. Blue-footed Booby in San Bernadino County, California. Condor 36: 88.

1930

Clary, B. L. 1930. Blue-footed Booby on the Salton Sea. Condor 32: 160-161.

1922

van Rossem, A. J. 1922. Possible occurrence of the Blue-footed Booby in southern California. Condor 24: 129.



Pair of Blue-faced Boobies, Nihoa Island, Hawaii, November 1980. Photograph by Roger B. Clapp.

BLUE-FACED BOOBY

(*Sula dactylatra*)

[EN: White Booby, FR: Fou masque, GE: Maskentolpel, IT: Sula zampe nere, SP: Bubia cariazul, Piquero blanco; US: Masked Booby]

GENERAL DISTRIBUTION

North America On the Atlantic side of North America the Blue-faced Booby breeds on cays (Cayos Arcas, Cayos Arenas, Alacran Reef) in the eastern Gulf of Mexico off Yucatan, and there are a number of known breeding stations in the Caribbean. On the Pacific side, it breeds on islands off western Mexico (Revilla Gigedos, Isabela, Clipperton, Alijos Rocks) (Lewis and Tyler 1978, Nelson 1978a). Like other members of the genus, this booby occasionally wanders far from its breeding areas, e.g., a recent sighting of this species off southern California (Lewis and Tyler 1978).

World Distribution Blue-faced Boobies are world-wide in tropical and subtropical waters. In the Indian Ocean they breed on islands in the Red Sea and Gulf of Aden, on islands to the north and east of Malagasy, in the Chagos Archipelago, on Cocos-Keeling, on islands off northeastern Australia and, although data are few, apparently in the Banda and China seas (Nelson 1978a).

In the Atlantic, Blue-faced Boobies breed on islands off Brazil (Rocas Reef, Fernando de Noronha, the Abrolhos Islands). They also breed on Boatswain Bird Island off Ascension (Nelson 1978a). Occurrence and numbers in the Caribbean are poorly known, but this species breeds or has bred in the Bahamas, Pedro and Seranilla cays, the Grenadines, the British Virgin Islands (Cockroach Cay), on Monito Island off Puerto Rico, and at least on Los Roques and Los Hermanos off the Venezuelan coast (Bond 1971, Nelson 1978a).

In the Central and Western Pacific, Blue-faced Boobies breed on islands from the Pitcairn Islands northeast to the Hawaiian Islands (Nelson 1978a). Relatively little is known of the breeding status west of Hawaii, and the species is by far the least common of the three pantropical boobies. They do breed in the southern Palau Islands (Engbring *in litt.*) and on Uracas Island, the northernmost of the Marianas (Clapp, unpubl.), as well as at several stations in the Marshall and Gilbert islands (Amerson 1969). To the south, the species breeds on many islands off northwestern Australia and reaches its southernmost breeding distribution on Lord Howe, Norfolk, and the Kermadec Islands (Nelson 1978a). In the eastern Pacific, the Blue-faced Booby nests in the Galapagos Islands, on Malpelo Island off Columbia, on La Plata Island off Ecuador, and on San Ambrosio and San Felix islands off Chile (Blake 1977, Nelson 1978a).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina We have found one published record for the Blue-faced

Booby in North Carolina waters, but consider it suspect because it was very near the northernmost latitude known for the species (Clapp 1980). It is quite likely that the birds seen were misidentified Northern Gannets, particularly because western Palearctic records attributed to Blue-faced Boobies have been discredited (Cramp et al. 1977).

1966	7 Jun.	2 imm. seen	300 yds off Bogue Banks, ca. 2 mi W Beaufort Inlet	Holmes 1966

South Carolina The only record of the Blue-faced Booby in South Carolina rests on Sprunt's assertion that he saw two adults that "swam, dived, and flew about" during a warm January day.

1937	23 Jan.	2 ad. seen	off Folly Island	Sprunt and Chamberlain 1949

Florida - Atlantic Coast Kale (1979 ms a) considers Blue-faced Boobies rare off the central and lower Atlantic coasts of Florida. This agrees with our findings from examination of the literature; we have only 19 records involving 19 individuals. Fifteen of the 19 Atlantic records are from August through November. The peak period of occurrence off the Atlantic coast is apparently at least several months later than in the Gulf (Table 60).

1961	20 May	1 seen	1 mi off Miami Beach	Abramson and Stevenson 1961
1964	1,3,9 Aug.	1 seen	18-25 mi off Cape Canaveral	Stevenson 1964a
1973	13 Aug.	1 seen	off Canaveral	Edscorn 1974
1973	20 Aug.	1 seen	off Canaveral	Edscorn 1974
1973	6 Sep.	1 seen	off Canaveral	Edscorn 1974
1974	12 Aug.	1 seen	off Canaveral	Edscorn 1975
1974	19 Aug.	1 seen	off Canaveral	Edscorn 1975
1974	18 Sep.	1 seen	off Canaveral	Edscorn 1975
1975	19 Oct.	1 photogr.	off Canaveral	Edscorn 1976
1975	31 Oct.	1 photogr.	off Canaveral	Edscorn 1976
1975	31 Oct.	1 photogr.	Homestead, Bayfront Park	Edscorn 1976
1976	13 Apr.	1 imm. seen	18 mi E Cape Canaveral	Kale 1976

1976	27 Dec.	1 seen	off Fort Pierce	Stevenson 1977
1977	12 Aug.	1 seen	off Palm Beach	Edscorn 1977
1977	5 Sep.	1 seen	off Palm Beach	Edscorn 1977
1978	8 Oct.	1 seen	off Palm Beach	Edscorn 1979
1978	11 Nov.	1 ad. caught	Palm Beach	Edscorn 1979
1978	13 Nov.	1 subad. caught	Dania Beach	Edscorn 1979
1979	13 May	1 seen	10 mi E Fort Pierce	Kale 1979

Florida - Keys (1) If there is one place where one can be almost certain of seeing Blue-faced Boobies in United States waters, it would be the warm waters of the Dry Tortugas. Until the last decade, a high proportion of the records of this species in the United States were made there. We know of approximately 27 records for the Keys, and believe that there would be more if the Tortugas were visited more frequently. The temporal distribution of records listed below probably should be regarded as biased because most were obtained when ornithologists visited the Tortugas to band Sooty Terns.

1919	16 May	1 imm. female coll. (USNM 255252)	Dry Tortugas	Howell 1932
1924	Jun.	several ad. photogr.	Dry Tortugas	Howell 1932
1925	13-24 Aug.	ca. 24 seen	Dry Tortugas	Howell 1932
1936	mid-Jun.	6 seen	Dry Tortugas	Doe and Russell 1936
1936	20 Jul.	6 seen (2 ad. photogr.)	Dry Tortugas	Russell 1937
1937	23-27 Jun.	2 ad. photogr. (1 caught, banded)	Dry Tortugas	Young and Dickinson 1937
1938	Jun.	1 ad. photogr.	Dry Tortugas	Mason 1938
1939	5 Jun.	1 seen	Dry Tortugas	Robinson 1939

(1) There is also a record of a "brown-faced booby" seen in the Tortugas in June 1940 (Robinson 1940). Presumably, the record refers to a Blue-faced Booby, because at that time the Brown Booby was usually referred to as the White-bellied Booby.

1941	9-14 Jun.	4 photogr.	Dry Tortugas	Kyle 1941
1945	Jun.	2 seen	Dry Tortugas	Sprunt 1946b
1946	17,19, 20 Jun.	2,3 seen	Dry Tortugas	Sprunt 1946a
1947	Apr.	9 seen	near Marquesas Keys	Sprunt 1948
1947	15-18 Jun.	3-4 seen	Dry Tortugas	Sprunt 1948
1947	20-27 Jun.	2 ad. seen	Dry Tortugas	Sprunt 1947
1949	Jun.	seen	Dry Tortugas	Dilley 1950
1951	22-23, 25-26 Mar.	2 ad. seen	Dry Tortugas	Robert and Stevenson 1951
1964	21 Apr.	3 seen	off Sand Key (near Key West)	Cunningham 1964b
1966	6 Nov.	1 dead subad.	Dry Tortugas	Robertson 1967
1970	3 May	4 subad. seen	Dry Tortugas, Middle Key	Kale 1970
1971	29 Apr.	17 seen (mostly ad. or subad.)	Dry Tortugas	Kale 1971
1971	1-2 May	11 seen	near Dry Tortugas	Kale 1971
1973	4 May	2 ad. seen	Dry Tortugas, near Middle Key	Kale 1973
1976	22 May	1 seen	Dry Tortugas	Kale 1976
1977	2-3 May	to 4 present	Dry Tortugas, Bush Key	Kale 1977
1978	6 May	(1?) seen	20 mi S Bahia Honda Key	Kale 1979
1978	25 May	several seen	20 mi NW Dry Tortugas	Kale 1978
1979	28 Apr., 5 May	2 seen	Middle Key, Dry Tortugas	Kale 1979

Florida - Gulf Coast Until recently, the Blue-faced Booby was considered accidental off the Gulf Coast (Kale 1979 ms b), and only a few birds had been seen. There are now no less than 18 records, half made in the last 5 years. These boobies have been recorded along the Florida Gulf Coast from March through October, but 16 of the 18 records were made from April to September, generally earlier than those on the Atlantic coast (Table 60).

1933	14 May	1 imm. seen	near Pensacola	Sprunt 1954
1950	14 Jul.	2 imm. seen	off Destin	Lowery and Newman 1951a
1954	23 Apr.	1 seen	Marco Island	Stevenson 1954b
1964	18 Apr.	3 seen	8 mi off Steinhatchee	Cunningham 1964b
1971	14 Sep.	1 sick bird (spec. USF)	St. Petersburg	Robertson 1972
1972	2 Jul.	2 seen	2 mi S St. Marks Light	Ogden 1972
1974	29 Jun.	1 imm. seen	N of Marquesas Keys	Ogden 1974
1974	1 Sep.	1 seen	2 mi off Panama City	Purrington 1975
1975	26 Oct.	1 roosting	near Marco Island	Edscorn 1976
1976	31 Mar.	1 ad. seen	Santa Rosa Island	Hamilton 1976
1976	29 May	1 sick bird found	St. Petersburg beach	Kale 1976
1977	27 Aug.	1 seen	80 mi off Clearwater	Buhrman and Hopkins 1978
1977	17 Sep.	1 seen	43 mi off Clearwater	Buhrman and Hopkins 1978
1978	6 Aug.	(1?) seen	off Clearwater	Edscorn 1979
1978	3 Sep.	(1?) seen	off Clearwater	Edscorn 1979
1978	17 Sep.	(1?) seen	off Clearwater	Edscorn 1979
1979	23 Apr.	(1?) seen	7 mi W Mullet Key	Kale 1979

Alabama As recently as 1976, Imhof (1976b) considered the Blue-faced Booby "casual, possibly rare" on the Alabama coast. The number of published records has more than doubled since then. Offshore surveys in the last few years by Duncan and Havard (1979 ms) have shown that the species is regular if not common in Alabama waters. A graph of observations in their unpublished report indicates that they made about 200 sightings of this species from 1974 through 1978, with a pronounced peak of occurrence from May through July.

1971	24 Jan.	1 subad., sick or injured	Lake Shelby, Gulf Shores	Stewart 1971, Imhof 1976b

1971	23 Apr.	6 seen (4 imm., 1 sub-ad., 1 ad.)	W end Dauphin Island	Imhof 1976b
1972	22 Jan.	1 ad. seen	Alabama Point	Imhof 1976b
1973	6 Jan.	1 seen	Alabama Point	Imhof 1976b
1974	8 Sep.	1 found	Dauphin Island	Imhof 1976b
1976	6,8 Apr.	3,4 seen	Mississippi Sound near Dauphin Island	Imhof 1976a
1977	9 Apr.	10 seen	Dauphin Island	Imhof 1977a
1977	15 Apr.	"many" seen	Dauphin Island	Imhof 1977a
1977	5 Jun.	1 imm. seen	Dauphin Island	Imhof 1977a
1977	9 Aug.	1 imm. seen	Fort Morgan	Purrington 1978
1978	10 Jun.	2 photogr.	7-8 mi off Sand Island near Dauphin Island	Jackson and Cooley 1978b
1978	2 Sep.	1 imm. seen	off Dauphin Island	Purrington 1979
1979	28 Jan.	2 seen	offshore S Alabama	Hamilton 1979
1979	24 Feb.	1 seen	offshore S Alabama	Hamilton 1979
1979	12 Apr.	4 seen	Dauphin Island	Imhof 1979

Mississippi At present there are only two sight records of the Blue-faced Booby from Mississippi. This lack of records should not be construed as showing that the species is less common there than in Alabama waters; it probably reflects the fact that more field work has been done off Alabama than off Mississippi.

1978	27 Sep.	5 ad. seen	off Biloxi	Jackson and Cooley 1978a, Purrington 1979
1979	6 July	1 imm. seen	off W end, Petit Bois Island	Cooley et al. 1979

Louisiana Through 1974, Lowery (1974) knew of 14 records for the state, extending from 1 May through 13 September. We have been able to find only 12

of these, to which we add 2 more recent December records and an October record that was apparently overlooked by Lowery. Data are few, but it appears that the status of Blue-faced Boobies off Louisiana is similar to that in other areas of the northern Gulf, i.e., probably regular or common, occurring offshore in most months but most common in mid-summer, and perhaps least common in mid-winter.

1929	28 Jul.	1 found dead	Chandeleur Islands, Grand Gosier Island	Oberholser 1938
1953	1 May	1 caught, coll. (LSU 19252)	Gueydon, Vermillion Par.	this paper
1958	4 Jun.	1 imm. apparently seen	ca. 45 mi SW Grand Isle	Newman 1958
1958	ca. 8 Aug.	1 imm. capt. (perhaps this species)	captured with broken wing in marsh near Cameron	Newman 1958
1961	13 Sep.	1 female found, coll. LSU 25127)	Jackson, E. Feliciana Par.	Lowery 1974
1967	4 Jul.	1 coll.	Caillou Bay, Terrebonne Par.	J. Stewart 1967
1969?	12 Aug.	1 coll. (1) (LSU 60752)	landed on boat, Cameron Par.	this paper
1970	10 Jul.	1 found dead in drift line	within 38 mi of S. Pass	J. Stewart 1970
1970	29 Jul.	2 seen	within 38 mi of S. Pass	J. Stewart 1970
1970	3 Sep.	1 seen	within 38 mi of S. Pass	J. Stewart 1970
1971	26 Aug.	2 imm. seen	27 mi off S. Pass	Purrington 1972
1971	15-16 Oct.	1+ ad. seen	27 mi off S. Pass	Purrington 1972
1976	4,11,14 Dec.	1 ad. seen	from oil rig ca. 120 km S of Sabine River	Hamilton 1977

(1) Specimen had oil spots on the breast.

1977	1-7 Dec.	several seen daily	from oil platform 100 mi S of Cameron	Hamilton 1978

Texas Oberholser (1974) considered Blue-faced Boobies scarce to rare and irregular visitors on the Texas coast. At the time of publication of his book, he knew of "at least 33 records" that had occurred between 15 March and 23 September. We found 47 records, not counting 5 made recently by Hoffman, but list only those believed to be based on collected specimens, or those which are more recent than the latest listed by Oberholser (1974).

The burgeoning number of records in recent years, coinciding with increased observation offshore, indicates that, as in Alabama, these boobies are regular and possibly common pelagic visitors. The species has been recorded in all months except December, but an examination of the records available to us indicates that Blue-faced Boobies are most frequent from May through August.

1885	8 Jun.	1 coll. (U. Iowa)	Matagorda Bay	Oberholser 1974
1892	6 Jul.	1 imm. coll. (USNM 131594)	Rockport, Aransas Co.	Oberholser 1974
1893	10 Jul.	1 imm. female coll. (USNM 131595)	Rockport, Aransas Co.	Oberholser 1974
1937	6 Sep.	1 coll.	Pelican Island in Pass Cavallo	Oberholser 1974
1953	30 Jun.	1 imm. coll. (Texas A&M 7074)	Galveston Island	Oberholser 1974, Goldman and Watson 1953
1966	15 Mar.	1 subad. found dead (WWF 1474)	N Padre Island, Kleberg Co.	Blacklock 1978 ms
1966	23 Jun.	1 imm. female (1) found dead (WWF 1510)	Loyola Beach, Kleberg Co.	Oberholser 1974
1966	24 Nov.	1 coll. (LSU 63565)	Copano Bay, Refugio Co.	Blacklock 1978 ms
1967	23 Sep.	1 female found dead (WWF 1405)	40 mi S Bob Hall Pier, Kleberg Co.	Oberholser 1974, Blacklock 1978 ms
1968	11 May	1 subad. female coll. (Texas A&I 33)	N. Padre Island, Kleberg Co.	Oberholser 1974

(1) Blacklock (1978 ms) lists this bird as a subadult male.

1968	6 Jun.	2 females coll. (WWF 1472,1473)	Mustang Island, Neuces Co.	Blacklock 1978 ms
1970	10 Jun.	1 male found dead (Texas A&I 382)	N. Padre Island, Neuces Co.	Oberholser 1974, Blacklock 1978 ms
1972	7 Aug.	1 subad. seen	feeding off Galveston beach	Webster 1972d
1972	3 Sep.	1 ad. seen	ca. 30 mi E Galveston	Webster 1973a
1972	9 Sep.	1 imm. male coll. (USNM 573669)	Port Aransas, Neuces Co.	Blacklock 1978 ms
1974	Jan.	several(?) seen	Corpus Christi area	Webster 1974b
1974	4 Mar.	1 subad. found dead (WWF 1932)	4 mi S Bob Hall Pier, N Padre Island	Blacklock 1978 ms
1974	10-17 Jun.	1 imm. seen	near Freeport	Webster 1974c
1974	21-24 Jun.	1 imm. seen	Galveston south jetty	Webster 1974c
1974	25 Jun.	1 ad. seen	Bolivar flats, Galveston	Webster 1974c
1975	Sep.	several seen	Padre Island and offshore	Webster 1976a
1975	Sep.(?)	3 subad. seen	fishing off Port Aransas jetties	Webster 1976a
1976	10 Apr.	1 seen	20 mi off Galveston	Webster 1976c
1976	16 Aug.	1 ad. seen	Freeport	Webster 1977a
1976	25 Aug.	1 female coll.	Port Aransas, Neuces Co.	Blacklock 1978 ms
1976	28 Aug.	1 subad. seen	Port Aransas jetty	Webster 1977a
1976	2 Oct.	2 subad. seen	ca. 40 mi off Port Aransas	Webster 1977a
1977	8 Mar.	2 seen	ca. 40 mi off Port Aransas	Webster 1977c
1977	27 Aug.	4 ad. seen	Bolivar Peninsula	Webster 1978a

1977	12 Nov.	a few late sub-ad. seen	off Freeport jetties	Webster 1978a
1979	16 Feb.	1 ad. seen	flying over resaca, Brownsville	Webster 1979b
1979	Aug.	8 found oiled	following IXTOC I spill	C. Duncan *in litt*.
1979	20 Aug.	3 seen	from air in one group off Brownsville	Hoffman, this paper
1979	21 Aug.	2 seen	from air in one group off Brownsville	Hoffman, this paper
1979	23 Aug.	1 seen	off Corpus Christi during aerial survey	Hoffman, this paper
1979	24 Aug.	4 seen	from air in two groups off Corpus Christi	Hoffman, this paper
1979	25 Aug.	3 seen	from air in one group off Corpus Christi	Hoffman, this paper

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Blue-faced Boobies are birds of pantropical distribution that breed between about 25° N and 29° 50' S latitude. They nest colonially on islands, and are believed to be one of the world's three most common sulids (Nelson 1978a). The majority of colonies are probably relatively small, but colonies can be very large where few nesting areas are available. The colony on Boatswain Bird Island in the Atlantic, with a total population of 8,500-11,000 birds, and the one on Culpepper Island in the Galapagos, with perhaps 5,000 pairs, are among the largest known (Nelson 1978a).

Colonies in the southern Gulf of Mexico are the most likely source of most Blue-faced Boobies seen in the northern Gulf, but little information is available on the size (or number) of these colonies. Boswall (1978) estimated that 2,000 adults and young were present on Isla Desertora, Alacran Reef, in early September 1975, and reported that the species still breeds, apparently in small numbers, on Isla Pajaros, Alacran Reef. Paynter (1955) estimated an additional 5,000 birds on Cayos Arcas and 400 on Cayos Arenas, but this information is almost 30 years out of date; a thorough survey of the area has apparently never been made during the probable peak (June-July) of breeding.

Nonbreeding and Migration Nonbreeding Blue-faced Boobies disperse widely at sea but are not known to perform true migrations. This may be the most oceanic booby (Palmer 1962), but it remains rather strictly within subtropical and tropical waters.

Blue-faced Boobies have been recorded from all of the southeastern states

Table 60. Approximate number of Blue-faced Boobies recorded by month for the coastal southeastern United States (a).

State/region	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	-	-	-	-	-	-	-	-	-	-	-
South Carolina	1	-	-	-	-	-	-	-	-	-	-	-
Georgia	-	-	-	-	-	-	-	-	-	-	-	-
Florida-Atlantic Coast	-	-	-	1	2	-	-	6	3	4	2	1
Subtotal-ATLANTIC COAST	1	-	-	1	2	-	-	6	3	4	2	1
Florida-Keys	-	-	2	31	28	27	-	24	1	-	-	-
Florida-Gulf Coast	-	-	1	5	2	2	4	2	5	1	-	-
Alabama	5	1	-	26	-	3	-	1	2	-	-	-
Mississippi	-	-	-	-	-	-	-	-	5	-	-	-
Louisiana	-	-	-	-	-	3	5	4	2	1	-	3
Texas	6	2	3	2	11	14	5	30	10	2	3	-
Subtotal-GULF COAST	11	3	4	33	13	22	14	37	24	4	3	3
Total-ALL AREAS	12	3	6	65	43	49	14	67	28	8	5	4

(a) Birds found dead within the first 10 days of a month are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. If the source indicated more than one was seen (i.e., "several", "a few"), we have assumed two were seen. The table does not include some records from Alabama not available to us.

except Georgia. There are only two records north of Florida, one of which is probably invalid. Records from the Atlantic coast are predominantly from fall and winter (Table 60), suggesting that these are nonbreeding birds dispersing northward. (Possibly some records are of misidentified Northern Gannets; reports of Blue-faced Boobies in more northern waters off the Atlantic coast should be viewed with skepticism unless documented very carefully). Records from the Gulf of Mexico have been made throughout the year (Tables 60, 61), with most between April and September. The relatively few reports that specify age suggest that most of these are of young birds wandering north from their natal islands.

The rapidly increasing number of records from states where offshore observations are now being made at least semi-regularly suggest that this booby has always been a significant component of the off-shore avifauna, but one whose status has been severely underestimated because of its pelagic nature.

Table 61. Dates of occurrence for Blue-faced Boobies in the coastal southeastern United States.

State/region	Approximate number of occurrences	Dates of occurrence
North Carolina	1	7 June
South Carolina	1	23 January
Georgia	unrecorded	
Florida-Atlantic Coast	19	13 April - 27 December
Florida-Keys	ca. 27	22 March - 6 November (a)
Florida-Gulf Coast	18	31 March - 26 October
Alabama	ca. 15 (b)	6 January - 8 September
Mississippi	1	27 September
Louisiana	ca. 16	1 May - 14 December
Texas	ca. 52	1 January - 24 November

(a) Record is from bird found dead.
(b) Data received from C. Duncan (in litt.) subsequent to the completion of this account list 37 records obtained offshore from 1975 through 1978.

HABITAT

Nesting Blue-faced Boobies breed colonially, primarily on tropical islands, but have been recorded nesting on headlands in Australia. They characteristically nest on barren slopes or more level ground, usually in peripheral areas of bare ground (e.g., sandy beaches) or in poorly vegetated, open areas among scrub. Nests are usually at low elevations, but may be found up to 800 ft (Clapp et al. 1977, Nelson 1978a).

These boobies rarely nest on cliff ledges; when they do, their nests are found in more level areas. Flat cliff top margins are used, however, as on Ascension Island and Nihoa Island (Clapp et al. 1977, Nelson 1978a). The primary factor in choice of nesting habitat is thought to be proximity to clear blue water (Nelson 1978a).

Colonies are usually small and of low density. Kepler (in Nelson 1978a) reported a nesting density of ca. 1 pair per 201 sq m, while Nelson (1978a) gave nesting densities of 1 pair per 125 sq m and 1 per 84 sq m for Tower and Hood islands in the Galapagos. On Malden Island in the Line Islands the nesting density for most areas is considerably less, with nests 100 m or more apart. This very low density is very likely a response to continued disruption of nesting activities by feral pigs (Sus scrofa). The greatest nesting density known is on Boatswain Bird Island (ca. 1 pair per 3.3 sq m), which Nelson (1978a) suggested was the result of a lack of alternative sites.

"Colony" size may vary from as small as a single pair (Sydney Island in the Phoenix Islands) to as large as 1,200-1,300 pairs on Boatswain Bird Island

(Dorward 1962a), and at least 2,500 pairs on Tower Island in the Galapagos (Nelson 1978a). Colonies are typically small, however, with most holding perhaps from 50 to several hundred pairs.

Feeding and Offshore Blue-faced Boobies are highly pelagic and seldom feed inshore, even off the breeding colonies. They are often attracted to ships, but usually circle the vessel a few times and depart. Young birds are more curious than adults and may land on vessels, remaining there for an hour or more. Although this species does not usually follow ships, we know of at least one instance in which a fledged juvenile followed a ship for 18 mi or more.

Palmer (1962) noted that Blue-faced Boobies readily perch on buoys and pilings, and Ortego (1978) presented some evidence that they prefer to feed close to oil production platforms in the Gulf of Mexico. Ortego suggested that this was because the petroleum platforms, like artificial reefs, attract fish. The boobies are in turn attracted to this unusually dense food concentration.

FOOD AND FEEDING BEHAVIOR

Blue-faced Boobies feed primarily on flying fish and ommastrephid squid; these items are those most commonly regurgitated on many islands of the Central Pacific. In the Northwestern Hawaiian Islands, a carangid fish (*Decapterus* sp.) is as important a source of food as flying fish (C. Harrison, *in litt*). Dorward (1962a) reported that the principal food at Ascension was a flying fish (*Exocoetus volitans*). Nelson (1978a) listed other localities at which flying fish and squid have been taken.

Some other species of fish reported eaten by Blue-faced Boobies include exocoetids *Oxyporhamphus micropterus*, *Cypselurus* sp., scombrids (*Euthynnus affinis*, *Katsuwonis pelamis*), trichiurids (*Benthodesmus simonyi*), carangids (*Selar crumenopthalmus*), holocentrids (*Holocentrus ascensionis*), centrolophids (*Centrolophus niger*), scomberesocids (*Scomberesox saurus*), coryphaenids (*Coryphaena equisitis*), and blennies (*Ophioblennius webbi*) (Dorward 1962a, Schreiber and Hensley 1976, C. Harrison, *in litt*).

Resource partitioning between Blue-faced Boobies and other pelecaniforms was clearly evident on Christmas Island, Pacific Ocean (Schreiber and Hensley 1976) and in the Northwestern Hawaiian Islands (C. Harrison, *in litt*.). The Blue-faced Boobies took more and larger fish than the Red-footed Booby but the latter took more squid.

Blue-faced Boobies primarily plunge dive and pursue fish under water. They may dive from 15-35 m to a depth of 6-10 ft, remaining submerged about 6 seconds (Palmer 1962, Simmons *in* Nelson 1978a). These boobies are apparently more typical vertical plungers than the Brown Booby, and only seldom make shallow slanting dives. They may also seize flying fish in flight, but apparently do so less than Red-footed and Brown boobies (Nelson 1978a). They primarily feed singly or in pairs far out at sea, but will occasionally congregate inshore where they may feed with Brown Boobies (Simmons *in* Nelson 1978a).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Blue-faced Boobies may lay in any month of the year in some areas but in most areas egg laying is concentrated during one portion of the year or another. Nelson (1978a) summarized much of what is known of laying periods and the remarks here on laying are largely taken from that source. On the Alacran Reefs in the Gulf of Mexico laying is apparently in February and May, whereas on Monito Island in the Caribbean most apparently occurs from September to June. At Ascension in the Atlantic, most laying occurs from June to August. In the Coral Sea birds breed continuously, with laying peaks in spring and fall; in the Phoenix Islands in the Central Pacific there is an April-June laying peak, but eggs may be laid in any month of the year. Laying also occurs in any month in the Galapagos, but peak laying is usually between August and January.

Mean Clutch Size Blue-faced Boobies frequently lay one-egg clutches; three-egg clutches are very rare, and two-egg clutches predominate. As many as seven eggs have been found in one nest (Dorward 1962a), but this resulted from eggs that had been rolled from neighboring nests. In one instance of a four-egg "clutch", two females had laid in the same nest (Clapp, unpubl.). The proportion of birds laying two-egg clutches varies from area to area and may vary between years within a single colony. Dorward (1962a) reported a mean "clutch-size" of 1.3 (n = 96) for birds at Ascension, but this was a count of eggs in nests. Dorward pointed out that this count gave a misleading result because these birds rolled eggs into their nests from others nearby and because eggs were lost. Some data on more accurately determined clutch-sizes are presented in Table 62.

Table 62. Mean clutch-size of the Blue-faced Booby (a).

Mean	N	Mode	Remarks	Area	Source
1.57	14	2 (57%)	(first) clutches in year, minimal clutch size recorded	Kure Atoll, Central Pacific	Woodward 1972
1.94	54	2 (91%)	(first) clutches in year, maximum clutch size recorded	"	"
1.88	192	2 (87%)	all clutches recorded over a 6 year period	"	"
1.67	24		replaced clutches	"	"

(a) Additional data are given by Nelson (1978a) for the Galapagos, but we are not certain that they are comparable to those included here.

Incubation Period Incubation period of the Blue-faced Booby is best known from studies conducted on Kure Atoll. There, the mean incubation period for first eggs of a clutch was 43.6 days (n = 97, range = 40-48); for second eggs, the mean was 42.7 days (n = 73, range = 40-47) (Woodward 1972). Dorward (1962a) stated that the incubation period of this booby at Ascension ranged from 42-46 days, but presented no further details.

Hatching Success Over 6 years at Kure Atoll, 53.7% of 410 eggs laid hatched (Woodward 1972). On Ascension, 37% of 631 clutches in one study area and 56% of 68 clutches in another "gave rise to a chick" (Nelson 1978a). Finally, 79.6% of 49 eggs laid on Tower Island, Galapagos, hatched but Nelson (1978a) felt this figure was unfairly high and probably not representative of the colony as a whole.

Fledging Success Fledging success is often regarded as the proportion of eggs laid that fledge young, or sometimes as the number of eggs hatched that fledge young. Neither of these figures is adequately comparable with those for most other species because Blue-faced Boobies practice fratricide and only seldom are two young fledged from one nest. Over 5 years at Kure Atoll (1964-68), 32.3% of 344 eggs laid yearly (range = 25.7-44.4%) fledged young, and 63.4% of 175 eggs hatched fledged young (range = 53.7-90.3%). At one Galapagos colony, 79.5% of eggs hatched fledged young but at another, the figure was only 25%; at Ascension, 25% of 272 eggs hatched fledged young during one year (Nelson 1978a).

Age at Fledging Woodward (1972) found a mean fledging period of 123 days (n = 44, range = 109-151) for Blue-faced Boobies at Kure Atoll, Northwestern Hawaiian Islands; similar values have been found elsewhere. The normal fledging age at Ascension was regarded as 120 days (Dorward 1962a), and a mean of about 117 days (n = 7, range = 113 $\pm$ ca. 121 days) resulted from data gathered at Tower Island in the Galapagos. Nelson (1978a) pointed out that the true mean in the latter area was probably closer to 120 days, because some of the figures he obtained were most likely underestimates.

Age at First Breeding The most complete information on this topic is from Kure Atoll where some birds may breed in their third year, but most apparently first breed in their fourth year (Woodward 1972). More limited information from the Galapagos suggests a similar pattern. One booby banded there as a young bird was found defending a nest site when almost 3 years old; another was found incubating eggs in its fourth year (Harris 1979).

Mortality of Eggs and Young The primary sources of egg loss in this species are apparently infertility and abandonment, the latter frequently the result of food shortages (Nelson 1978a). In some areas where nests are found near sea-level, climatic conditions may result in considerable egg loss at times (Amerson 1971). Predation is rare, because few of the breeding islands have any natural predators of the eggs.

Nelson (1978a) considered that chick loss in the Blue-faced Booby was primarily attributable to direct or indirect difficulties in finding food. Predation by animals other than man is thought to be unimportant in determining nesting success in this species (Nelson 1978a). Nelson does mention predation

of chicks by birds (in the Galapagos, Short-eared Owls, Asio flammeus) and introduced mammals suchs as rats, cats, and pigs. In at least some instances, predation by introduced mammals has been considered serious (Gillham 1977 in Feare 1978).

Renesting Blue-faced Boobies may renest after loss of eggs and young; Nelson (1978a) suggested that the extent to which this occurs may vary from area to area and season to season. Renesting was not observed in the Galapagos or on Ascension, but 10.5% (n = 19) to 42.9% (n = 21) of lost clutches were replaced in 1964 and 1965 on Kure Atoll (Nelson 1978a). The average interval between loss of egg or chick and replacement of the first egg on Kure Atoll was 30.5 days (range = 17-59, n = 11) (Kepler 1969).

Maximum Natural Longevity The oldest Blue-faced Booby recorded by Old World banding organizations was a bird banded as a pullus and breeding when recaptured (Rydzewski 1978). This bird had an estimated minimum age of 11 years and 6 months. In fact, this species regularly lives to this age, and often lives much longer. The oldest bird yet recorded under the auspices of the North American bird-banding program was a juvenile banded on Howland Island in the Central Pacific that was recaptured at the same place when at least 25 years, 3 months old (Clapp et al. 1979 ms).

Nelson (1978a) used Woodward's (1972) data and calculated that average annual mortality after the second year was 8.6%, and he thought that it might be even a little lower; he suggested an average life expectancy of 16.2 years, with some birds reaching an age of more than 30 years.

Weight (in grams) Pertinent information on Blue-faced Booby weights is listed in Table 63.

SUSCEPTIBILITY TO OIL POLLUTION

Oiled Blue-faced Boobies have been recorded several times in the Gulf of Mexico, and oiled birds have been seen in the Northwestern Hawaiian Islands (C. Harrison, pers. comm.). This species was the most frequent victim of the recent IXTOC I oil spill in the Gulf of Mexico (C. Duncan, in litt.), and Duncan and Havard (1980) estimated that as many as 800 birds may have been affected. This number possibly composed a large proportion of the Gulf population. This plunge-diving species is probably less susceptible in other areas of warmer water, but it may be attracted both to ships and oil production platforms. Blue-faced Boobies are clearly at hazard from oil-development activities in southeastern waters.

This species is the rarest and most local of the pantropical boobies, and many populations are declining (Feare 1978, Nelson 1978a). Consequently, every attempt should be made to monitor the remaining North American population and to take preventive measures to avoid its elimination.

Table 63. Weights of Blue-faced Boobies (in grams).

Mean weight	Range	N	Sample and season	Area (a)	Source
1,596	1,390-1,696	4	males, Feb.-Apr.	Central Pacific	Clapp, in prep.
1,566	1,310-1,780	12	males, Sep.-Dec.	"	"
1,687	1,549-1,966	6	males, May-Jun.	"	"
1,880	1,503-2,211	27	males	Kure Atoll, Central Pacific	Kepler 1969
1,733	1,550-2,000	9	males	Christmas Island	Schreiber and Hensley 1976
1,627	1,220-1,970	48	males	Galapagos	Nelson 1978a
1,565	1,480-1,660	6	males	Arabian Sea	Bailey 1966
1,868	1,603-2,232	10	females, Feb.-Apr.	Central Pacific	Clapp, in prep.
1,710	1,628-1,820	9	females, Sep.-Dec.	"	"
1,828	1,373-2,085	9	females, May-Jun.	"	"
2,095	1,616-2,353	27	females	Kure Atoll, Central Pacific	Kepler 1969
1,620	1,550-1,700	8	females	Christmas Island	Schreiber and Hensley 1976
1,881	1,470-2,350	37	females	Galapagos	Nelson 1978a
-----	40 to ca. 60	--	newly hatched chick	----------	Nelson 1978a
67.3	52-82.5	12	fresh eggs	Ascension	Dorward 1962a
68.3	65-70	3	fresh eggs	Galapagos	Nelson 1978a

(a) Birds from the Central Pacific are *Sula dactylatra personata*, those from the Galapagos, *S. d. granti*, and those from the Arabian Sea, *S. d. melanops*.

BIBLIOGRAPHY

1980

Clapp, R. B. 1980. Occurrence of Central Pacific Blue-faced Booby and Sooty Tern in Southeast Asia. Tori 29: 95-96.

Harrison, C. S. and T. S. Hida. 1980. The status of seabird research in the Northwestern Hawaiian Islands. Pp. 17-31 in Proc. Sympos. on Status of Resource Investigations in the Northwestern Hawaiian Islands, April 24-25, 1980. Univ. Hawaii Sea Grant Program (UNHI-SEAGRANT-MR-80-04), Honolulu, HI.

Stevenson, H. M. 1980. A specimen of the Blue-faced Booby in northwest Florida. Fla. Field Nat. 8: 46.

1979

Brown, B. and D. A. Lawrie. 1979. Masked (Blue-faced) Boobies in the Firth of Thames. Notornis 26: 304-305.

Cooley, C. D., J. A. Jackson and D. K. Cavin. 1979. Blue-faced Booby near Horn Island, Mississippi. Mississippi Kite 9: 42.

Harris, M. P. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

Morrison, M. L. 1979. Eggshell thickness changes in Pacific Ocean Phaethonidae and Sulidae. Condor 81: 209.

1978

Feare, C. J. 1978. The decline of the booby (Sulidae) populations in the western Indian Ocean. Biol. Conserv. 14: 295-305.

Lewis, D. B. and W. B. Tyler. 1978. First record of the Blue-faced Booby from the Pacific coast of the United States. West. Birds 9: 175-176.

Nelson, J. B. 1978a. The Sulidae. Gannets and Boobies. Oxford Univ. Press, Oxford. 1012 pp.

Ortego, B. 1978. Blue-faced Boobies at an oil production platform. Auk 95: 762-763.

Peirce, M. A. and C. J. Feare. 1978. Piroplasmosis in the Masked Booby *Sula dactylatra melanops* in the Amirantes, Indian Ocean. Bull. Br. Ornithol. Club 98: 38-40.

1977

Gillham, M. E. 1977. Observations on the vegetation of Blue-faced Booby colonies on Cosmoledo Atoll, western Indian Ocean. Atoll Res. Bull. 199: 1-11.

Roberts, G. 1977. A record of the Red-footed Booby and Masked Booby from southeastern Queensland. Sunbird 8: 23.

1976

Schreiber, R. W. and D. A. Hensley. 1976. The diets of Sula dactylatra, Sula sula and Fregata minor on Christmas Island, Pacific Ocean. Pac. Sci. 30: 241-248.

1974

Bahamonde, N. 1964. El piquero blanco (Sula dactylatra granti Rothschild) de Islas Desventuradas. Notic. Mens. Mus. Nac. Hist. Nat. 18: 3-7.

Oreel, G. J. and K. H. Voous. 1974. Masked Boobies Sula dactylatra off the coast of West Africa: a correction. Ardea 62: 130-132.

1969

Kepler, C. B. 1969. Breeding biology of the Blue-faced Booby Sula dactylatra personata on Green Island, Kure Atoll. Publ. Nuttall Ornithol. Club 8. 97 pp.

1968

van Gessel, F. W. C. 1968. The Masked Gannet a sight record from Granite Island, S.A. S. Austr. Ornithol. 25: 55.

1967

Nelson, J. B. 1967. The breeding behaviour of the White Booby Sula dactylatra. Ibis 109: 194-231.

1966

Batholomew, A. 1966. The role of behavior in the temperature regulation of the Masked Booby. Condor 68: 523-535.

Holmes, R. P. 1966. Atlantic Blue-faced Booby off Bogue Banks, North Carolina. Chat 30: 107.

Parnell, J. F. 1966. Atlantic Blue-faced Booby off Bogue Banks, North Carolina. Chat 30: 107.

1964

Curio, E. 1964. Fluchtmangel bei Galapagos-Topeln. J. Ornithol. 105: 334-339.

1962

Dorward, D. F. 1962a. Comparative biology of the White Booby and the Brown Booby Sula spp. at Ascension. Ibis 103b: 174-220.

Dorward, D. F. 1962b. Behavior of boobies Sula spp. Ibis 103b: 221-234.

Wetmore, A. 1962. An erroneous report for Sula dactylatra melanops. Auk 79: 265.

1937

Russell, J. C. 1937. Blue-faced Booby at Tortugas. Fla. Nat. 10: 41-42.

1933

DuMont, P. A. 1933. Old specimen of the Blue-faced Booby from Texas. Auk 50: 92.

1932

Risser, A. 1932. Unusual summer birds from the vicinity of Brownsville, Texas. Auk 49: 106-107.

Wetmore, A. 1932. An erroneous record for the Peruvian Booby. Condor 44: 34-48.

1931

Bailey, A. M. and E. G. Wright. 1931. Birds of southern Louisiana. Wilson Bull. 43: 114-142, 190-219.

1915

Rothschild, W. 1915. Notes on the genus Sula. Bull. Br. Ornithol. Club 35: 41-45.

1904

Fisher, W. K. 1904. Three boobies interviewed. Condor 6: 89-94.

RED-FOOTED BOOBY

(*Sula sula*)

[RU: (Red-legged Gannet), SP: Bubia pies rojos]

GENERAL DISTRIBUTION

North America Off the west coast of North America, Red-footed Boobies breed on islands off Mexico (Revilla Gigedos, Clipperton) and Costa Rica (Cocos Island). These boobies do not breed in the Gulf of Mexico, but do breed widely in the Caribbean from Half Moon Cay off Belize and Little Swan and Little Cayman islands east to Mona and Desecheo islands off Puerto Rico, and to the Virgin Islands (Nelson 1978a).

Red-footed Boobies may wander widely within their breeding range and occasionally straggle well outside it. They have wandered north to Quintana Roo, Mexico (Blake 1977), and to the Farallon Islands in California (Huber 1975, Stallcup and Winter 1976).

World Distribution Red-footed Boobies occur pantropically in the world's oceans. There are many other breeding areas in the Caribbean south of those noted above: these boobies breed south to Albuquerque Cay and from Las Aves and Los Roques off Venezuela east to Trinidad and Tobago (Nelson 1978a). In the Atlantic Red-footed Boobies breed on Fernando de Noronha, South Trinidad (Trindade) off Brazil, and on isolated Boatswain Bird Island near Ascension.

In the Indian Ocean and adjacent areas these boobies breed on islands north of Malagasy (Aldabra to the Agalega Islands) and to the east (Tromelin Island); they also breed at scattered localities in the central Indian Ocean (e.g., Chagos Archipelago) and in the eastern Indian Ocean at Cocos-Keeling and Christmas islands. Breeding distribution to the east of here is poorly documented, but the species is known to breed at stations in the Banda, Sulu, and South China seas (Nelson 1978a).

In the central and western Pacific, the Red-footed Booby breeds from the Pitcairn Islands north through the Marquesas, Line, and Hawaiian islands west to Maug in the northern Marianas (Clapp, unpubl.), south to the Palau Islands, to Raine Island and islands in the Coral Sea off northeastern Australia, then east to Fiji and the Austral islands. They also breed in the Galapagos Islands in the eastern Pacific (Nelson 1978a).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

These boobies have been recorded from only three of the southeastern states, and occur fairly regularly only at the Dry Tortugas in Florida. They are not known to breed in the Gulf of Mexico, and are vagrant in the two other states, Louisiana and Texas, from which they have been recorded. Records known to us from these three states are listed below:

	Florida - Atlantic Coast			
1895	16 Feb.	many seen after severe storm (1)	off Micco (near Sebastian Inlet), Brevard Co	Bangs 1902, Woolfenden 1965
1949	4 Sep.	1 imm. seen (2)	Neptune Beach, Duval Co.	Nicholson 1955
	Florida - Keys			
1964	14-30 Jun.	1 imm. seen, photogr.	Dry Tortugas	Robertson and Mason 1965
1968	27-28 Jul.	1 seen, photogr.	Dry Tortugas	Stevenson 1968b
1970	30 May	1 subad. seen	Dry Tortugas	Kale 1970
1970	4 Aug., 6 Sep.	2, 1 subad. seen	Dry Tortugas	Ogden 1970, Robertson 1971
1974	4-5 May, 17-22 Jun.	1 subad. seen	Dry Tortugas	Kale 1974, Ogden 1974
1977	2-3 May	1 seen	Dry Tortugas	Kale 1977
1978	22 Apr.	1 seen	20 mi NW Dry Tortugas	Kale 1978
1978	6 May	? seen	20 mi S Bahia Honda Key	Kale 1979
1978	4 Jul.	1 subad. seen	Dry Tortugas	Ogden 1978
1979	24 Apr.-26 May	1 imm. seen	Dry Tortugas	Kale 1979
	Florida - Gulf Coast			
1963	30 Sep.	1 sick subad. male coll.	Clearwater Beach, 1 mi S Carlouel	Woolfenden 1965
	Louisiana			
1940	1 Nov.	1 imm. coll.	mouth of Bayou Scofield	Lowery 1974

(1) The validity of this record is somewhat suspect.
(2) From the description given, this bird might have been an immature Brown Booby. The locality at which this bird was seen (northeastern Florida) is also one at which the occurrence of a Brown Booby would be more likely.

Texas

before 1910 -----	1 coll.	Rockport, Aransas Co.	Oberholser 1974
1968 26 Aug.	1 seen	S. Padre Island, Cameron Co.	Oberholser 1974

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

The Red-footed Booby is an abundant, widespread pantropical seabird with a world population in the hundreds of thousands. Adequate information on populations throughout its range is lacking, but the population on Tower Island, Galapagos, an estimated 140,000 pairs, is presently thought to be the largest in the world (Nelson 1978a). Other particularly large populations (Nelson 1978a) are on Christmas Island in the Indian Ocean (5,000-10,000 pairs or more), Christmas Island in the Pacific Ocean (ca. 5,000 pairs), Aldabra in the Indian Ocean (more than 10,000 birds), and Palmyra Atoll in the Pacific Ocean (more than 20,000 birds).

The species occurs widely in the Caribbean but details on populations and occurrence are largely lacking. It is likely, although unproven, that this area is the source of wandering birds occasionally found along the southeastern coast of the United States and more regularly at the Dry Tortugas.

HABITAT

Nesting Red-footed Boobies breed colonially on islands, cays, and other isolated areas and build their nests primarily in trees or shrubs. On islands where there are few or no bushes or shrubs, nests are occasionally placed on low structures such as bare rock walls (e.g., McKean Island) or protruding rock outcroppings (e.g., Malden Island). Nests may be in bushes so sparse that the nest entirely obscures the bush and is almost on the ground, or they may be in the boughs of trees. "Stack" nests are rarely built on the ground but some of these nests may have been "adopted" from previous owners (such as Great Frigatebirds, *Fregata minor*), or may have originally been placed on very small bushes.

Almost any sort of emergent shrub or tree will serve their nesting requirements, although they avoid coconut palms. Nelson (1978a) pointed out that the most frequently used trees within their range may be mangroves (*Pisonia* and *Tournefortia*). Various species of *Cordia* are also frequently used, and on the desert islands of the Central Pacific the relatively frail *Sida fallax* is used in the absence of other, better, nest sites. In taller trees, Red-footed Boobies usually nest under the canopy and often well within the outer fringes of the leaves. Most nests are relatively low, usually on the order of 5-10 m above the ground (Nelson 1978a).

Feeding and Offshore Among the most pelagic boobies, Red-footed Boobies often feed many kilometers from the nearest land. In open waters this

species may be found 100-150 km from the breeding colony and more than 70 km from land (Nelson 1978a). Inshore feeding may also occur, as Diamond (1974) recorded them feeding as close as a half mile from the reef at Aldabra Atoll. He pointed out, however, that this species might better be termed a "deep-water" feeder because even half a mile off the reef the water may have been over 500 m deep.

FOOD AND FEEDING BEHAVIOR

Like its congener, the Blue-faced Booby, the diet of the Red-footed Booby consists primarily of flying fish (Exocoetidae) and squid. In studies conducted at Aldabra Atoll in the Indian Ocean, Diamond (1974) found that food regurgitated by chicks consisted by weight of 79% and 99% fish (almost entirely flying fish) in the wet and dry seasons, respectively, with squid constituting the remainder. Most of the food weighed 50 to 100 g, and length was mostly between 10 and 22 cm.

On Christmas Island in the Pacific, Schreiber collected regurgitation samples from adults, subadults, and nestlings (Schreiber and Hensley 1976). Fish (again mainly flying fish) and squid predominated, with some variation in the amounts of each taken from season to season. Fish (by weight) made up 66% (June-July) to 85% (August) of all food taken, with squid constituting the rest of the diet. Samples from May had intermediate values. The majority of the fish (87%) ranged from 6 to 15 cm in length; a similar proportion of squid (89%) fell within this size range.

A few regurgitation samples were taken by the Ashmoles during April-June on Oahu, Hawaiian Islands. They found that fish were 61% (by volume) of the diet, and squid 39%. Most of the fish (78%) were between 4 and 12 cm in length (Ashmole and Ashmole 1967).

Aside from flying fish, fish found in regurgitation samples had representatives from the following families: Gempyidae, Coryphaenidae, Tetradontidae, Balistidae, and Hemirhampidae (Ashmole and Ashmole 1967, Diamond 1974, Schreiber and Hensley 1976). Squid eaten, when identifiable, have been predominantly Ommastrephidae, mainly Symplectoteuthis sp. (Ashmole and Ashmole 1967, Diamond 1974).

Red-footed Boobies primarily feed by plunge diving, but also have been observed catching flying fish in the air. Harris (1975) stated that they also commonly power dive, using their wings to increase their speed before they enter the water. Red-footed Boobies also seize fish while sitting on the surface of the water; Nelson (1978a) speculated that this booby is particularly prone to capture fish at or near the surface of the water.

The majority of foraging is done in the early morning but fishing may be actively undertaken at any time of day. Nelson (1978a) pointed out that this sulid is "markedly nocturnal" and may forage more at night than do other species of Booby.

Birds may feed solitarily or in small groups, but large flocks of several

hundred or more have been seen feeding in inshore waters off Christmas and Jarvis islands and off Aldabra Atoll (Nelson 1978a, Clapp, unpubl.).

SUSCEPTIBILITY TO OIL POLLUTION

A few instances of oil pollution affecting this species are known. The first specimen from Florida, found moribund on the shores of Pinellas County, had "a small amount of tar on the feathers of the nape and right shoulder, and many contour feathers in this area [were] missing, possibly the result of preening" (Woolfenden 1965). Another heavily oiled Red-footed Booby was found at Kilauea Point, Kauai, 28 December 1977 (Byrd, in litt.), and another was seen during August 1978 by Clapp at Sealife Park, Oahu. According to personnel there, the bird, although heavily stained with oil, had been in captivity for some time and was responding well to treatment.

Although little information is available on the effect of oiling on the Red-footed Booby, its feeding habits of plunge and power diving should make it relatively vulnerable to oiling, particularly in the vicinity of breeding colonies. Tropical seabirds apparently suffer less direct mortality from oil than do species in cooler waters. It seems quite likely that this booby, among sulids, is distinctly less vulnerable than forms inhabiting cooler waters, such as the Northern Gannet, or those which do much more inshore feeding, such as the Blue-footed Booby. This species is rare in waters of the southeastern United States, and oil pollution in these waters does not constitute a hazard to the species as a whole.

BIBLIOGRAPHY

1980

Diamond, A. W. 1980. The Red-footed Booby colony on Little Cayman: size, structure and significance. Atoll Res. Bull. 241: 165-170.

Harrison, C. S. and T. S. Hida. 1980. The status of seabird research in the Northwestern Hawaiian Islands. Pp. 17-31 in Proc. Sympos. on Status of Resource Investigations in the Northwestern Hawaiian Islands, April 24-25, 1980. Univ. Hawaii Sea Grant Program (UNHI-SEAGRANT-MR-80-04), Honolulu, HI.

Pettit, T. N. 1980. Rifle range impacts on Red-footed Boobies. Elepaio 41: 22-23.

1979

Morrison, M. L. 1979. Eggshell thickness changes in Pacific Ocean Phaethonidae and Sulidae. Condor 81: 209.

1978

Feare, C. J. 1978. The decline of booby (Sulidae) populations in the western Indian Ocean. Biol. Conserv. 14: 295-305.

Nelson, J. B. 1978a. The Sulidae. Gannets and Boobies. Oxford Univ. Press, Oxford. 1012 pp.

1977

Britton, P. L. 1977. First African records of two Malagasy sea-birds. Bull. Br. Ornithol. Club 97: 54-56.

Harrington, B. A. 1977. Winter distribution of juvenile and older Red-footed Boobies from the Hawaiian Islands. Condor 79: 87-90.

Roberts, G. 1977. A record of the Red-footed Booby and Masked Booby from southeastern Queensland. Sunbird 8: 23.

1976

Nakamura, K. and T. Yada. 1976. [Occurrence of Red-footed Booby and Black Tern after typhoon.] Tori 25: 51-52.

Schreiber, R. W. and D. A. Hensley. 1976. The diets of *Sula dactylatra*, *Sula sula*, and *Fregata minor* on Christmas Island, Pacific Ocean. Pac. Sci. 30: 241-248.

Woodward, P. W. 1976. Red-footed Booby helper at Great Frigatebird nests. Condor 78: 264-265.

1975

Harris, M. P. 1975. Unusual feeding by Blue-footed Booby. Auk 92: 601-602.

Huber, H. R. 1975. Red-footed Booby, another Farallon "first". Point Reyes Bird Observ. Newsl. 36: 5.

Jing-Xian, L. and W. Zi-Yu. 1975. The Red-footed Booby in the Xisha (Paracel) Islands. Zoo. Mag. (Dongwuxue Zazhi) 3: 40.

1974

Diamond, A. W. 1974. The Red-footed Booby on Aldabra Atoll, Indian Ocean. Ardea 62: 196-218.

Goodman, D. 1974. Natural selection and a cost ceiling on reproductive effort. Am. Nat. 108: 247-268.

Schallenberger, R. J., G. C. Whittow and R. M. Smith. 1974. Body temperature of the nesting Red-footed Booby (*Sula sula*). Condor 76: 476-478.

1971

Diamond, A. W. 1971. The ecology of the sea-birds of Aldabra. Philos. Trans. R. Soc. Lond. Ser. Biol. Sci. 260: 561-571.

1969

Nelson, J. B. 1969a. The breeding behavior of the Red-footed Booby *Sula sula*. Ibis 111: 357-385.

Nelson, J. B. 1969b. The breeding ecology of the Red-footed Booby in the Galapagos. J. Anim. Ecol. 38: 181-198.

1968

Simmons, K. E. L. 1968. Occurrence and behavior of the Red-footed Booby at Ascension Island, 1962-64. Bull. Br. Ornithol. Club 88: 15-20.

1967

Ashmole, M. J. and N. P. Ashmole. 1967. Notes on the breeding season and food of the Red-footed Booby (*Sula sula*) on Oahu, Hawaii. Ardea 55: 265-267.

1966

Nieboer, E. 1966. Red-footed Booby (*Sula sula*) far in the open sea. Ardea 54: 88-89.

1965

Verner, J. 1965. Flight behavior of the Red-footed Booby. Wilson Bull. 77: 229-234.

Woolfenden, G. E. 1965. A specimen of the Red-footed Booby from Florida. Auk 82: 102-103.

1964

Curio, E. 1964. Fluchtmangel bei Galapagos-Topeln. J. Ornithol. 105: 334-339. [In German.]

Ord, W. M. 1964. Mongoose attacks young Red-footed Booby at nest. Elepaio 24: 50-51.

1962

Howell, T. R. and G. A. Bartholomew. 1962. Temperature regulation in the Red-tailed Tropic Bird and the Red-footed Booby. Condor 64: 6-18.

1961

Verner, J. 1961. Nesting activities of the Red-footed Booby in British Honduras. Auk 78: 573-594.

1959

Verner, J. 1959. Nesting activities of the Red-footed Booby in British Honduras. M. S. thesis, Louisiana St. Univ.

1955

Nicholson, D. J. 1955. Record of the Red-footed Booby on the Florida mainland. Fla. Nat. 28: 29.

1947

Tomlinson, J. N. 1947. Occurrence of the Red-footed Booby at Ascension Island. Ibis 89: 122-123.

1933

Grant, C. H. B. and C. W. Mackworth-Praed. 1933. The correct type locality of the Red-footed Booby, *Sula sula sula* Linnaeus. Bull. Br. Ornithol. Club. 53: 185-187.

1920

Mathews, G. M. 1920. Name of the Red-footed Booby. Auk 37: 180-181.

1910

Osburn, P. I. 1910. A Booby (*Sula sula*) on the west coast of Mexico. Condor 12: 80.

1904

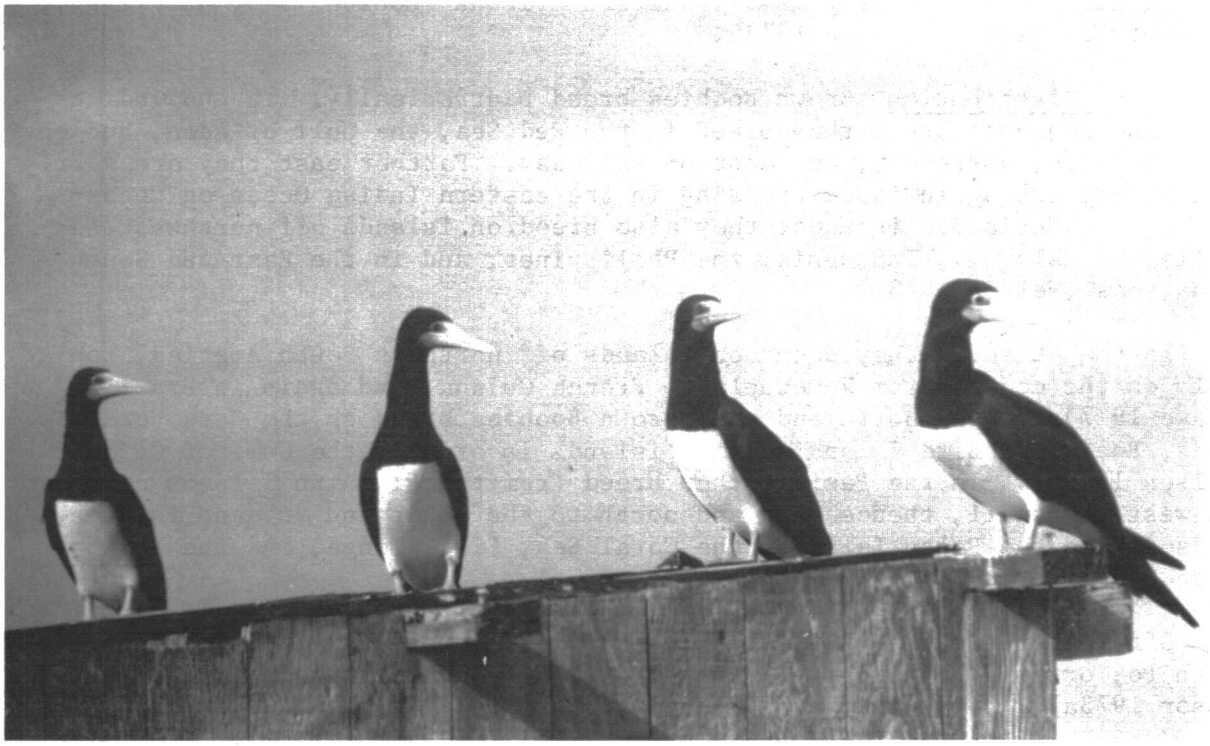
Fisher, W. K. 1904. Three boobies interviewed. Condor 6: 89-94.

Sharpe, R. B. 1904. [On Cory's Gannet]. Bull. Br. Ornithol. Club. 14: 65-69.

1902

Bangs, O. 1902. The occurrence of boobies in numbers on the east coast of Florida, during a storm. Auk 19: 395-396.

Incubating Red-footed Booby, Tern Island, French Frigate Shoals, Hawaii, November 1980. Photograph by Roger B. Clapp.



Adult Brown Boobies roosting on shed, Enderbury Island, Phoenix Islands, July 1968. Photograph by Roger B. Clapp.

BROWN BOOBY

(*Sula leucogaster*)

[DU: Bruine Gent, EN: Brewster's Booby, White-bellied Booby; FR: Fou brun, GE: Brauntolpel, IT: Sula fosca, JA: Katsuodori, PR: Alcatraz, SP: Alcatraz pardo, SW: Brun sula]

GENERAL DISTRIBUTION

North America Brown Boobies breed on islands in the eastern Gulf of Mexico (Paynter 1955), and from the southern Bahamas south in the Caribbean to Tobago (Nelson 1978a), as well as on islets off Costa Rica and Panama. On the Pacific side of North America, this species breeds on islands in the Gulf of California south to San Ignacio Farallon off northern Sinaloa (AOU 1957), on islands off Mexico and Central America (the Revilla Gigedos, Clipperton, Tres Marias, Cocos, Malpelo), and on the Pearl Islands in the Bay of Panama (Nelson 1978a).

Outside of their breeding range on the Atlantic side of North America, Brown Boobies range regularly to the Dry Tortugas and irregularly north along the coast to Virginia (Buckley 1970), New York (Raynor 1976, Richard and Chevalier 1978), Massachusetts (AOU 1957), and Nova Scotia (Godfrey 1966). On the Pacific side of the continent these boobies have occurred north to southeastern California (McMurry 1948), western Arizona (Monson 1946, Huey 1959), and southern Nevada (Lawson 1973).

World Distribution Brown Boobies breed pantropically. In the Indian Ocean and adjacent areas they breed in the Red Sea, the Gulf of Aden, and on islands north, northeast, and east of Malagasy. Farther east they are nearly absent, but are again found breeding in the eastern Indian Ocean on Cocos-Keeling and Christmas islands; they also breed on islands off northwest Australia, in Malaysia, Indonesia, the Philippines, and in the East and South China seas (Nelson 1978a).

In the Atlantic they occur on islands off northern South America, locally on the coasts from Venezuela to French Guiana, and again in Brazil (Blake 1977); to the north and east Brown Boobies breed on the Cape Verde Islands, Boatswain Bird Island, and on islands in or near the Gulf of Guinea (Nelson 1978a). In the Pacific they breed from the Pitcairn Islands north and west to Hawaii, thence east and north to the Bonin and Volcano islands, and south to the Palau Islands, the Coral Sea, Fiji, Tonga, and the Austral Islands (Nelson 1978a).

Off western South America they breed on Gorgona Island off Colombia, and south to, or somewhat short of, the Gulf of Guayaquil, Ecuador (Blake 1977, Nelson 1978a).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina There are no acceptable records of this species from North Carolina. A bird that may have been a Brown Booby was seen 10 May 1979 about 15 miles off Cape Hatteras (Lee and Booth 1979). It seems likely that this species will eventually be recorded from the state since it is known to straggle even farther north. It will probably always be regarded as accidental, because North Carolina is well north of the usual range.

South Carolina There are only two records of this species in South Carolina. Wayne (1910) reported that four immature specimens with labels indicating that they had been taken in "South Carolina" had been in the Charleston Museum, but no subsequent worker has reported anything more substantive on these birds. The only other record is listed below:

1968	4 Jan.	1 imm. found on lawn (spec. CM #68.30)	Charleston	Burton 1970

Georgia Other than a statement given by Audubon (1840-44 in Burleigh 1958) that the Brown Booby occurred off Georgia, this species is unrecorded.

Florida - Atlantic Coast Brown Boobies are considered rare on the Florida Atlantic Coast (Kale 1979 ms a), but may occur in any month of the year.

1895	16 Feb.	numbers seen	off beach opposite Micco	Bangs 1902
1907	11 Mar.	12 seen	mouth of St. Johns River	Chapman in Hampton 1969
1918	8 Feb.	seen	from beach, Volusia Co.	Howell 1932
1918	24 Feb.	seen	from beach, Volusia Co.	Howell 1932
1918	3 Apr.	seen	from beach, Volusia Co.	Howell 1932
1932	26 Nov.	1 seen, coll.	Mosquito Lagoon	Longstreet 1953-55
1932	13 Dec.	1 coll.	Brevard Reserve	Shannon 1934
1957	5 Jan.	6 seen	Straits of Florida	Stevenson 1957a
1958	20 Nov.	1 seen	Banana River, Brevard Co.	Nicholson 1960
1959	3 Apr., 16 May, 29 Jun.	1 seen (1)	Port Canaveral; Banana River; off Titusville	Stevenson 1959b, 1959c

(1) It is not certain, but seems likely that these observations were all of the same bird.

1959	20 Nov.	1 seen	20-30 mi E Mayport	Mason 1960
1959	23-23 Nov.	5 seen	offshore Jacksonville	Mason 1960
1960	18 Feb.	1 seen	30 mi off Titusville	Stevenson 1960b
1960	28 Dec.	1 seen (1)	Port Canaveral	Stevenson 1961
1965	28 Dec.	1 seen	Cocoa	Cunningham 1966a
1966	29 Dec.	1 ad. seen	off Cocoa	Robertson 1967
1967	11 Feb.	1 imm. seen	off Cocoa	Robertson 1967
1967	22 Oct.	1 imm. seen	off Miami	Robertson and Ogden 1968
1969	25 Feb.	1 ad. seen	Fort Lauderdale, 3/4 mi off Dania Beach	Hampton 1969
1970	21 Nov.	(1?) seen	E of Key Biscayne	Robertson 1971
1971	19 Jul.	1 imm. found badly oiled (spec. USF)	Fort Pierce beach	Ogden 1971
1972	21 Apr.	1 seen	off Port Canaveral	Kale 1972
1972	22 Jan.	1 seen	20 mi off Jacksonville	Stevenson 1972
1973	22 Feb.	1 ad. seen	off Indiatlantic	Woolfenden 1973
1973	9 Mar.-5 Apr.	1 imm. seen	along Indian River, near Sharps, Brevard Co.	Woolfenden 1973, Kale 1973
1974	9 Aug.	1 injured? bird seen	Port Everglades	Edscorn 1975
1974	28 Jul.	1 nonad. seen	off Cocoa	Ogden 1974
1975	7 Sep.	4 seen	off Mayport	Edscorn 1976
1977	13-15 Sep.	1 seen	Port Canaveral	Edscorn 1978

(1) This bird was at this locality for 20 months.

Florida - Keys Brown Boobies occur regularly in the Florida Keys. We have found about 30 records for that area, and there may be others that we have overlooked. Brown Boobies may be found in the Keys throughout the year (Kale 1979 ms b), but the dates they have been recorded are strongly biased for the May-June period when most trips were made to the Dry Tortugas. If these observations are discounted, the temporal distribution of records is much more even.

In 1832, according to Audubon (in Howell 1932), Brown Boobies bred abundantly at the Dry Tortugas, where their nests were "placed on the top of a bush, at a height of from four to ten feet" (Audubon in Bent 1922). The nesting habits ascribed to the Brown Boobies are so clearly at odds with those known for the species that one may safely conclude (as Nelson [1978a] pointed out) that this breeding record is an example of mistaken identity. There is no reason to disbelieve that these boobies were there in numbers and it is quite possible that they did in fact breed there, but adequate documentation is lacking.

1832	14 May	evidently common	Dry Tortugas	Audubon in Howell 1932
1861		present in numbers but not breeding	Dry Tortugas	Bryant in Howe 1904 in Howell 1932
1917 et seq.		a few seen	Dry Tortugas	Bartsch 1919
1929	23 Oct.	1 coll. (USNM #300324)	Key West	Howell 1932
1935	18-19 Jun.	3 seen	Dry Tortugas	Longstreet 1936
1938	Jun.	several seen (1 ad. caught and banded)	Dry Tortugas	Mason 1938, Sprunt 1962
1939	5 Jun.	2 seen	Dry Tortugas	Robinson 1939
1939	12 Oct.	2 seen	near Sand Key	Greene in Hundley and Hames 1960-62
1941	9-14 Jun.	2 photogr.	Dry Tortugas	Kyle 1941
1945	Jun.	ca. 2 seen	Dry Tortugas	Sprunt 1946b
1947	15-18 Jun.	to 3 seen (1 photogr.)	Dry Tortugas	Sprunt 1948

1947	20-27 Jun.	to 6 seen (1 ad., 2-3 subad., rest imm.)	Dry Tortugas	Sprunt 1947
1949	Jun.	to 6 seen	Dry Tortugas	Dilley 1950
1951	19-20 Mar.	1 ad. seen	Dry Tortugas, N end Garden Key	Robert and Stevenson 1951
1958	24 May	1 seen	Marathon	Stevenson 1958c
1959	11 Jul.	4 seen	Dry Tortugas	Stevenson 1959c
1960	17 May	1 seen	off Marathon	Stevenson 1960c
1961	2 Sep.	1 seen	off Tavernier	Stevenson 1962
1961	16 Sep.	2 coll. from small group	off Tavernier	Stevenson 1962
1965	22 Dec.	1 seen	Marathon/Grassy Keys	Cunningham 1966a
1967	mid-Jan.	1 seen	Rebecca Shoal	Robertson 1967
1970	2-4 May	2-4 seen	Dry Tortugas area	Kale 1970
1970	12 Dec.	1 seen	off Key Largo	Stevenson 1971
1971	1-2 May	9 seen	Dry Tortugas	Kale 1971
1972	30 Apr.	1 seen	Dry Tortugas	Kale 1972
1972	11 Jun.	1 imm. seen	Molasses Reef, off Upper Keys	Ogden 1972
1973	6,7 May	2, 1 seen	Dry Tortugas near Garden Key	Kale 1973
1974	22 Jul.-6 Aug.	1 seen (1)	Stock Island	Ogden 1974
1978	6 May	seen	20 mi S Bahia Honda Key	Kale 1979
1978	25 May	several seen	20 mi NW Dry Tortugas	Kale 1978
1979	Apr. and/or May	4 seen	Middle Key; Rebecca Shoal	Kale 1979

(1) Banded near Marathon 1 March 1973 (Edscorn 1975).

1979	early Aug-8 Nov.	1 seen	Tavernier, Key West	Edscorn 1979

Florida - Gulf Coast According to Kale (1979 ms b), this species occasionally occurs on the Gulf Coast. Our review of the records agrees with his observation, because we have found markedly fewer records (21) for the Gulf Coast than for the Keys or the Atlantic Coast.

1949	1 Jan.	1 seen	ca. 35 mi off Pensacola	Sprunt 1954
1949	8 May	1 seen	St. Joseph Point, Gulf Co.	Sprunt 1954
1950	14 Jul.	1 ad. seen	Destin	Lowery and Newman 1951a
1953	26 May	1 ad. seen	Santa Rosa Island	Lowery and Newman 1953
1956	3 May	14 seen	1.5 mi off Broad River area, SW Florida	Stevenson 1956c
1956	1 Jul.	2 seen	Pensacola	Newman 1956b
1957	7 Apr.	1 ad. seen	Pensacola	Newman 1957
1959	24 Nov.	1 seen	off Pensacola	Newman 1960a
1962	15 Jul.	1 seen	off Pensacola	J. Stewart 1962
1968	Jan.	1 photogr.	Tampa	Stevenson 1968a
1968	5 May	1 seen	Pensacola	Imhof 1968
1969	14 Jun.	1 imm. seen	75 yds off Manasota Key near Englewood	Saunders 1969
1971	8 Aug.	1 ad. seen	ca. 15 mi off Seahorse Key, Levy Co.	Ogden 1971
1972	22-26 Sep.	1 imm. seen, subseq. injured	Venice	Stevenson 1973, Collett 1972
1973	29 Apr.	4 seen (2 ad.,2 imm.)	Fort Pickens	Kennedy 1973
1974	8 Jun.	1 seen	Destin	Kennedy 1974
1974	28 Jul.	1 seen	Pensacola Bay	Kennedy 1974

1974	24 Sep.	1 seen	off Destin	Purrington 1975
1974	3 Oct.	1 injured bird seen	Venice	Edscorn 1975
1976	26 Mar.	1 seen	Pensacola Beach	Hamilton 1976
1977	28 May	1 ad. or near-ad. seen	between Carrabelle and Dog Island, Franklin Co.	Kale 1977

Alabama Imhof (1976b) considered Brown Boobies casual or perhaps rare along the Alabama coast in summer. Recent offshore surveys have now amassed a total of about 18 records, but particulars of these sightings are not yet available. Only four records were listed by Imhof 4 years ago. Clearly, the species is considerably more common off Alabama than was thought even recently. Duncan and Havard (1979 ms) now regard Brown Boobies as regular in summer in the northern Gulf of Mexico, and casual during other seasons.

1961	26 Aug.	1 (?) seen	W end Dauphin Island	Imhof 1976b
1969	11-14 Apr.	7 seen (ad. and imm.)	W end Dauphin Island	Imhof 1976b
1969	6 Jul.	1 (?) seen	Sand Island	Imhof 1976b
1970	18 Jun.	1 seen	Mississippi Sound	Imhof 1976b, J. Stewart 1970
1975	17 Jul.	1 seen	off Alabama	Duncan and Havard 1979 ms
1976	15 Jul.	1 seen	off Alabama	J. Stewart 1976
1977	23 Jun.	1 seen	off Alabama	Duncan and Havard 1979 ms
1977	6,7 Aug.	4 total seen	off Alabama	Duncan and Havard 1979 ms
1978	22 Jun.	1 seen	S of Dauphin Island	Jackson and Cooley 1978a
1978	4,18 Jul.	3 total seen	off Alabama	Duncan and Havard 1979 ms
1978	4,6 Aug.	4 total seen	off Alabama	Duncan and Havard 1979 ms
1979	11 Jan.	5 seen	off Alabama	Hamilton 1979

1967	19 Aug.	1 imm. found ill	N. Padre Island, 16 mi S Bob Hall Pier	Oberholser 1974
1967	23 Sep.	1 seen	Padre Island, Neuces Co.	Oberholser 1974
1971	21 Sep.	1 imm. male coll. (U. Dallas 1864)	Port Aransas, Neuces Co.	Oberholser 1974
1972	8 Jun.	1 seen	West Flower Garden Reef (100 mi S Galveston)	Oberholser 1974
1974	30 May	1 found	Port Isabel, S. Padre Island	Webster 1974c
1975	30 Aug.	1 seen	snapper banks off Port Aransas	Webster 1976a
1976	4 Sep.	1(+?) seen	off Port Aransas?	Webster 1977a
1977	8 Mar.	1 seen	off Port Aransas	Webster 1977c
1977	20 Aug. et seq.	2 subad. seen	Port Aransas jetties	Webster 1978a
1979	20 Aug.	1 seen	off Brownsville during aerial survey	Hoffman, this paper

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Brown Boobies occur pantropically, nesting along continental margins and on islands in tropical waters around the world. In North America and adjacent waters they breed in the Gulf of Mexico, the Caribbean, the Gulf of California, and on islets off Mexico and Central America. Information on the world population is inadequate. Feare (1978) remarked that the species has lost at least half its known breeding colonies in the western Indian Ocean within the last 100 years, and Nelson (1978a) pointed out that present populations are "...undoubtedly but a fraction of former days". Nelson (1978a) suggested that Clipperton Island may hold the world's largest colony; it contained over 15,000 birds in 1968.

Nonbreeding and Migration Brown Boobies in most areas are apparently resident at the breeding areas and evidently do not perform regular migrations. Individuals often show strikingly long dispersals, but this is apparently the exception rather than the rule. Like most species of seabirds, its ocean-going capacities are great. Birds occurring several hundred miles from their point of origin are not uncommon, although this is considerably less frequent than in the more pelagic Blue-faced and Red-footed boobies.

In the southeastern United States, Brown Boobies are rare or unrecorded on the northeastern portion of the Atlantic coast, but are regular if uncommon off Florida (Table 64); they reach peak abundance in the Florida Keys. This booby occurs regularly during summer in the northern Gulf of Mexico, but is uncommon (Duncan and Havard 1979 ms). Birds may occur throughout the year in most areas (Table 65), but Table 64 suggests that they may be somewhat more frequent along the Florida Atlantic coast from fall through spring. It is likely that many, if not most, of the birds in the Gulf of Mexico originate from breeding areas on the Campeche Bank, but this is not documented. The origin of those occurring off the Florida Atlantic coast is unknown. These birds could be from the Caribbean, the Gulf, or both.

HABITAT

Nesting Brown Boobies nest on the ground where they usually build substantial nests of twigs, stems, and other vegetation. Colonies are usually small and contain dozens to hundreds of birds. The species is only loosely

Table 64. Approximate number of Brown Boobies recorded by month for the coastal southeastern United States (a).

State/Region	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
North Carolina	-	-	-	-	-	-	-	-	-	-	-	-
South Carolina	1	-	-	-	-	-	-	-	-	-	-	-
Georgia	-	-	-	-	-	-	-	-	-	-	-	-
Florida-Atlantic Coast	7	8	13	4	1	1	2	1	5	1	9	5
Subtotal-ATLANTIC COAST	8	8	13	4	1	1	2	1	5	1	9	5
Florida-Keys	1	-	1	1	21	27	5	2	4	4	1	2
Florida-Gulf Coast	2	-	1	5	18	2	5	1	2	1	1	-
Alabama	8	-	-	11	-	3	7	9	-	-	-	-
Mississippi	-	-	-	-	-	-	-	-	-	-	-	-
Louisiana	3	-	-	1	-	6	2	-	5	1	1	-
Texas	-	-	1	-	1	2	-	7	4	-	-	-
Subtotal-GULF COAST	13	-	2	17	19	13	14	17	11	2	2	-
Total-ALL AREAS	22	8	16	22	41	41	21	20	20	7	12	7

(a) Birds found dead within the first 10 days of the month are arbitrarily assigned to the preceding month. If the source did not make it clear whether one or more was seen, we have assumed only one was seen. If more than one was seen and the number is unknown (e.g., "a few", "numbers", "several"), we have assumed two birds were seen. When what may have been a single bird is seen in more than one month, it was counted separately in each month.

Table 65. Dates of occurrence for Brown Boobies in the coastal southeastern United States.

State/region	Approximate number of occurrences	Dates of occurrence
North Carolina	not certainly recorded	
South Carolina	1	4 January
Georgia	not certainly recorded	
Florida-Atlantic Coast	ca. 30	5 January - 29 December
Florida-Keys	ca. 30	mid January - 22 December
Florida-Gulf Coast	21	1 January - 24 November
Alabama	ca. 18	11 January - 26 August
Mississippi	unrecorded	
Louisiana	9	15 January - 15 November
Texas	13	8 March - 23 September

colonial and, at least in the central Pacific, pairs are often found nesting well away from primary nesting concentrations. As Nelson (1978a) pointed out, Brown Booby nests are typically more widely spaced than those of the other ground nesting boobies.

These boobies prefer to nest in well elevated areas that are often rocky, rough, and on steep slopes. Nelson (1978a) described sites at Christmas Island in the Indian Ocean "...on broad ledges a few metres below the cliff top and commonly on the very edge of the cliff and among broken terrain on extremely steep slopes." Similar nest sites are found in the northwestern Hawaiian Islands and in the northern Marianas Islands. Simmons (1967a in Nelson 1978a) described nest sites chosen on Ascension. There, 61% of the sites were on ledges, 11% on eminences, and 9% on slopes; the other 19% are not mentioned by Nelson. In the absence of such sites, Brown Boobies use a wide variety of habitats. Nests may be built in the open, with little or no surrounding vegetation, on substrates varying from bare rock to sandy beach, or they may be built under shrubbery so dense that the bird is not seen until it flushes.

Feeding The Brown Booby, compared with the two other species with which it is often sympatric, i.e., the Blue-faced and Red-footed boobies, is more of an inshore feeder and does not forage as far from land. However, most food is obtained out in the ocean rather than close inshore (Nelson 1978a), and birds are known to travel as much as 60 mi to the feeding grounds (Bent 1922).

Nonbreeding and Offshore Although a species of tropical waters, the Brown Booby is much more likely to wander north of these areas than the other tropical pelagic species of booby. They are also more likely to occur in coastal waters, harbors, and estuaries (Nelson 1978a), where they commonly roost on pilings or buoys (Palmer 1962). At sea these boobies occur alone

or in small groups, but they may congregate in considerable numbers over shoaling fish (Cramp et al. 1977).

FOOD AND FEEDING BEHAVIOR

Nelson (1978a), who summarized much of the available information on food habits, reported that most of the diet of the Brown Booby consisted of flying fish and ommastrepid squid, and that a wide variety of species were eaten. His report should be consulted for further details.

The most detailed report of food habits was based on 56 regurgitations, largely from adults, at Ascension Island. This material revealed that the flying fish, *Exocoetus volitans*, occurred in the most samples (nearly half), and that two other fish (*Ophioblennius webbii* and *Holocentrus ascensionis*) were frequently captured and found in a large proportion of samples (Dorward 1962a). The size distribution of food items taken was bimodal, with the greatest proportion (84%) in the 5-7 cm range; another 8% were in the 15-20 cm range (Dorward 1962a).

Craig Harrison (*in litt.*) informed us that the principal foods in the Northwestern Hawaiian Islands are squid, flying fish (*E. volitans* and *Cypselurus* sp.), and carangid fish (*Decapterus* sp.). Skipjack tuna (*Katsuwonus pelamis*), goat fish (Mullidae), and needle fish (*Ablennus hians*, Belonidae) are also eaten there.

Brown Boobies, like other sulids, feed primarily by plunging. This species frequently makes repeated slanting dives but also may dive perpendicularly from considerable heights. Gibson-Hill (1947 *in* Palmer 1962) noted that dives were from 30-50 ft above the surface to depths of 5-6 ft, and that birds remained beneath the surface for periods of 25-40 seconds. Prey may also be obtained by prolonged underwater pursuit in which both wings and feet are used for propulsion. Brown Boobies may also pursue and capture flying fish in flight. Nelson (1978a) noted that Simmons (1967b) suggested this species is an aerial feeding specialist, but Nelson believed that insufficient information was available to determine whether this species really differed from other blue-water sulids in this regard.

Other feeding techniques used by Brown Boobies, evidently to a much lesser extent than those mentioned above, are hovering (= aerial dipping), contact swooping (= surface plunging), plunging from a perch, surface seizing, and kleptoparasitism on its own and other seabird species (Cramp et al. 1977).

These boobies are often attracted to ships and may follow them for hours, and may even land on the ship itself. Some evidence suggests that Brown Boobies feed at night as well as by day, and that the extent to which they feed nocturnally may vary from area to area (see Nelson 1978a for details). Birds feed both solitarily and co-operatively, the latter at times co-ordinated by a vocal signal (Watson *in* Nelson 1978a).

SUSCEPTIBILITY TO OIL POLLUTION

At least one of the birds recorded above had been heavily oiled, and oiled birds have also been seen in the Northwestern Hawaiian Islands (C. Harrison, pers. comm.). Although we have not received reports of Brown Booby mortality following the IXTOC I oil spill, a closely related species, the Blue-faced Booby, may have been the primary victim. Because Brown Boobies are known to be attracted to man-made structures, are plunge-divers, and may occur relatively close to shore, we consider populations in southeastern waters at least moderately at hazard from oil development activities. Brown Boobies also feed out of sight of land and could easily die unseen from primary or secondary effects of oiling. The islands in the southeastern Gulf of Mexico may harbor most of the birds occurring in the northern Gulf, and it is possible that this population could have already suffered major effects from oil pollution.

BIBLIOGRAPHY

1980

Harrison, C. S. and T. Hida. 1980. The status of seabird research in the Northwestern Hawaiian Islands. Pp. 17-31 in Proc. Sympos. on Status of Resource Investigations in the Northwestern Hawaiian Islands, April 24-25, 1980. Univ. Hawaii Sea Grant Program (UNHI-SEAGRANT-MR-80-04), Honolulu, HI.

Miskelly, C. 1980. Brown Boobies in New Zealand. Notornis 27: 395.

1979

Morrison, M. L. 1979. Eggshell thickness changes in Pacific Ocean Phaethonidae and Sulidae. Condor 81: 209.

Polunin, N. V. C. 1979. *Sula leucogaster* and other species in the Isles Mitsios, Madagascar. Bull. Br. Ornithol. Club 99: 110-111.

Wassink, A. 1979. Brown Boobies attacking a Slender-billed Gull. Ardea 67: 138.

1978

Burt, D. R. R. 1978. On the cestode *Tetrabothrium sula* Szpotanska 1929 from the Brown Booby or Gannet *Sula leucogastra plotus* (Forster, 1844) of the Indian Ocean. Zool. J. Linn. Soc. 64: 9-14.

Feare, C. J. 1978. The decline of booby (Sulidae) populations in the western Indian Ocean. Biol. Conserv. 14: 295-305.

Nelson, J. B. 1978a. The Sulidae. Gannets and Boobies. Oxford Univ. Press, Oxford. 1012 pp.

Richard, H. and S. Chevalier. 1978. Brown Boobies at Riis Park, Queens County. Kingbird 28: 32.

1976

Burt, D. R. R. 1976. On two new Tetrabothiid cestodes from the Gannet or Booby Sula leucogaster plotus (Forster) from the Indian Ocean. Zool. J. Linn. Soc. 58: 27-32.

Raynor, G. S. 1976. Brown Boobies on Long Island. Kingbird 26: 23-25.

1975

Gaze, P. D. 1975. Brown Booby in Wellington Harbour. Notornis 22: 253-255.

1974

Carins, M. 1974. Garnot's Cormorants and the "Brown Booby" in the Falkland Islands. Ardea 62: 242-245.

Smith, F. T. H., R. Swindley and R. Sympson. 1974. Brown Gannet near Point Lonsdale, Victoria. Austr. Bird Watcher 5: 184-189.

1973

Lawson, C. S. 1973. Notes on Pelecaniformes in Nevada. West. Birds 4: 23-30.

Millie, G., B. Araya and O. Magnere. 1973. Un piquero neuvo para los mares chilenos: Sula leucogaster (Boddaert, 1738) (Pelecaniformes, Sulidae). Notic. Mens. Mus. Nac. Hist. Nat. 17: 9-10.

Mochizuki, H. 1973. [Recent status of Inanba-Jima, the northernmost breeding ground of Brown Booby Sula leucogaster.] Tori 22: 71-72. [In Japanese with English summary.]

Pulich, W. M., Sr. and W. M. Pulich, Jr. 1973. First Brown Booby specimen from Texas. Auk 90: 683-684.

1972

Collett, R. 1972. Brown Booby (Sula leucogaster) sighted at Venice. Fla. Nat. 45: 192.

Sanchez-Hernandes, G. and L. A. Perez-Jimenez. 1972. Notas sobre la biologia de la "Bubia de Vientre Blanco" (Sula leucogaster nesiotes Familia: Sulidae) en la Bahia de Chamela, Jalisco, Mexico. [Notes on the biology of the White-bellied Gannet: Family: Sulidae, (Sula leucogaster nesiotes) in the Bay of Chamela, Jalisco, Mexico.] Rev. Soc. Mex. Hist. Nat. 33: 113-122. [In Spanish.]

1970

Buckley, P. A. 1970. Brown Booby, Magnificent Frigatebird and Sabine's Gull new to Virginia. Aud. Field Notes 24: 650-652.

McCaskie, G. 1970. The occurrences of four species of Pelecaniformes in the southwestern United States. Calif. Birds 1: 117-142.

1969

Edgar, A. T. 1969. Brown Booby in the Bay of Islands. Notornis 16: 60-61.

Hampton, G. C. 1969. Brown Booby, Sula leucogaster, at Fort Lauderdale. Fla. Nat. 42: 171.

Mason, C. R. [ed. note]. 1969. Brown Booby, Sula leucogaster, at Fort Lauderdale. Fla. Nat. 42: 171.

Pierce, R. J. 1969. Brown Booby on South Canterbury coast. Notornis 16: 125.

Saunders, G. B. 1969. Brown Booby, Sula leucogaster. Fla. Nat. 42: 171.

1968

Saotome, Y. 1968. [Brown Boobies observed near Ogasawara Islands (Bonin Is.).] Misc. Repts. Yamashina Inst. Ornithol. Zool. 5: 414-419. [In Japanese with English summary.]

Woodward, P. W. 1968. The Brown Booby. Pac. Bird Observ. No 8: 5-7.

1967

Simmons, K. E. L. 1967a. The role of food supply in the biology of the Brown Booby at Ascension Island. M. Sc. thesis, Bristol Univ.

Simmons, K. E. L. 1967b. Ecological adaptations in the life history of the Brown Booby at Ascension Island. Living Bird 6: 187-212.

1966

Ozawa, K. 1966. [Observation of the Brown Booby, around Kusagakijima and Sumisuto, south of Japan.] Misc. Repts. Yamashina Instit. Ornithol. Zool. 4: 378-383. [In Japanese with English summary.]

Watson, I. 1966. Brown Gannet, Sula leucogaster: a new record for Victoria. Emu 65: 311.

1962

Dorward, D. F. 1962a. Comparative biology of the White Booby and the Brown Booby Sula spp. at Ascension. Ibis 103b: 174-220.

Dorward, D. F. 1962b. Behavior of boobies Sula spp. Ibis 103b: 231-234.

1960

Mason, C. R. 1960. Brown Boobies (Sula leucogaster) off coast at Jacksonville. Fla. Nat. 33: 99.

Nicholson, D. J. 1960. Brown Booby seen on the Banana River, Brevard County. Fla. Nat. 33: 165-166.

1959

Huey, L. M. 1959. The second occurrence of a Brown Booby near Parker Dam on the Colorado River. Condor 61: 223.

1956

Rossi, J. A. H. 1956. Notas ornitologicas I: Presencia del Piquero Pardo en la Argentina. Hornero 10: 166-167. [In Spanish.]

1955

Hindwood, K. A. 1955. The Brown Gannet: a New South Wales record. Emu 55: 159.

Stein, P. A. S. 1955. Brown Booby in the Hauraki Gulf. Notornis 6: 157-159.

1953

Stein, P. A. S. 1953. Brown Booby in the Hauraki Gulf. Notornis 5: 165.

1952

Stein, P. A. S. 1952. Brown Booby in the Hauraki Gulf. Notornis 4: 213.

1948

Gibson-Hill, C. A. 1948. The Brown Booby. Malaysan Nature J. 4: 19-23.

McMurry, F. B. 1948. Brewster's Booby collected in the United States. Auk 65: 309-310.

1946

Monson, G. 1946. Brewster's Booby in Arizona. Auk 63: 96-97.

1945

van Rossem, A. J. 1945. A northern occurrence of the Brewster Booby. Condor 47: 129.

1939

Wetmore, A. 1939. Birds from Clipperton Island collected on the Presidential Cruise of 1938. Smithson. Misc. Coll. No. 98. 6 pp.

1938

Sawaya, P. 1938. Indicacoes sobre a orientacao do Beija-Flor (Agytrina sp.) e do Mergulhao (Sula leucogaster Bodd.) em relacao ao ninho. Bolm. Biol. Univ. Sao Paolo 3: 62-66. [In Portuguese.]

1935

Huey, L. M. 1935. Second record for the Brewster Booby on the west coast of Lower California. Condor 37: 287-288.

1932

Wetmore, A. 1932. The breeding of the Brown Booby in Porto [sic] Rican Territory. Auk 49: 341.

1931

Bailey, A. M. and E. G. Wright. 1931. Birds of southern Louisiana. Wilson Bull. 43: 114-142, 190-219.

1928

Robinson, H. C. and N. B. Kinnear. 1928. Note on Sula leucogaster (Bodd.). Bull. Br. Ornithol. Club 48: 63-65.

1911

Thayer, J. E. 1911. A nesting colony of Heerman Gulls and Brewster Boobies. Condor 13: 104-106.

1908

Chapman, F. M. 1908. A contribution to the life histories of the Booby (Sula leucogastra) and Man-O'-War Bird (Fregata aquila). Pap. Mar. Biol. Lab. Tortugas. Carnegie Instit. Washington Publ. 103: 139-151.

1902

Bangs, O. 1902. The occurrence of boobies in numbers on the east coast of Florida during a storm. Auk 19: 395-396.

AMERICAN WHITE PELICAN

(*Pelecanus erythrorhynchos*)

[SP: Alcatraz blanco]

GENERAL DISTRIBUTION

North America White Pelicans breed locally in southern interior British Columbia, in northern and eastern Alberta, central and southern Saskatchewan, southwestern Manitoba, and extreme southwestern Ontario (Godfrey 1966, Vermeer 1970d). In the United States breeding has occurred locally in recent years in northern California, southeastern Oregon, western Nevada, northern Utah, south-central Idaho, northwestern Wyoming, northeastern Colorado, northeastern Montana, south-central North Dakota, northeastern and southwestern South Dakota, and in isolated colonies on the central Texas coast (Sloan 1973, Rogers 1977). The White Pelican also breeds at least sporadically in the Laguna Madre de Tamaulipas, Mexico (Selander et al. 1962, Oberholser 1974, A. R. Phillips, pers. comm.). Recently, it has begun breeding at Honey Lake, Lassen County, California (Tait et al. 1978).

White Pelicans winter inland and along the Pacific coast from north-central California and central Arizona (AOU 1957) south to Mexico and Guatemala and from Florida along the Gulf of Mexico to Tabasco, Mexico (Palmer 1962).

These birds frequently wander, and there are records for most of the eastern United States (Palmer 1962). In Canada White Pelicans have straggled as far north as Liverpool Bay, Mackenzie (on the Arctic Ocean) and to northern Ontario and Nova Scotia (AOU 1957, Godfrey 1966). To the southeast they have wandered into the Caribbean, where there are records from Bimini in the Bahamas, Cuba, Puerto Rico (Bond 1971), Grand Cayman (Bond 1978), and Trinidad (Blake 1977). Along the Central American coasts these pelicans have wandered as far south as El Salvador and Nicaragua (Strait and Sloan 1975).

World Distribution: As above.

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina White Pelicans are only occasional visitors to North Carolina. We have only 20 records for the state, involving about 90 individuals. These records are nearly evenly divided between inland and coastal localities and have occurred between 2 August and 23 June. Some of these pelicans apparently were birds straggling northeast of the normal wintering range; others apparently were nonbreeding birds summering far from the breeding areas.

1884	12 May	1 shot	near Raleigh, Wake Co.	Pearson et al. 1942

1889	May	40 seen, 5 shot	French Broad River, Buncombe Co.	Pearson et al. 1942
1907	2 Oct.	1 shot	Catawba River near Sloan's Ferry	Pearson et al. 1919
1924	16-17 Sep.	2 shot	Warren Co.	Pearson et al. 1942
1924	23 Sep.	1 coll.	Bunnlevel, Harnett Co.	Pearson et al. 1942
1935	16 Jun.	1 seen	Lake Mattamuskeet	Pearson et al. 1942
1939	4 Jun.	3 seen	Southport waterfront	Pearson et al. 1942
1943	11,14 Dec.	4 seen	Lake Mattamuskeet	Lamb 1944
1944	13 Feb.	10 seen	Lake Mattamuskeet	Lamb 1944
1944	2 Apr.	8 seen	sound near New Inlet, Pea Island NWR	Cook 1945
1945	11 Oct.	1 coll. (NCSM)	near Nashville	Wray and Davis 1959
1953	26-30 May	7-3 seen	Lake Junaluska, Haywood Co.	Lesley 1953
1954	28 Aug. (1)	1 seen	over Clinton, Samson Co.	Chamberlain 1955b
1958	late Sep.-4 Dec.	1 seen	Pea Island NWR	Chamberlain 1959a
1975	2 Aug.	1 seen	Carrot Island, near Beaufort	Teulings 1976a
1976	25 May-23 Jun.	1 seen	Pea Island NWR	Teulings 1976c, LeGrand 1976
1977	19 Feb.	1 seen	N end Carolina Beach	Alexander et al. 1977
1978	8 Oct.	1 seen	Bird Shoal near Beaufort	LeGrand 1979a, 1979d

(1) Wray and Davis (1959) listed this date as 8 August.

1978	early Sep. et seq.	1-2 imm. seen	Wrightsville Beach	LeGrand 1979a
1979	2 Feb.	1 seen	Hatteras Inlet	LeGrand 1979b

South Carolina The status of the White Pelican in South Carolina is similar to that in North Carolina, but the species has occurred slightly more frequently and more individuals have been seen. We have found 23 records involving at least 150 individuals. Birds have been recorded all months except April and September, with larger numbers present in both mid-winter and mid-summer. More than two-thirds of the records and most individuals are from coastal localities.

1814	1 Jul.	flock seen, 2 adults shot	Bird Banks, Bull's Island	Sprunt and Chamberlain 1949
1910	26 Oct.	1 killed	Santee Swamp	Sprunt and Chamberlain 1949
1929	12,19 May	1 seen	near mouth of Savannah River	Tomkins 1930
1930-31		1 seen	near Bluffton	Sprunt and Chamberlain 1949
1934	13 Jun.	10 seen	.5 mi off Folly Island Beach	Sprunt 1934
1935	26 Nov.	1 coll. (CM 35.373)	near Orangeburg	Sprunt and Chamberlain 1949
1939	7 Jan.	1 seen	Cape Island	Sprunt and Chamberlain 1949
1939	9-12 Jun, 30 Jun-5 Jul.	11 seen	South Island, Winyah Bay, Cape Romain	Sprunt and Chamberlain 1949
1944	21 Aug.	1 seen	Cape Romain	Sprunt and Chamberlain 1949
1945	20 Nov.	1 seen	Cape Island	Sprunt and Chamberlain 1949

1947	13 Oct, 8-12 Nov.	1 seen	Charleston Harbor; Ashley River, W edge Charleston	Sprunt and Chamberlain 1949
1952	18 May	2 seen	Charleston harbor shore	Chamberlain 1952
1953	6 Mar.	2 seen	in surf at Folly Island	Chamberlain 1953b
1955	14 Oct.	1 seen	sand bank 10 mi N Charleston	Chamberlain 1956b
1955-56	mid-Dec.-mid-Mar.	ca. 50 seen	Cape Romain NWR	Chamberlain 1956b
1956	late Jul.	29 seen	Charleston Harbor	Burton 1970
1957	24 Dec.	1 seen	over Wando River, Cainhoy, Charleston Co.	Chamberlain 1959b
1962	18 Jan.	1 seen	Bear Island WMA, Colleton Co.	Chamberlain 1959b
1969	22 Oct.	4 seen	North Edisto Sound	Anon. 1970
1969	Nov.	1 seen	John's Island	Anon. 1970
1971	12-14 Jan.	3 seen	near Citadel, Charleston	Teulings 1971b
1973	early Jan.	to 25 seen	Charleston	Teulings 1973b
1977	18 Dec.	1 seen	near Murphy Island, McClellanville	Shuler 1978, LeGrand 1978

Georgia Denton et al. (1977) considered the White Pelican a rare visitor both to the coast and inland. Burleigh (1958) listed 13 records from Georgia, and there are at least 11 others. The records extend from 1 March through 28 November, with about half occurring from September through November; the rest are largely from March through May.

1903	fall	1 caught	St. Mary's River	Arnow 1904
1903	fall	1 caught	Satilla River near Satilla Bluff	Arnow 1904
1903	fall	1 caught	Cumberland Island	Arnow 1904
1912	9 Oct.	1 shot	Savannah River	Rossignol 1913
1916	14 Sep.	1 coll.	Savannah River	Murphey 1937 in Burleigh 1958

1926	ca. late Sep.	3 seen (1 coll.)	near Lithonia, DeKalb Co.	Greene 1930
1929	May	1 seen	Long Island Fill, Savannah River Delta	Tomkins 1958
1929	early Oct.	1 taken	St. Catherines Island	Sprunt 1930
1930	16 Sep.	1 seen	Atlanta	Greene 1933 in Burleigh 1958
1933	15 Apr.	1 seen	near Cumberland Island	Sprunt 1936
1933	16 May	1 seen	near E end Hutchinson Island	Tomkins 1958
1935	27 Jul.	1 seen	Atlanta Reservoir	Spratt 1936
1938	2 Jun.-15 Aug.	1 seen	Oysterbed Island in mouth of Savannah River	Eyles 1938a
1941	10 May	(1?) seen	Okefenokee Swamp	Denton et al. 1977
1945	10 Oct.	1 seen	Gym Creek near Cordele, Crisp Co.	Fletcher 1946
1946	13 Oct.	2 seen	Savannah River near Tybee Light	Howe 1947
1950	28 Nov.	2 seen	King's Bay River near Cumberland	Burleigh 1958
1958	early Jun.	1 seen	Sapelo Island	Teal 1959
1963	11 Jun.	(1?) seen	Fitzgerald	Denton et al. 1977
1964	8-10 May	2 seen	Sapelo Island	Kale and Hyypio 1966
1971	1 Mar.	7 seen	St. Simons Island	Teulings 1971b
1972	7 Apr.	1 seen	off Jekyll Island	Teulings 1972c
1975	15 Nov.	12 seen	over Atlanta	Teulings 1976a
1977	28 Apr.	ca. 160 seen	Eufala NWR	Teulings 1977b

Florida White Pelicans regularly winter along the coasts of Florida, and a few occasionally remain for the summer. Numbers wintering on the upper Atlantic coast have been gradually increasing in recent years (Kale 1979 ms a).

Along the Gulf Coast they winter most commonly from Cedar Key southward, where flocks of up to several hundred birds may be found in most of the larger bays and sounds. These pelicans winter less commonly along the northern Gulf Coast (Map 12) but are common there during migration (Kale 1979 ms b).

White Pelicans arrive along the Gulf Coast in October and gradually move to Cape Sable and Florida Bay, in and near Everglades National Park, where Kushlan (1978) found 5,240 wintering White Pelicans in December 1976; 70% of these were in the Cape Sable area, most of the rest in Florida Bay. Kushlan noted that this figure is not markedly different from an estimate made 20 years previously, and suggested that the population wintering in the park is stable. He also pointed out that this population may represent a significant proportion of those breeding east of the Continental Divide.

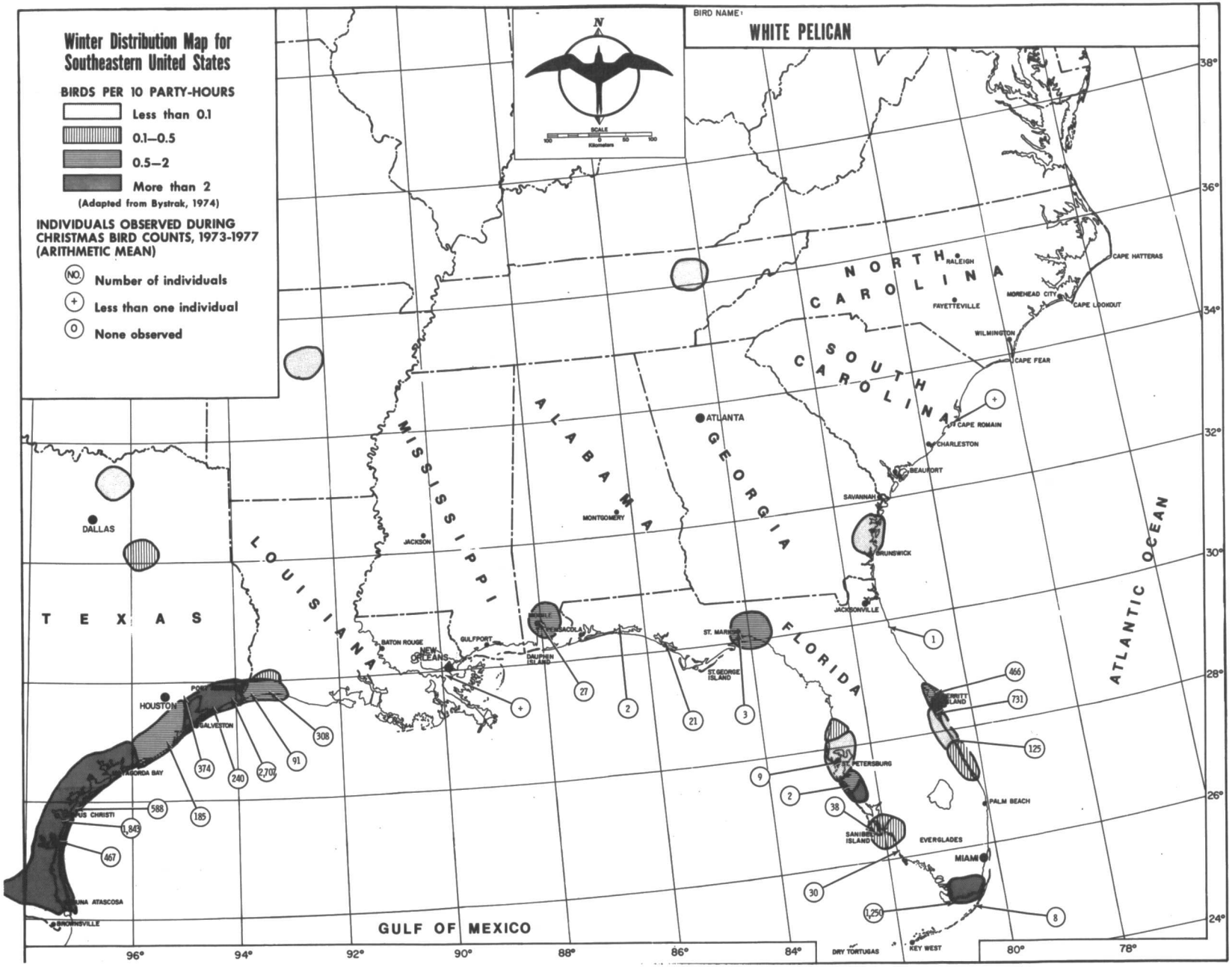
Alabama White Pelicans occur along the Alabama coast throughout the year, but are common to abundant only during migration and in winter. Peak numbers are present from mid-September to late May, and birds are regularly seen in summer (Imhof 1976b).

Mississippi Burleigh (1944) reported that White Pelicans were extremely scarce along the Mississippi Gulf Coast; he recorded them only once in 8 years despite reported greater abundance along state coasts to the east and west. A listing of records from 1961 through 1963 (Gandy and Turcotte 1970) supports Burleigh's statement; the largest number of birds reported by them was 10 on 24 June 1962, and none have been reported on recent Christmas Counts (Map 12). The species is evidently present throughout the year, because Gandy and Turcotte gave records for all months except February and August. These pelicans are probably more abundant in Mississippi, at least at times, than these scanty data indicate; further information clearly is needed on their status in Mississippi waters.

Louisiana Along the Louisiana coast these pelicans are common in winter and on migration. Small flocks also winter inland. Nonbreeding summer populations are often large; flocks of over 1,000 birds have been noted. Fall migration is mainly in late October and early November; the return migration is in April and May (Lowery 1974).

Texas Oberholser (1974) regarded the White Pelican as irregularly very common to uncommon as a migrant in eastern Texas and locally very common to uncommon as a winter resident along the coast. He reported that fall migration occurs primarily from late August to mid-November, and that spring migration occurs from early April to early June. Nonbreeding birds are fairly common to scarce in summer along the coast.

Texas has the only breeding population of White Pelicans in the southeastern United States. There, they now breed only on South Bird Island in the Upper Laguna Madre (Blacklock et al. 1978 ms, 1979). They nest there on bare ground along the periphery of *Leucaena leucocephala* trees (Chaney et al. 1978). Eggs have been recorded in Texas colonies from 25 March through 14 July (Oberholser 1974, Chaney et al. 1978), but most egg laying is probably in March and April; dependent young may be present into August (Blacklock 1978 ms, Chaney et al. 1978).


BIRD NAME:
WHITE PELICAN
Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1—0.5
0.5—2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
GALVESTON
CORPUS CHRISTI
BROWNSVILLE
BATON ROUGE
NEW ORLEANS
GULFPORT
DAUPHIN ISLAND
PENSACOLA
JACKSON
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
JACKSONVILLE
BRUNSWICK
SAVANNAH
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
PALM BEACH
EVERGLADES
MIAMI
KEY WEST
DRY TORTUGAS
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°
308
91
2,707
240
374
185
588
1,843
467
27
2
21
3
+
9
2
38
30
1,250
8
1
466
731
125

The breeding population is small, about 500 birds (Table 66, Map 6 [cf. p. 355]), but apparently is stable or slowly declining (Blacklock et al. 1978 ms). The Texas birds, like those elsewhere, are extremely sensitive to disturbance (Chaney et al. 1978); activity in and near the colony during critical periods of the reproductive cycle would likely result in severe nest loss. Blacklock et al. (1979) state that this species feeds primarily in fresh or brackish waters in Texas and occasionally feed in marine habitats.

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding White Pelicans breed solely in North America. Most colonies are in the western United States and Canada, but there are isolated colonies along the Gulf Coast in Texas and Mexico. It is now regarded as a "Blue-list Species", one that is "...giving indications of non-cyclical population declines or range contractions, either locally or widespread" (Arbib 1979). Arbib (1979) indicates that it is declining in most of the breeding range.

Sloan (1973) reported a U.S. breeding population of 33,690 breeding birds for 1971-72, Vermeer (1970d) indicated an additional 30,000 birds bred in Canada, 1967-69, and Oberholser (1974) reported there were about 1,000 breeding birds in Mexico in 1970. Thus, the world breeding population in the late 1960's and early 1970's was on the order of 65,000 birds (1); the addition of pre-breeding and nonbreeding birds would augment this total considerably. The largest colony is at Chase Lake, North Dakota, where some 8,000 to 10,000 birds breed annually (Sloan 1973). The next three largest colonies are apparently those at Anaho NWR, Nevada (5,000 breeding birds in 1972), Gunnison Lake, Utah (5,000 in 1972), and Primrose Lake, Saskatchewan (4,900 in 1968). These four colonies contain over a third of the world's breeding White Pelicans.

Fairly extensive information on recent breeding populations of the White Pelican is available but it is scattered and may be incomplete for any given survey. Table 66 summarizes the information available to us and lists some earlier estimates for comparison.

Winter and Migration Wintering populations are found in southern California and western Arizona, south along the coasts of Baja California and western Mexico to Guatemala, in Florida, and along the shores of the Gulf of Mexico (Palmer 1962). Table 67 lists notable concentrations of these pelicans in southeastern waters in winter and other seasons.

Most White Pelican populations are migratory; a few of the southernmost ones (California, Texas) are resident (Palmer 1962). In fall, birds leave the breeding colonies and gather at staging points, often in very large numbers; these birds gradually leave these areas (mainly in late September and October) and migrate overland to the wintering grounds. Return migration occurs mainly during March and April (Palmer 1962).

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(1) Johnson and Sloan (1978) stated that "two recent surveys have been conducted (Lies and Behle 1966, Sloan 1973) and each have [sic] placed the continental [i.e., world] population between 30,00 and 35,000 individuals." This is incorrect; both studies covered only the United States.

Table 66. Breeding population estimates for the American White Pelican (a).

Area	Number of breeding birds	Number of nesting areas	When data obtained	Source
CANADA				
British Columbia	ca. 170	1	1968	Vermeer 1970d
	ca. 280	1	1953	Lies and Behle 1966
Alberta	1,000	8	1978	Markham and Brechtel 1979
	ca. 440	4	1967	Vermeer 1970d
Saskatchewan	ca. 11,710 (b)	7	1975-76	Roney 1978
	8,560	6	1971	Boeker 1972
	8,170	6	1968	Vermeer 1970d
	13,120	8	1968	Vermeer 1970d
Manitoba	14,780	6	1971	Boeker 1972
	11,520	6	1969	Vermeer 1970d
	ca. 13,600	8	1969	Vermeer 1970d
Ontario	800	1	1974	Goodwin and Rosche 1974
	880	1	1969	Vermeer 1970d
	320 (c)	1	1964	Lies and Behle 1966
	800 (c)	1	1961	Lies and Behle 1966
UNITED STATES				
Oregon	500 (d)	1	1972	Sloan 1973
	1,760 (e)	2	1971	Boeker 1972

(a) Figures rounded to the nearest 10; except where otherwise indicated, figures listed in parentheses are for 1971 and 1972, respectively. Boeker's survey was incomplete; figures provided by Vermeer are included for purposes of comparison.
(b) Figure includes estimate for Lavallee Lake obtained in 1975 (Trottier and Breneman in Roney 1978).
(c) Lies and Behle (1966) listed the data as approximately 800 breeding pairs and 320 breeding pairs for 1961 and 1964. The second number is precisely twice the number of nests; the first very nearly twice the number of nests. Consequently, we believe that "pairs" was probably a lapsus calamus for "birds" and have adjusted the estimate given here appropriately.
(d) Data for Crump-Pelican Lakes only.
(e) Estimate includes data for Upper Klamath NWR subsumed in California totals in Sloan (1973) as well as the estimate for Crump Lake.

Table 66. Continued.

Area	Number of breeding birds	Number of nesting areas	When data obtained	Source
Idaho	10	1	1977	Rogers 1977
Montana	5,500 (5,500-5,550)	2	1971-72	Sloan 1973
Wyoming	330 (f)	1	1972	Sloan 1973
	600	1	1962-63	Schaller 1964, Lies and Behle 1966
North Dakota	6,200	1	1978	Serr 1979
	8,120	1	1974	R. Stewart 1975
	7,820	1	1973	R. Stewart 1975
	9,000 (8,000-10,000)	1	1971-72	Sloan 1973
South Dakota	3,660	5	1973	McCrow 1974a
	2,080 (2,100-2,050)	ca. 3	1971-72	Sloan 1973
California (g)	5,120 (6,000-5,800)	4?	1971-72	Sloan 1973
Nevada	5,900 (6,000-5,800)	1	1971-72	Sloan 1973
Utah	4,750 (4,500-5,000) (h)	1	1971-72	Sloan 1973
	5,000	1	1963	Lies and Behle 1966
Colorado	530	1	1976	Kingery 1976
	380 (350-400) (i)	1	1971-72	Sloan 1973

(f) In text, Sloan (1973) indicated no information was available for the 1972 breeding season; nonetheless, a figure of 325 is listed for 1972 by him in his Table 1.
(g) Data includes estimate for birds in Upper Klamath NWR.
(h) Estimate of adults.
(i) Spring adults.

Table 66. Continued.

Area	Number of breeding birds	Number of nesting areas	Where data obtained	Source
Texas	400	1	1978	Blacklock et al. 1979
	580	1	1977	Blacklock et al. 1979
	620 (460-700) (j)	1	1973-76	Blacklock et al. 1978 ms
	550 (400-475)	1	1971-72	Sloan 1973
MEXICO				
Tamaulipas	1,000	1	1970	Oberholser 1974

(j) First figure is a four-year mean; figures in parentheses are the range of estimates for the period.

Several recent publications present data on specific dispersal patterns of certain colonies. Vermeer (1977) summarized many earlier reports and compared movements of young White Pelicans from Stum Lake, British Columbia, the only Canadian pelican colony west of the Rocky Mountains, with movements from Primrose Lake, Saskatchewan, to the east. Young pelicans from Stum Lake went south to Idaho, Utah, and California, presumably joining with these populations to proceed farther south. Other reports (Behle 1958, Kridler 1960 in Vermeer 1977) had indicated that birds from Utah and Nevada moved largely to the west coast of Mexico. Those from Yellowstone Park, Wyoming, migrated mainly to southern California and the west coast of Mexico, with some wintering on the Texas coast and in eastern Mexico (Diem 1967 in Vermeer 1977).

Vermeer also reported that young from Primrose Lake wintered primarily in Texas and eastern Mexico, but two had wandered as far east as Florida. Houston (1972) had previously reported recoveries from colonies at Redberry, Last Mountain, Dore, Quill, and Crane lakes in Saskatchewan. These, too, wintered primarily along the Texas, Louisiana, and eastern Mexican coasts, but three of the young from Crane Lake, the most southeastern colony, were recovered on the west coast of Mexico and El Salvador. Other reports by Houston deal with banding at Quill Lake (Houston 1967), Redberry Lake (Houston 1968, 1970), and Old Wives Lake (Houston 1970), and provide supplementary information on dispersal from these colonies.

Strait and Sloan (1975) noted similar results for young banded at Chase Lake, North Dakota. They reported that only 15 of the young recovered along the Gulf Coast were found east of the Mississippi River, while 38 were recovered along the Texas and Louisiana coasts. Seventy-eight were recovered in

Table 67. Peak concentrations of wintering, migrant, and nonbreeding American White Pelicans in the coastal southeastern United States (a).

Date	seen	Number seen	Locality	Source
			GEORGIA	
1977	28 Apr.	160	over Eufala NWR (inland)	Teulings 1977b
			FLORIDA-ATLANTIC COAST (b)	
1979	early Mar.	ca. 3,000	Lake Tohopelaliga S of Kissimmee	Kale 1979
1971	20 Apr.	140	Loxahatchee NWR	Kale 1971
1971	12 May	275	Loxahatchee NWR	Kale 1971
1972	31 May	200	Merritt Island NWR	Kale 1972
1962	14 Jun.	225	marshes near Titusville	Robertson 1962
1963	18 Jul.	234	near Titusville	Stevenson 1963d
			FLORIDA-KEYS	
1953	11 Aug.	350	near Bush Key	Stevenson 1953b
			FLORIDA-GULF COAST	
1955	15 Oct.	150	Alligator Point near Panacea	Stevenson 1956a
1955	16 Oct.	600	Tampa Bay	Stevenson 1956a
1960	19 Oct.	ca. 500	Snake Bight	Robertson and Paulson 1961
1954	20 Oct.	ca. 400	Mullet Key	Stevenson 1955a
1953	27 Oct.	ca. 800	Mullet Key	Stevenson 1954a
1952	21 Nov.	1,000	on Bear and 'Gator Lakes	Brookfield 1953
1957	30 Nov.	1,000	Cape Sable	Stevenson 1958a
1956-57	winter	ca. 5,000	wintering, Everglades Natl. Park	Stevenson 1957a
1958-59	winter	ca. 3,000	wintering, Shark and Broad River areas, Everglades Natl. Park	Stevenson 1959a
1972-73	winter	ca. 3,000	Everglades Natl. Park	Ogden 1973
1974-75	winter	2,000	near Lakeland	Stevenson 1975
1958	28 Jan.	3,600	Cape Sable area	Stevenson 1958b
1972	21 Mar.	ca. 400	in one flock, St. Marks Light	Stevenson 1972
1959	22 Mar.	ca. 2,000	Tampa Bay	Stevenson 1959a
1972	9 Apr.	306	St. Marks Light	Kale 1972

Table 67. Continued.

Date seen		Number seen	Locality	Source
			FLORIDA-GULF COAST (continued)	
1972	9 Apr.	306	St. Marks Light	Kale 1972
1970	23 Apr.	200	migrating over St. Marks NWR	Kale 1970
1972	9 May	ca. 400	Cape Sable	Kale 1972
1972	15 May	120	St. Marks Light	Kale 1972
1972	20 May	250	McKay Bay, Hillsborough Co.	Kale 1972
1973	9 Jun.	535	McKay Bay	Ogden 1973
1975	15 Jun.	400	Lake Hancock	Ogden 1975
1956	13 Jul.	5,000	Tampa Bay	Lies and Behle 1966
1955	8 Jul.	200	Myakka State Park	Stevenson 1955c
			ALABAMA	
1970	14 Oct.	3,000	Mobile Bay	Imhof 1976b
1955	late Oct.	1,000	Heron Bay	Imhof 1976b
1975	19 Nov.	ca. 1,000	Blakely Lake	Purrington 1976
			MISSISSIPPI	
1978	3 Oct.	200	Biloxi	Jackson and Cooley 1978a
1960	8 Oct.	ca. 1,000	Mississippi River near Rosedale	Newman 1961a
1978	4 Nov.	100+	Bellefontaine Beach	Jackson and Cooley 1978a
1977	7 Nov.	117	Bellefontaine Point	Weber and Jackson 1978
1977	18 Apr.	150	Hattiesburg sewage ponds	Weber and Jackson 1977
			LOUISIANA	
1975	6 Nov.	5,000+	Rockefeller WR	Purrington 1976
1969	12 Jun.	200+	Rockefeller WR/Holly Beach	J. Stewart 1969
			TEXAS	
1971	17 Sep.	500	Austin	Webster 1972a
1974	22 Sep.	ca. 400	over Austin	Webster 1975a
1967	27 Sep.	ca. 5,000	over Galveston Bay	Webster 1968a
1971	4-5 Oct.	2,200	over Barlett, 40 mi. N Austin	Webster 1972a
1965	18 Oct.	ca. 10,000	Galveston Bayshore area	Webster 1966a

Table 67. Continued.

Date seen		Number seen	Locality	Source
			TEXAS (continued)	
1963	29 Oct.	ca. 3,000	Cove	Webster 1964a
1963	29 Oct.	ca. 10,000	Galveston Bayshore area	Webster 1964a
1956	10 Nov.	1,000	Cove	Webster 1957a
1951	17 Nov.	1,500	Cove	Goldman and Watson 1952
1967	28 Mar.	ca. 1,000	over Austin, northbound	Webster 1967c
1972	8 Apr.	ca. 1,500	migrating over San Marco	Webster 1972c
1970	17 Apr.	1,000+	over Austin	Webster 1970c

(a) Within states, records are arranged chronologically by season.
(b) Several Florida localities listed are more inland than coastal; these have been listed with the nearest coast.

Mexico, El Salvador, and Nicaragua. Most (57%) of those from Mexico (75) were recovered in the coastal states of Tamaulipas and and Veracruz. There were 18 recoveries from the northeastern Gulf: 11 from Florida, 4 from Alabama, and 3 from Mississippi.

HABITAT

Nesting White Pelicans nest colonially and typically breed on well isolated small islands (Behle 1958) in freshwater lakes. These islands must have flat or gently sloping surfaces that are free from dense vegetation (Behle 1958). At Gunnison Island in Great Salt Lake, for example, these pelicans nested on flat areas no more than 3 m above water level (but there were no extensive areas of flat terrain higher than this). For 51 colonies the substrate was loose soil (35), sod (7), sand (6), or fine gravel (3); about 25% of the colonies were among driftwood. Open areas vegetated with annuals were used most frequently (69%), but colonies were also placed among shrubs (18%) or on unvegetated sites (14%) (Knopf 1979). A less typical nesting site is found in the Klamath Lake region of Oregon, where these pelicans nest on floating tule islands (Finley 1907).

Colonies are usually small and contain from a few to several hundred pairs (Palmer 1962); where the number of breeding birds is larger than this they usually nest in a number of small colonies rather than in one large colony. At Gunnison Island nearly 60% of the colonies in 1973 and 1974 held 50 nests or less, but most (60%) of the breeding population was in colonies containing 175 or more nests (Knopf 1979). During these 2 years, colony size ranged from 2 to 633 nests, with a mean of 145 nests in 1973, 81 in 1974. Similar colony sizes have been reported elsewhere: 7 colonies in Alberta

ranged from 19 to 225 nests (mean = 73) in 1978 (Markham and Brechtel 1979); 13 at Pyramid Lake, Nevada, ranged from 11 to 791 nests (Hall 1925a).

Palmer (1962) noted that spacing between nests is variable. Knopf (1979) reported that the mean distance between nests for 153 pairs of nests at Gunnison Island was 0.59 ± 0.16 m.

Feeding Breeding White Pelicans generally feed on expanses of freshwater. Wintering birds feed in saltwater bays and estuaries (Palmer 1962). Those breeding at Chase Lake, North Dakota, fed in seasonal, semi-permanent lakes and ponds containing fresh or slightly brackish water. There, pelicans fed along shorelines or in expanses of shallow, open water (Lingle and Sloan 1980).

Offshore White Pelicans are much less sea-going than the Brown Pelican; on brackish and salt water they prefer shallow coastal bays and inlets (Palmer 1962) and along the southeastern coast they are frequently found inland on freshwater.

FOOD AND FEEDING BEHAVIOR

Palmer (1962) summarized information from 14 earlier papers that gave information on the food habits of the White Pelican, reporting that the diet consisted "almost entirely [of] rough fish of little market value." He also indicated that salamanders (*Ambystoma* sp., *Necturus maculosa*) and crayfish were eaten. In some instances, amphibians may form a major part of the diet.

Recent papers by Johnson and Sloan (1978) and Lingle and Sloan (1980) provide some additional information on food habits at Chase Lake, North Dakota. Studies conducted in 1973 and 1974 revealed that the pelicans mostly ate rough fish and amphibians (Johnson and Sloan 1978). Fish tags found in the colony identified three species: walleye (*Stizostedion vitreum*), northern pike (*Esox lucius*), and bigmouth buffalo (*Ictiobus cyprinellus*). Lingle and Sloan (1980) reported the food fed to chicks during the 1976 and 1977 breeding seasons in more detail. They found that the most important item of diet was larval tiger salamanders (*Ambystoma tigrinum*). These formed 45.8 to 60.2% of the total volume of food eaten, and adult salamanders comprised another 3.9 to 4.2% of the diet. With the exception of some crayfish (*Astacus* sp.), the rest of the diet consisted of fish, most important of which was the black bullhead (*Ictalurus nebulosus*), which made up about 13.5% of the diet in both years. Other fish eaten (none totaling as much as 10% of the diet) included brook stickleback (*Eucalia inconstans*), fathead minnow (*Pimephales promeias*), carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), northern pike, and white sucker (*Catastomus commersoni*).

Other fish known to be eaten by the White Pelican include *Siphaletes obesus*, *Richardsonius egregius*, *Archoplites interruptus*, *Amerurus nebulosus*, *Chasmistes cujus*, *Micropterus salmoides*, *Leucichthys* sp., *Gila atraria*, and *Salmo gairdnerii* (Palmer 1962).

Hall (1925a) estimated that it requires 150 lb of fish to raise a young bird to age of first flight and that adults consumed 4 lb per day.

White Pelicans feed primarily by surface seizing, i.e., birds swim along the surface and plunge their head beneath the surface, scooping up their prey in the pouch (Palmer 1962). Most of the prey is living, but these pelicans will also scavenge dead fish or other meat (Behle 1958, Palmer 1962).

In some areas (e.g., Utah Lake, Pyramid Lake) White Pelican flocks feed co-operatively in areas of shallow water. The pelicans form a ring or semicircle and drive the fish together; the fish thus concentrated are easily scooped up by the encircled birds (Palmer 1962). Gunter (1958) noted that this behavior was rarely seen along the Gulf Coast, where White Pelicans usually fed as individuals, catching their prey by "rather languid jabs into the water". Palmer (1962) pointed out that birds feeding in deep water usually fed as individuals. Gunter remarked that the birds he observed in Texas apparently fed mostly in the deeper channels. He added that it was common for these birds to position themselves in the center of the channel and float downstream with the tide, flying back upstream after a quarter mile or so to begin again.

According to authors cited by Palmer (1962), White Pelicans have peaks of feeding activity in the early morning and late evening. Nesting birds are active only during the day; those away from the colony evidently regularly feed at night (Schaller 1964), but wintering birds apparently do not do so (Palmer 1962).

White Pelicans often forage considerable distances for food. Stansbury (1852 in Behle 1958) indicated that the pelicans from colonies at Great Salt Lake had to fly more than 30 miles to reach the nearest areas that could provide food. Behle added that these areas were still being used as foraging areas although closer, artifically constructed bodies of water were also used. Low et al. (1950) reported that birds from this colony might forage as much as 100 or 150 mi away.

Similar observations have been made about birds at other colonies. Johnson and Sloan (1978) analyzed the origin of fish-tags found in the colony at Chase Lake, North Dakota, and determined that 28 of 31 fish had been caught within a 128 mi radius of the colony; the remaining 3 fish were from even farther away. Foraging distances for birds at Arrowood NWR ranged from 96-611 km, according to Johnson (in Lingle and Sloan 1980).

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Egg laying within White Pelican colonies exhibits considerable synchrony but may also very substantially between colonies nesting at the same and other localities (Behle 1958). Knopf (1979) found that pelicans at Gunnison Island, Utah, laid from late March to late June in 1973 and 1974, but noted that most nesting began from early April through early May in both years; earlier, Behle (1958) had indicated that most laying occurred in May or June. At Yellowstone Lake, Wyoming, the first eggs are sometimes laid in late May (Skinner 1917 in Behle 1958, Schaller 1964), in other years, in early May (Schaller 1964); most laying in North Dakota apparently occurs in June (R. Stewart 1975).

Mean Clutch Size Much of the information on clutch size of colonial birds consists of the number of eggs found in a nest, which is not necessarily the number of eggs laid in that nest. This is particularly true for the White Pelican, which may roll eggs from neighboring nests into its own nest or which may dislodge eggs when leaving the nest rapidly at a disturbance. In this easily disturbed species, adequate quantitative data based on monitored, undisturbed nests is largely lacking. Behle (1958) indicated that White Pelicans in Utah normally laid two eggs, with clutches of one and three not uncommon. One nest on Gunnison Island contained 5 eggs, similar in shape and appearance, and he suggested that they had all been laid by one bird. Data from monitored nests suggest that true clutch size is usually two. Chaney et al. (1978) reported a mean clutch size of 1.90 for 10 nests on an island in the Laguna Madre, Texas, and McCrow (1974a) reported a mean clutch size of 1.95 for 20 nests at Sand Lake, South Dakota.

Incubation Period Until 1962, incubation period in the wild was unknown; Palmer (1962) cited an earlier report of incubation under a domestic hen that took 29 days. Knopf (1979) stated that "incubation requires about 30 days and eggs hatch asynchonously." Earlier, however, Knopf (1975b) stated that "for 13 eggs, incubation averaged 31.5 $\pm$ 1.20 days."

Hatching Success Information on hatching success in White Pelicans that is unbiased by the effects of disturbance is extremely scanty. McCrow (1974a) reported that 20 of 22 eggs hatched (90.9%) in 11 fully monitored nests at Sand Lake, South Dakota, in 1973.

Fledging Success Knopf (1979) reported a fledging success of 0.85 chicks per clutch (n = 1,323), comparing this to 0.42 chicks per egg for birds at Gunnison Island, Utah. Strait and Sloan (1975) estimated a fledging success of 0.54 young per nest in 1973 and 0.39 young per nest in 1974 for the colony at Chase Lake, North Dakota. In 14 nests at Sand Lake, South Dakota, 13 of the 28 hatched eggs (46.4%) resulted in fledged young in 1973 (McCrow 1974a). In terms of the estimated total eggs laid in the entire colony, the fledging success was 22.8%. Additional figures on productivity (young per nest) are given by Johnson and Sloan (1978).

If one assumes that two eggs are laid in most nests and that activities of the older chick result in the destruction of the younger in most instances, then a 50% fledging success (in terms of young per egg) would be maximal. The figures given above suggest that White Pelicans are, in fact, relatively successful in fledging young.

Age at Fledging Age at fledging is not precisely known. Hall (1925a) indicated that age of first flight was 62-64 days; this is probably the source of the statement in Palmer (1962) that "age at first flight [is] presumably about 2 months." Knopf (1975b), on the other hand, reported that chicks fledged 12 to 13 weeks after hatching.

Age at First Breeding Age at first breeding has not been adequately established. At Pelican Island, Riverside Reservoir, Colorado, Miller (1978) saw three 2-year-old birds courting and noted that McCrow (1974a) had witnessed similar activites by birds of this age in South Dakota. Miller also ob-

served a 2-year-old feeding a young bird and saw one male of that age copulating, but found no evidence of successful nesting by this age group.

Mortality of Eggs and Young Abandonment was a particularly important source of nesting failure at Gunnison Island in 1973 and 1974; about one-quarter of the nests were abandoned in both seasons. Other sources of nest loss included addling of eggs, death of an adult, morphological deformities of newly hatched young, and eggs rolling from nests (Knopf 1979). Abandonment is a major source of nest loss elsewhere. Johnson and Sloan (1978) reported 31% and 75% nest loss in two colonies at Chase Lake, North Dakota, in 1973 and 1974. Four other colonies visited there in 1974 lost 99% of the nests to abandonment. McCrow (1974a) reported that 55% of the nests in the Sand Lake, South Dakota, colony were abandoned or destroyed in 1973.

In nests containing two White Pelican chicks, the younger is often lost to starvation or to harassment by the older (Knopf 1979). At Chase Lake, North Dakota, Johnson and Sloan (1978) reported that the smaller nestling died as a direct result of physical abuse by the larger in 90% of the nests under observation; Behle (1958) suggested that this persecution usually accounts for about 50% of the nestling mortality, and Knopf (1979) reported that 45% of the pelican young in two-chick nests died from this cause. As is true of the Blue-faced Booby, the older may physically displace the younger from the nest; this may be an evolved form of brood reduction and not mortality in the more conventional, proximal, sense.

Disturbance by humans is a major factor in White Pelican nest loss. Johnson and Sloan (1976) cited instances in which entire colonies were lost to human disturbance, and Hall (1925a) estimated that 75% of the nest loss at Pyramid Lake, Nevada, was directly or indirectly due to the influence of man. Forms of nest-failure promoted by this disturbance include increased egg predation by gulls (California and Ring-billed gulls at Chase Lake, Herring Gulls at East Shoal Lake, Manitoba [Hosford 1965], California Gulls at Suggi Lake, Saskatchewan [Carson 1966]), loss of naked young to heat stress, and trampling of eggs and young by fleeing birds (Johnson and Sloan 1976). Undoubtedly, much nest abandonment and failure of eggs to hatch may also be attributed to human disturbance.

Loss of nests to human disturbance has been attributed to researchers (Johnson and Sloan 1976), to misguided fisherman who casually destroy adults, eggs, and young because they feel the pelicans are a threat to their livelihood (Behle 1958, Carson 1966, Kolstoe 1966), and to vacationers visiting colonies (Hall 1925a).

Other recorded sources of egg and chick mortality include inundation of eggs and young (Schaller 1964, Hosford 1965, Evans 1972), mortality of chicks from hail, and salt incrustation (Behle 1958).

Renesting White Pelicans lay only one clutch per season if undisturbed (Behle 1958). Schaller (1964) noted no instances of renesting following nest failure at Yellowstone Lake in Wyoming.

Maximum Natural Longevity The oldest White Pelican known to us was an

immature bird banded at Clear Lake NWR in 1935 and found dead near Lorella, Oregon, in 1961. It had attained an estimated minimum age of 26 years, 5 months (Clapp et al. 1979 ms). Strait and Sloan (1974) provided some additional information on longevity in this species basing their work on an analysis of birds banded at Chase Lake. They noted a 41% mortality rate from the time young departed the breeding colony through the first year of life, a 21.3% annual mortality rate for birds 3 to 13 years old, and a greater mortality in older birds. They pointed out, however, that the 3-13 year old mortality rate is too high judging from observed rates of production of young.

Weight (in grams) Few data on weights of White Pelicans are available. Marshall and Erickson (1945) reported that two males collected in April and November in Minnesota weighted 5,980 and 4,384 g, respectively. Behle (1958) stated that adults weigh from 10 to 17 lb (4,530 to 7,701 g), but that some might weigh as much as 30 lb (13,590 g). Evans (1969) reported that 26 fresh eggs from East Shoal Lake, Manitoba, ranged in weight from 134.5 to 187.2 g (mean = 154.2, SD 14.5).

SUSCEPTIBILITY TO OIL POLLUTION

We have found only one report of oiling in White Pelicans. Behle (1958) mentioned a bird that had become covered with waste oil in a drainage ditch near oil refineries at North Salt Lake. The bird was still alive but unable to fly. The absence of reports from the southeastern coasts and other areas suggests that this species is relatively insusceptible to oil pollution; certainly there are far more reports for other pelecaniforms that inhabit the area (e.g., Northern Gannet, Brown Booby, Brown Pelican) than there are for this species. The other forms principally dive for food, however; the White Pelican swims along the surface and seizes its prey. It seems likely that the White Pelican may avoid oiled waters, and its tendency to forage in freshwater and estuarine situations would render it less vulnerable. It should be kept in mind, however, that a large proportion of its total population winters in southeastern waters; thus, any significant denial of foraging range due to oil pollution or to development of facilities for oil production might have an adverse long term effect on the species.

BIBLIOGRAPHY

1981

Beaver, R. D. and V. Lewin. 1981. Scheduling censuses of breeding White Pelicans (*Pelecanus erythrorhynchos*) in northern Alberta. Can. Field Nat. 95: 398-399.

Findholt, S. and C. H. Trost. 1981. White Pelicans nesting in Idaho. Murrelet 62: 19-20.

Koonz, W. 1981. White Pelicans at a nuisance grounds. Blue Jay 39: 101-103.

Ryder, R. A. 1981. Migration and mortality of White Pelicans fledged in Colorado. (Abstract only). J. Colo.-Wyo. Acad. Sci. 13: 62-63.

1980

Dunbar, D., L. Koza and F. L. Bunnell. 1980. White Pelicans in British Columbia. Pp. 74-84 in R. Stace-Smith, L. Johns and P. Joslin (eds.) Threatened and Endangered Species in British Columbia and the Yukon.

Knopf, F. L. 1980. The hatching interval of White Pelican eggs. Proc. Okla. Acad. Sci. 60: 26-28.

Lingle, G. R. and N. F. Sloan. 1980. Food habits of White Pelicans during 1976 and 1977 at Chase Lake National Wildlife Refuge, North Dakota. Wilson Bull. 92: 123-125.

O'Malley, J. B. E. and R. M. Evans. 1980. Variations in measurments among White Pelican eggs and their use as a hatch date predictor. Can. J. Zool. 58: 603-608.

Trottier, G. C., R. J. Breneman and N. A. Young. 1980. Status and foraging distribution of White Pelicans, Prince Albert National Park, Saskatchewan. Can. Field Nat. 94: 383-390.

1979

Diem, K. L. 1979. White Pelican reproductive failures in the Molly Islands breeding colony in Yellowstone National Park. Pp. 489-496 in R. M. Linn (ed.). Proceedings of the 1st Conference on Scientific Research in the National Parks; November 9-12, 1976, New Orleans, LA. Natl. Park Service Trans. and Proc. Series No. 5

Janssen, R. B. 1979. Wintering White Pelicans. Loon 51: 53.

Knopf, F. L. 1979. Spatial and temporal aspects of colonial nesting of White Pelicans. Condor 81: 353-363.

Laycock, G. 1979. The pelican no one knows. Audubon 81: 36-47.

Markham, B. J. and S. H. Brechtel. 1979. Status and management of three colonial waterbird species in Alberta. Pp. 55-64 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, Am. Mus. Nat. Hist., New York, 20-23 October 1978. xi and 213 pp.

Roney, K. 1979. Saskatchewan's pelicans and cormorants in 1978. Blue Jay 37: 216-218.

1978

Clark, E. S. 1978. Wood Storks using White Pelicans as beaters. Fla. Field Nat. 6: 45-46.

DesGranges, J.-L. 1978. The first American White Pelican specimen in Quebec. Tchebec Annu. Rept. 1978: 90-91.

Johnson, R. F., Jr. and N. F. Sloan. 1978. White Pelican production and survival of young at Chase Lake National Wildlife Refuge, North Dakota. Wilson Bull. 90: 346-352.

Kushlan, J. A. 1978. White Pelican numbers in Everglades National Park. Fla. Field Nat. 6: 16-17.

Lingle, G. and N. F. Sloan. 1979. Sexing and aging criteria for the White Pelican. Prairie Nat. 11: 83-88.

Miller, G. C. 1978. Two-year-old White Pelicans at colony sites. Pp. 73-77 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, Dekalb, Illinois, 20-23 October 1977. viii and 205 pp.

Roney, K. 1978. Pelicans, cormorants and Great Blue Herons in Saskatchewan in 1976. Blue Jay 36: 28-35.

Stotz, J. and Y. A. Greichus. 1978. The effects of a polychlorinated biphenyl (Aroclor 1254) on the White Pelican: ultrastructure of hepatocytes. Bull. Environ. Contam. Toxicol. 19: 319-325.

Tait, I. C., L. Knopf and J. L. Kennedy. 1978. White Pelicans nesting at Honey Lake, California. West. Birds 9: 38-40.

Weseloh, D. V., S. Brechtel and R. D. Burns. 1978. Recent population changes in Double-crested Cormorants and California and Ring-billed gulls in Alberta, Canada, with a note on White Pelicans. Pp. 10-18 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, DeKalb, Illinois, 20-23 October 1977. viii and 205 pp.

1977

Alexander, K. A., A. T. Nicholson and Mr. and Mrs. W. P. Grant. 1977. White Pelican at Carolina Beach, N.C. Chat 41: 95.

Bremer, P. E. 1977. Pelican kill. Loon 49: 240-241.

Lingle, G. R. 1977. Food habits and sexing-aging criteria of the White Pelican at Chase Lake National Wildlife Refuge, North Dakota. M. S. thesis, Mich. Technol. Univ.

Miller, G. C. and R. A. Ryder. 1977. Productivity of White Pelicans in Colorado. (Abstract only). J. Colo.-Wyo. Acad. Sci. 9: 41.

Vermeer, K. 1977. Comparison of White Pelican recoveries from colonies east and west of the Canadian Rocky Mountains. Murrelet 58: 79-82.

1976

Benson, W. W., D. W. Brock, J. Garcia and M. Loomis. 1976. Pesticide and mercury levels in pelicans in Idaho. Bull. Environ. Contam. Toxicol. 15: 543-546.

Greichus, Y. A., A. Greichus and D. J. Call. 1976. Care and growth of captive White Pelicans. Avic. Mag. 82: 139-142.

Johnson, R. R., Jr. and N. F. Sloan. 1976. The effects of human disturbance on the White Pelican colony at Chase Lake National Wildlife Refuge, North Dakota. Inl. Bird-Banding News 48: 163-170.

Knopf, F. L. 1976. A pelican synchrony. Nat. Hist. 85: 48-57.

Lapp, A. 1976. White Pelicans colonize Hartson Reservoir. Outdoor Calif. 37: 24-25.

Peck, G. K. 1976. Recent revisions to the list of Ontario's breeding birds. Ont. Field Biol. 30: 9-16.

1975

Greichus, Y. A., D. J. Call, B. M. Ammann, A. Greichus and H. Shave. 1975. Physiological effects of polychlorinated biphenyls or a combination of DDT, DDD, and DDE in penned White Pelicans. Arch. Environ. Contam. Toxicol. 3: 330-343.

Johnson, R. F. and N. F. Sloan. 1975. Fishing gear - a deadly hazard. Inl. Bird-Banding News 47: 115-117.

Knopf, F. L. 1975a. Schedule of presupplemental molt of White Pelicans with notes on the bill horn. Condor 77: 356-359.

Knopf, F. L. 1975b. Spatial and temporal aspects of colonial nesting of the White Pelican, Pelecanus erythrorhynchos. Ph. D. thesis, Utah St. Univ. 77 pp.

Strait, L. E. and N. F. Sloan. 1975. Movement and mortality of juvenile White Pelicans from North Dakota. Wilson Bull. 87: 54-59.

Weseloh, D. V., D. Dekker, S. Brechtel and R. Burns. 1975. Notes on the Double-crested Cormorants, White Pelicans and Great Blue Herons of Beaverhill Lake, summer, 1975. Alberta Naturalist 5: 132-137.

1974

Caldwell, P. J. and B. D. J. Batt. 1974. Snow Goose soaring with White Pelicans. Wilson Bull. 86: 67-68.

Call, D. J., N. H. Granholm and I. J. Stotz. 1974. Comparative ultrastructure of proximal and distal tubules in the pelican kidney. Proc. S. Dak. Acad. Sci. 53: 191-195.

Dinsmore, J. J. 1974. White and Brown pelicans feeding together. Fla. Field Nat. 2: 11.

Ganier, E. J., Jr. 1974. White Pelicans. MOS Newsl. 19: 6.

Knopf, F. L. and J. C. Street. 1974. Insecticide residues in White Pelican eggs from Utah. Wilson Bull. 86: 428-434

McCrow, V. P. 1974a. Reproduction of White Pelicans in South Dakota in 1973. Proc. S. Dak. Acad. Sci. 53: 135-152.

McCrow, V. P. 1974b. Studies of the White Pelican in South Dakota: reproductive biology of wild populations and effects of polychlorinated biphenyls and DDT on the behavior of penned birds. M. S. thesis, S. Dak. St. Univ./Brookings.

Strait, L. E. and N. F. Sloan. 1974. Life table analysis for the White Pelican. Inl. Bird-Banding News 46: 20-28.

1973

Greichus, Y. A., A. Greichus and R. J. Emerick. 1973. Insecticides, polychlorinated biphenyls and mercury in wild cormorants, pelicans, their eggs, food and environment. Bull. Environ. Contam. Taxicol. 9: 321-328.

Hatfield, J. P. 1973. White Pelicans return to Last Mountain Lake. Blue Jay 31: 98.

Sloan, N. F. 1973. Status of breeding colonies of White Pelicans in the United States through 1972. Inl. Bird-Banding News 45: 83-96.

Strait, L. E. 1973. Population dynamics of a White Pelican population, Chase Lake Wildlife Refuge, North Dakota. M. S. thesis, Mich. Technol. Univ., Houghton, Mich. 76 pp.

1972

Boeker, E. L. 1972. A survey of White Pelican nesting colonies in 1971. Am. Birds 26: 24, 125.

Evans, R. M. 1972. Some effects of water level on the reproductive success of the White Pelican at East Shoal Lake, Manitoba. Can. Field Nat. 86: 151-153.

Houston, C. S. 1972. Recent Saskatchewan banding of the White Pelican. Blue Jay 30: 24-27.

Linder, R. L. and Y. A. Greichus. 1972. Tests on learning ability of the White Pelican. Proc. S. Dak. Acad. Sci. 51: 132-135.

1971

Anon. 1971. The pelican--protection or extinction. Proc. Annu. Fed. Prov. Wildl. Conf., Toronto, 6-8 July 35: 1-5.

Liu, S-K. and A. G. Edward. 1971. Gastric ulcers associated with Contracaecum spp. (Nematoda: Ascaroidea) in a Stellar Sea Lion and a White Pelican. J. Wildl. Dis. 7: 266-271.

Manning, D. and G. Manning. 1971. Avocets and White Pelican on Kentucky Lake in Henry County, Tennessee. Migrant 42: 88-89.

1970

Amaral, A. 1970. Nevada's endangered pelicans. Nat. Parks Conserv. Mag. 44: 23-27.

Anon. 1970. White Pelicans in Charleston area. Chat 34: 45.

Brocke, R. H. and G. F. Mattfeld. 1970. A White Pelican sighted at Tupper Lake, New York. Kingbird 20: 12.

Burkholder, J. C. and R. K. Plakke. 1970. Aspects of thermoregulation in the White Pelican (P. erythrorhynchos). (Abstract only). J. Colo.-Wyo. Acad. Sci. 7: 13.

Campbell, R. W. 1970. The White Pelican in southwestern British Columbia. Murrelet 51: 18-19.

Houston, C. S. 1970. Saskatchewan bird banders: Fred G. Bard. Blue Jay 28: 150-156.

Rhodes, L. 1970. White Pelican seen at Blackwater Refuge. Md. Birdlife 26: 3-4.

Vermeer, K. 1970a. Autumn migration of juvenile White Pelicans from western Canada. Blue Jay 28: 88.

Vermeer, K. 1970b. Colonies of Double-crested Cormorants and White Pelicans in Saskatchewan, Canada. Can. Field Nat. 84: 39-42.

Vermeer, K. 1970d. Distribution and size of colonies of White Pelicans (Pelecanus erythrorhynchos) in Canada. Can. J. Zool. 48: 1029-1032.

Wagner, J. E. and D. R. Dietlein. 1970. Steatitis in an American White Pelican, Pelecanus erythrorhynchos. Internatl. Zoo Yearbk. 10: 174.

1969

Anderson, D. W., R. W. Risebrough, D. F. Hughes and R. E. Christenson. 1969. Significance of chlorinated hydrocarbon residues to breeding pelicans and cormorants. Can. Field Nat. 83: 93-112.

Campbell, R. W. and D. L. Frost. 1969. Additional notes on the White Pelican colony at Stum Lake, British Columbia. Condor 71: 73.

Evans, R. M. 1969. Specific gravity of White Pelican eggs. Auk 86: 560-561.

Vermeer, K. 1969. Colonies of Double-crested Cormorants and White Pelicans in Alberta. Can. Field Nat. 83: 36-39.

1968

Adolfson, D. G. and M. Adolfson. 1968. Size, distribution, and populations of three colony nesting species in South Dakota. S. Dak. Bird Notes 20: 1-10.

Breckenridge, W. J. 1958. Minnesota nesting of White Pelicans. Loon 40: 100.

Houston, C. S. 1968. Saskatchewan bird banders: William I. Lyon and H. E. McArthur. Blue Jay 26: 185-194.

McNicholl, M. 1968. Vocalization in the White Pelican. Blue Jay 26: 124-125.

1967

Anderson, D. W. and J. C. Bartonek. 1967. Additional observations on the status of North American White Pelicans. Condor 69: 311-313.

Houston, C. S. 1967. Saskatchewan bird banders: Judge J. A. M. Patrick (1873-1943). Blue Jay 25: 172-174.

1966

Carson, R. D. 1966. Destruction of colonial birds on an island on Suggi Lake. Blue Jay 24: 96-97.

Kolstoe, S. O. 1966. The White Pelican. N. Dak. Outdoors 29: 16-20.

Lies, M. F. and W. H. Behle. 1966. Status of the White Pelican in the United States and Canada through 1964. Condor 68: 279-292.

McDaniel, B. and I. Patterson. 1966. Nematode infestation of a White Pelican found along the Gulf Coast of Texas. Southwest. Nat. 11: 312.

1965

Hosford, H. 1965. Breeding success of the White Pelican in two colonies in Manitoba. Blue Jay 23: 21-24.

Mansell, W. D. 1965. Present status of the White Pelican in Ontario. Ont. Field Biol. 19: 11-14.

1964

Cook, F. A. 1964. White Pelicans. MOS Newsl. 9: 3.

Schaller, G. B. 1964. Breeding behavior of the White Pelican at Yellowstone Lake, Wyoming. Condor 66: 3-23.

1963

Biaggi, V., Jr. 1963. Record of the White Pelican and additional information on the Glossy Cowbird from Puerto Rico. Auk 80: 198.

Ryder, R. A. and J. R. Grieb. 1963. White Pelicans breeding in Colorado. Wilson Bull. 75: 92.

Stephens, W. M. 1963. The peculiar pelican. Sea Frontiers 9: 227-236.

1962

Houston, C. S. 1962. Hazards faced by colonial birds. Blue Jay 20: 74-77.

1961

Murphy, R. C. 1961. A continental water bird. Nat. Hist. 70: 28-31.

1960

Kridler, E. 1960. Banding White Pelicans at Anaho National Wildlife Refuge, Nevada. News from Bird Banders 35: 5-6.

Oglesby, L. C. 1960. Heavy nematode infestation of White Pelican. Auk 77: 354.

1958

Barnes, G. 1958. White Pelicans on coast. MOS Newsl. 3: 1.

Behle, W. H. 1958. The Bird Life of Great Salt Lake. Utah Univ. Press, Provo, Utah. 230 pp.

Gunter, G. 1958. Feeding behavior of Brown and White pelicans on the Gulf Coast of the United States. Proc. La. Acad. Sci. 21: 34-39.

Turcotte, W. H. 1958. White Pelicans. MOS Newsl. 3: 2.

1955

Atkeson, T. Z., Jr. 1955. White Pelican records from Wheeler Reservoir. Ala. Birdlife 3: 4-5.

Chamberlain, B. R. 1955c. White Pelican at Clinton, N.C. Chat 19: 26-27.

1954

Bartholomew, G. A. and W. R. Dawson. 1954. Temperature regulation in young pelicans, herons, and gulls. Ecology 35: 466-472.

Schorger, A. W. 1954. The White Pelican in early Wisconsin. Passenger Pigeon 16: 136-140.

1952

Mengel, R. M. 1952. White Pelican from the Pleistocene of Oklahoma. Auk 69: 81-82.

1953

Bartholomew, G. A., W. R. Dawson and E. J. O'Neill. 1953. A field study of temperature regulation in young White Pelicans, Pelecanus erythrorhynchos. Ecology 34: 554-560.

Behle, W. H. 1953. Migration of the White Pelicans of Gunnison Island. Proc. Utah Acad. Sci. Arts Lett. 30: 32-38.

Lesley, S. 1953. White Pelicans at Lake Junaluska, Haywood County, North Carolina. Chat 17: 69-70.

Marshall, D. B. and L. W. Giles. 1953. Recent observations on birds of Anaho Island, Pyramid Lake, Nevada. Condor 55: 105-115.

1950

Low, J. B., L. Kay and D. I. Rasmussen. 1950. Recent observations on the White Pelican on Gunnison Island, Great Salt Lake, Utah. Auk 67: 345-356.

1949

Behle, W. H. 1949. Report on the colonial nesting birds of Great Salt Lake, 1947-49. Condor 51: 268-270.

Krumm, K. 1949. White Pelicans nesting in LaCreek Refuge. S. Dak. Bird Notes 1: 13.

Tufts, R. W. 1949. First record for White Pelican in Nova Scotia. Can. Field Nat. 63: 116.

Walker, L. W. 1949. Refugee pelicans of the desert. Nat. Hist. 58: 471-474.

1948

Friedman, R. 1948. Black Skimmer and White Pelican in the Bahamas. Auk 65: 142.

1947

Howe, B., Jr. 1947. The White Pelican at Tybee Island, Georgia. Oriole 12: 11.

Nichols, H. K., Jr. 1947. White Pelicans seen at Redondo, Washington. Murrelet 28: 6.

1946

Fletcher, O. K. 1946. Sight record of a White Pelican at Cordele. Oriole 11: 44.

1945

Cook, F. W. 1945. Two unusual records for North Carolina. Auk 62: 465.

Meade, G. M. and C. B. Seagears. 1945. White Pelican in New York State. Auk 62: 637-638.

Weakley, S. A. 1945. White Pelicans and Cliff Swallows on the Tennessee River. Migrant 16: 33.

1944

Behle, W. H. 1944a. A secondary function of the gular pouch of the White Pelican. Condor 46: 128.

Behle, W. H. 1944b. The pelican colony at Gunnison Island, Great Salt Lake, in 1943. Condor 46: 198-200.

1943

Alcorn, J. R. 1943. Observations on the White Pelican in western Nevada. Condor 45: 34-36.

Richardson, F. M. 1943a. Pneumaticity of the White Pelican. Condor 45: 38-39.

Richardson, F. M. 1943b. Mallophaga on young White Pelicans. Condor 45: 201-202.

Walker, L. W. 1943. Pelican profiles. Nat. Geogr. 84: 589-598.

1942

Cottam, C., C. S. Williams and C. A. Sooter. 1942. Cooperative feeding of White Pelicans. Auk 59: 444-445.

1941

Lincoln, F. C. 1941. Pelicans killed by lightning. Auk 58: 91.

1940

Hall, E. R. 1940. An ancient nesting site of the White Pelican in Nevada. Condor 42: 87-88.

1939

Cottam, C. and C. S. Williams. 1939. Food and habits of some birds nesting on islands in Great Salt Lake. Wilson Bull. 51: 150-155.

1938

Eyles, D. 1938a. White Pelican at mouth of the Savannah River. Oriole 3: 29-33.

1936

Spratt, N. 1936. White Pelican in Atlanta, Georgia. Oriole 1: 8.

1935

Allen, R. P. 1935. Notes on some bird colonies on the Gulf Coast. Auk 52: 198-200.

Bailey, A. M. 1935. The White Pelican. Bird-Lore 37: 329-336.

Jennings, B. 1935. The plight of the pelican. Our Dumb Animals (Sept.) 1935: 133-134.

May, J. B. 1935. White Pelicans in Florida. Auk 52: 180.

1934

Sprunt, A., Jr. 1934. The White Pelican (Pelecanus erythrorhynchos) on the South Carolina coast. Auk 51: 508-509.

1933

Nicholson, W. H. 1933. Roseate Spoonbills and White Pelicans in Brevard County, Florida. Auk 50: 429.

Ross, R. C. 1933. Traveling speed of White Pelicans. Condor 35: 70.

Thompson, B. H. 1933. History and present status of the colonies of White Pelican, Pelecanus erythrorhynchos, in the United States. M. A. thesis, Univ. Calif./Berkeley, CA.

1932

Felton, W. R. 1932. A large fall migration of the White Pelican. Wilson Bull. 44: 41.

Lumley, E. 1932. White Pelicans in Montana. Bird-Lore 34: 371.

Madsen, D. H. 1932. White Pelicans in Great Salt Lake. Bird-Lore 34: 304-305.

Pearson, T. G. 1932. Status of the White Pelican. Bird-Lore 34: 240-241.

Thompson, B. H. 1932. History and present status of the breeding colonies of the White Pelican (Pelecanus erythrorynchos) in the United States. U.S. Dept. Int., Natl. Park Serv. Contrib. Wildl. Div. Occas. Pap. 1. 82 pp.

1930

Carroll, J. J. 1930a. Breeding of the American White Pelican on the Texas coast. Condor 32: 202-204.

Carroll, J. J. 1930b. More on the White Pelican on the Texas coast. Condor 32: 304.

Greene, E. R. 1930. White Pelican (Pelecanus erythrorynchus) in Georgia. Auk 47: 415-416.

Sprunt, A., Jr. 1930. White Pelican (Pelecanus erythrorhynchus) in Georgia. Auk 47: 242.

Sugden, J. W. 1930. White Pelicans killed by lightning. Auk 47: 72-73.

1929

Sutton, G. M. 1929. White Pelican in Chester County, Pennsylvania. Auk 46: 104.

Yeagher, D. 1929. A trip to pelican island. Yellowstone Nat. Notes 6: 3-4.

1928

Christy, B. H. 1928. Bird notes from southern Florida. Auk 45: 283-289.

1927

Bailey, A. M. 1927. The pelicans at home. Am. Forests & Forest Life 33: 87-92.

Sutton, G. M. 1927. White Pelican in southeastern Pennsylvania. Auk 44: 94.

1926

Bennett, W. W. 1926. White Pelicans and other birds of Chase Lake, North Dakota. Wilson Bull. 38: 65-79.

1925

Eaton, S. H. 1925. White Pelican at Lawrenceville, Illinois. Auk 42: 263.

Hall, E. R. 1925a. Pelicans versus fishes in Pyramid Lake. Condor 27: 147-160.

Hall, E. R. 1925b. A study of the food habits of the White Pelican at Pyramid Lake, Nevada, with special reference to its relation to the fishing industry. M. A. thesis, Univ. Calif./Berkeley, CA.

Mills, L. 1925. White Pelicans in Nevada. Condor 27: 32-33.

1924

Ward, H. B. 1924. Banding White Pelicans. Condor 26: 136-140.

1923

Evermann, B. W. 1923. The pelicans of Pyramid Lake. Overland Month. 1923 (May): 16-18, 45.

1922

Brannon, P. A. 1922. Pelicans in the interior of Alabama. Auk 39: 411.

Lano, A. 1922. White Pelican (Pelecanus erythrorhynchos) nesting in Minnesota. Auk 39: 105.

Prill, A. G. 1922. Pelecanus erythrorhynchos-- A.O.U. no. 125. American White Pelican, Malheur Lake Bird Reservation, Oregon. Oologist 39: 32-33.

Ward, H. B. 1922 ms. The pelicans of Yellowstone Lake. [25 pp. ms report to U.S. Bureau Fisheries & U.S. Natl. Park Service.]

1919

Farley, F. M. 1919. The White Pelican, Pelecanus erythrorhynchos, in Alberta. Can. Field Nat. 33: 38-39.

1917

Skinner, M. P. 1917. The birds of Molly Island, Yellowstone National Park. Condor 19: 117-182.

1916

Neale, G. 1916. White Pelicans formerly nested near Sacramento, California. Calif. Fish Game 3: 161-162.

1913

Rossignol, G. R., Jr. 1913. White Pelican at Savannah, Ga. Auk 30: 106.

1911

Rea, P. M. 1911. White Pelican in South Carolina. Auk 28: 113.

1909

Brewster, W. 1909. A recent instance of the occurrence of the White Pelican (*Pelecanus erythrorhynchos*) in Massachusetts. Auk 26: 185-186.

1907

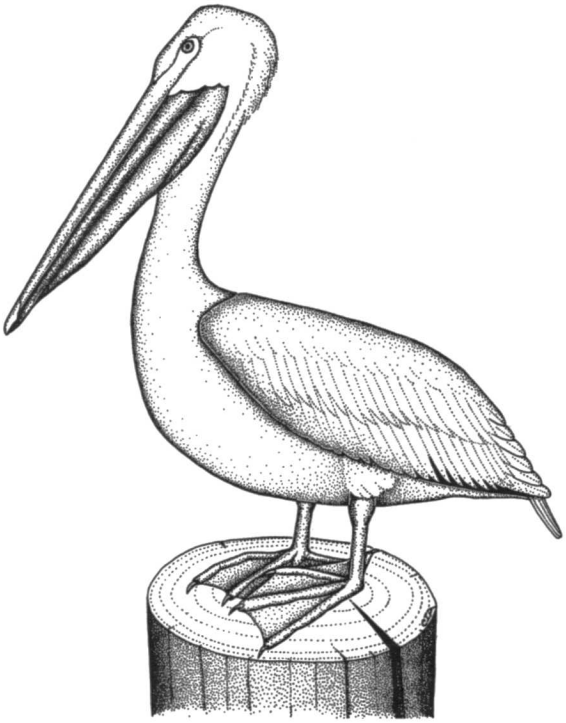
Finley, W. L. 1907. Among the pelicans. Condor 9: 34-41.

1904

Arnow, I. F. 1904. Holboell's Grebe and the White Pelican at St. Mary's, Georgia. Auk 21: 277.

Goodwin, S. H. 1904. Pelicans nesting at Utah Lake. Condor 6: 126-129.

Whitleaves, J. F. 1904. A White Pelican at Manotick. Ottawa Nat. 18: 71-72.



BROWN PELICAN

(*Pelecanus occidentalis*)

[SP: Alcatraz, Alcatraz moreno]

GENERAL DISTRIBUTION

North America On the Pacific coast of North America, Brown Pelicans breed from Anacapa and Santa Cruz islands (Scorpion Rock) off California (Anderson et al. 1977b) south along the Mexican coast and in the Gulf of California (AOU 1957) and on islets in Panama (Wetmore 1965). Formerly, they bred north to Bird Island, Point Lobos Reserve, Monterey County, California (Small 1974).

This species breeds on the Atlantic coast of the United States from Ocracoke Inlet, North Carolina, south to Florida. Along the Gulf of Mexico it breeds on the Florida west coast (and rarely in the Dry Tortugas), in Louisiana (reestablished population), Texas, and at least formerly, off northern Mexico (Schreiber and Risebrough 1972, Schreiber et al. 1975a). Off the southern Mexican Atlantic coast it breeds at least on Isla Contoy (Paynter 1955, A.R. Phillips, pers. comm.) and probably elsewhere, but breeding status along this coast is poorly known. To the south, these pelicans breed in Belize (Man-O-War Cay)(Russell 1964) and perhaps elsewhere, but information is very sparse.

Brown Pelicans regularly disperse north from Mexican waters to the California coast in late summer and early fall; these dispersals coincide with those into the interior southwestern United States and interior Mexico (Anderson and Anderson 1976). Atlantic coast populations tend to move southward in fall. Most birds winter in the United States, particularly in Florida, but some disperse to the Cuban coast. Gulf Coast birds tend to remain near their breeding colonies but they may wander along the coast (Palmer 1962).

Brown Pelicans wander casually or accidentally north to the coast of British Columbia and Nova Scotia (Godfrey 1966) and east to Bermuda (Palmer 1962). This species has wandered inland to many of the continental United States. Inland states from which this species has been recorded and which are not listed by the AOU (1957) include Oklahoma (Sutton 1967, Carlton 1979), Nevada (Lawson 1973), and Ohio (Longstreet 1945b).

World Distribution Brown Pelicans also breed in the Galapagos Islands and on the Pacific coast of South America from Colombia south to Chile (Santiago); on the Atlantic side they breed from the Venezuelan offshore islands of Los Roques to Trinidad and Tobago (Blake 1977). The breeding status of this species in the Caribbean is not well known but breeding has been reported from the Greater Antilles (off Cuba) to Pelican Cay near St. Martin in the Lesser Antilles (Bond 1956). The Brown Pelican ranges casually southward off Tierra del Fuego, Argentina; on the Atlantic coast of South America it ranges to Guyana and Surinam and casually to northern Brazil at the mouth of

the Amazon (Blake 1977).

DISTRIBUTION IN THE COASTAL SOUTHEASTERN UNITED STATES

North Carolina Brown Pelicans occur regularly along the North Carolina coast throughout the year, but only in relatively small numbers. Historically, the species has usually nested annually at one or two localities near Ocracoke (Map 13). The 1977 breeding population of some 200 birds was about evenly divided between two localities, Shell Castle Island and the North Rock Islands; both have been used frequently for nesting during the last 20 years but neither was used in 1978. Instead, pelicans nested at nearby Beacon Island and on a dredge spoil island in the Cape Fear River, a considerable distance southwest (Parnell and Soots 1979 ms).

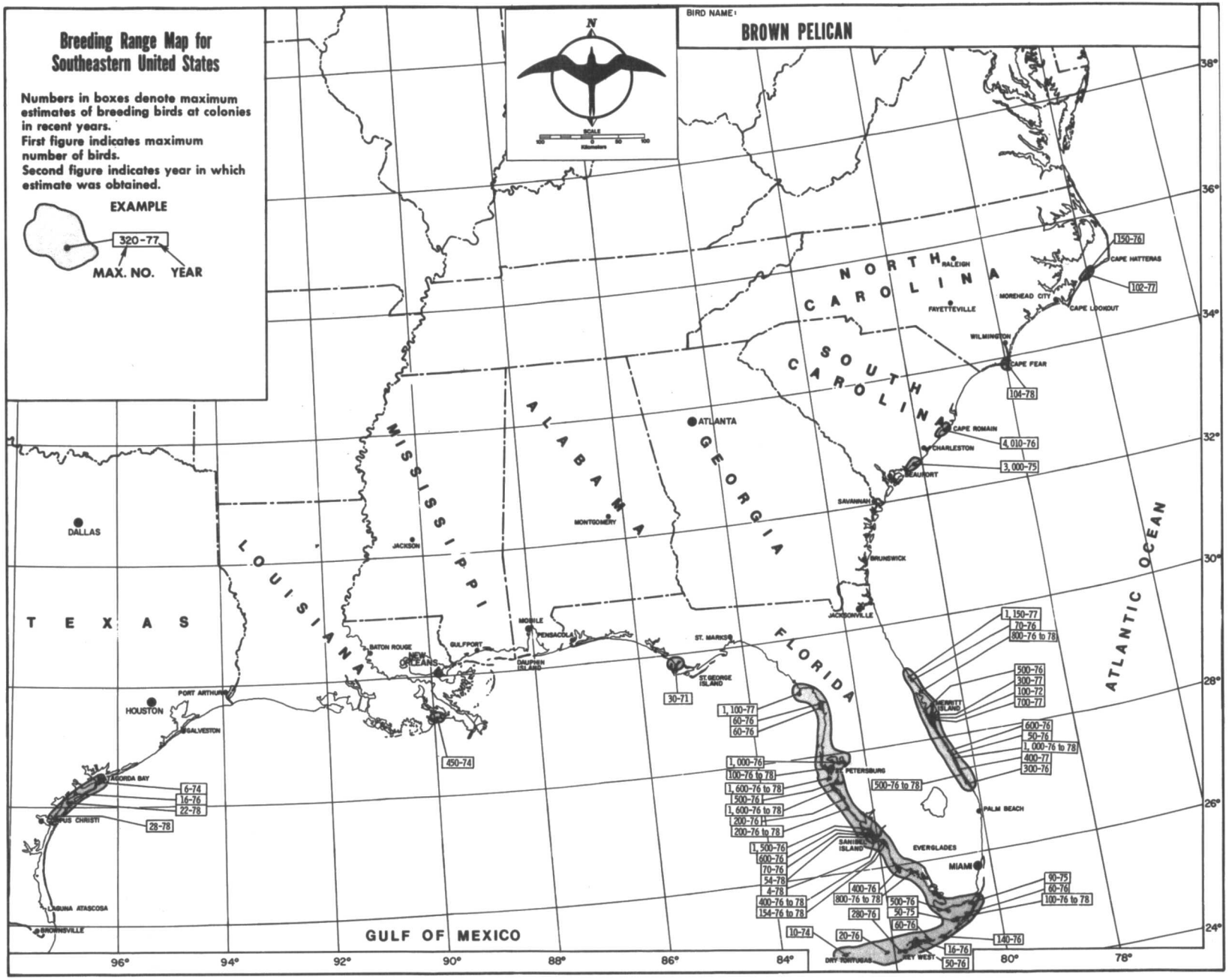
Information on nesting populations is limited, with considerable gaps in the data. Historically, the population has evidently consisted of no more than a few hundred breeding birds. There is no evidence that the population has declined in recent years as it has in some of the other southeastern states (Parnell and Soots 1979 ms). Few are present in winter (Map 14, Table 68).

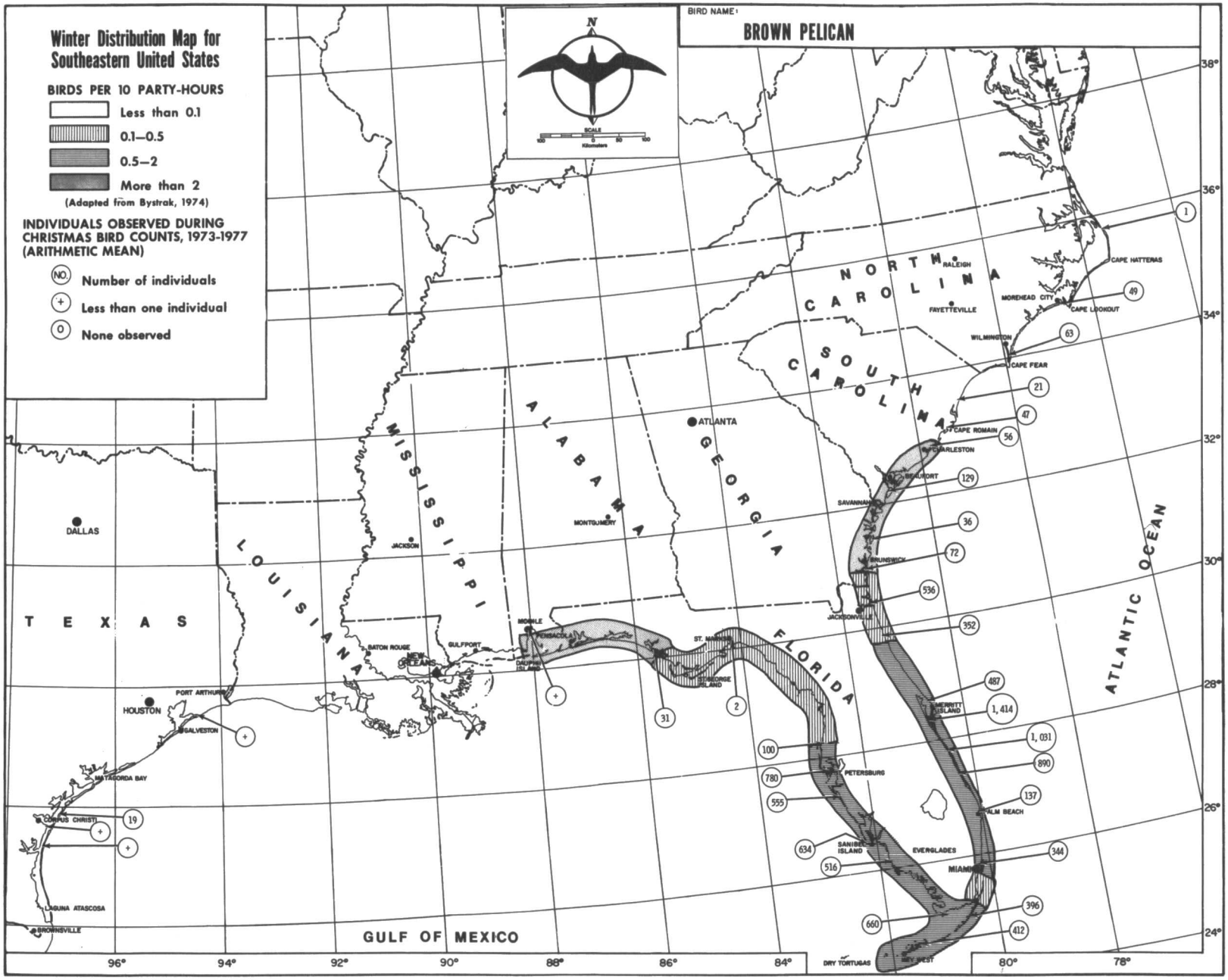
South Carolina About the early 1960's, some 12,000 Brown Pelicans bred in South Carolina (Beckett 1966, Schreiber and Risebrough 1972, Blus et al. 1979b), but the breeding population decreased sharply in the latter half of the decade and in 1970 only about 2,230 pelicans nested there. This decline was attributed to the effects of pollutants, primarily DDE (Blus et al. 1974a), on the pelicans' reproductive success. Since then the breeding population has increased steadily; by 1978 about 6,710 pelicans were breeding in the state (Blus et al. 1979b, Mendenhall and Prouty 1979). Additional useful information on the history of breeding by Brown Pelicans in South Carolina and other southeastern states is given by Schreiber and Risebrough (1972).

Two colonies of Brown Pelicans are now found in South Carolina (Map 13). One is on Deveaux Bank, 25 km south of Charleston. The other is in Cape Romaine NWR 35 km north of Charleston, where the birds nest on either of two islands, Marsh Island (1969-77) or Bird Bank (1978) (Mendenhall and Prouty 1979). Blus et al. (1974a) listed and discussed earlier nesting areas, but from 1966 on all nesting has occurred at the localities given above.

Georgia The Brown Pelican does not breed in Georgia, but it occurs throughout the year along the coast where Denton et al. (1977) regard it as usually fairly common except in December and January. Judging from Burleigh's (1958) remarks, it is most common during the spring and fall migration; exceedingly little is known of seasonal variation in numbers (cf. Table 68). Burleigh pointed out that "possibly because it is such a common bird, ornithologists have failed to record it in due proportion."

Whether the Brown Pelican ever bred in Georgia is inadequately resolved. Burleigh (1958) was unaware of any records of breeding; Anderson and Hickey (1970), who examined many egg collections, listed eggs collected "on [a] beach" in Chatham County, 16 June 1898, by T. D. Perry.


Breeding Range Map for Southeastern United States
Numbers in boxes denote maximum estimates of breeding birds at colonies in recent years.
First figure indicates maximum number of birds.
Second figure indicates year in which estimate was obtained.
EXAMPLE
320-77
MAX. NO.
YEAR
BIRD NAME:
BROWN PELICAN
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
TASCORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
PENSACOLA
DAUPHIN ISLAND
MONTGOMERY
ATLANTA
ST. MARKS
ST. GEORGE ISLAND
SAVANNAH
BRUNSWICK
JACKSONVILLE
BEAUFORT
CHARLESTON
CAPE ROMAIN
CAPE FEAR
WILMINGTON
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
HERBERT ISLAND
PALM BEACH
EVERGLADES
MIAMI
KEY WEST
DRY TORTUGAS
SANIBEL ISLAND
PETERSBURG
6-74
16-76
22-78
28-78
450-74
30-71
1,100-77
60-76
60-76
1,000-76
100-76 to 78
1,600-76 to 78
500-76
1,600-76 to 78
200-76
200-76 to 78
1,500-76
600-76
70-76
54-78
4-78
400-76 to 78
154-76 to 78
10-74
20-76
400-76
800-76 to 78
280-76
500-76
50-75
60-76
16-76
50-76
140-76
90-75
60-76
100-76 to 78
500-76 to 78
1,150-77
70-76
800-76 to 78
500-76
300-77
100-72
700-77
600-76
50-76
1,000-76 to 78
400-77
300-76
4,010-76
3,000-75
104-78
150-76
102-77
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°


Winter Distribution Map for Southeastern United States
BIRDS PER 10 PARTY-HOURS
Less than 0.1
0.1—0.5
0.5—2
More than 2
(Adapted from Bystrak, 1974)
INDIVIDUALS OBSERVED DURING CHRISTMAS BIRD COUNTS, 1973-1977 (ARITHMETIC MEAN)
NO. Number of individuals
+ Less than one individual
0 None observed
BIRD NAME:
BROWN PELICAN
N
SCALE
Kilometers
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
ATLANTIC OCEAN
GULF OF MEXICO
DALLAS
HOUSTON
PORT ARTHUR
GALVESTON
MATAGORDA BAY
CORPUS CHRISTI
LAGUNA ATASCOSA
BROWNSVILLE
JACKSON
BATON ROUGE
NEW ORLEANS
GULFPORT
MOBILE
PENSACOLA
DAUPHIN ISLAND
MONTGOMERY
ST. MARKS
ST. GEORGE ISLAND
ATLANTA
JACKSONVILLE
SAVANNAH
BRUNSWICK
BEAUFORT
CHARLESTON
CAPE ROMAIN
WILMINGTON
CAPE FEAR
FAYETTEVILLE
RALEIGH
MOREHEAD CITY
CAPE LOOKOUT
CAPE HATTERAS
PETERSBURG
MERRITT ISLAND
PALM BEACH
SANIBEL ISLAND
EVERGLADES
MIAMI
DRY TORTUGAS
KEY WEST
96°
94°
92°
90°
88°
86°
84°
80°
78°
38°
36°
34°
32°
30°
28°
26°
24°
19
+
+
+
+
31
2
100
780
555
634
516
660
487
1, 414
1, 031
890
137
344
396
412
36
72
536
352
129
56
47
21
63
49
1

Florida Brown Pelicans breed along both coasts of peninsular Florida and are common throughout the year. Blus et al. (1979b) state that the Florida Brown Pelican population has been essentially stable since 1968.

Florida - Atlantic Coast About one-third of the Brown Pelican colonies in Florida are along the Atlantic coast; the rest are along the Gulf portion of the peninsula. Colonies on the Atlantic coast tend to be larger, possibly because suitable nesting habitat is more scarce in this area (Williams and Martin 1968). Six colonies found there in 1968 contained an average of 333 nests (range = 80-600)(Williams and Martin 1968); in 1976, nine colonies held an average of 174 nests (range = 35-350)(Nesbitt et al. 1977), and in 1978 there were eight colonies with an average of 316 nests (range = 100-625)(Williams, pers. comm.). In 1978, the three largest colonies on the Atlantic coast were at Port Orange, Volusia County (675 nests), Vero Beach, Indian River County (500), and Crane Island, Volusia County (425); together these colonies contained 63% of the birds nesting on the Atlantic coast and 21% nesting within the state that year.

Large numbers winter on the Atlantic coast of Florida (Map 14). These winter populations are thought to be generally stable, but apparently fluctuate more than those on the Gulf Coast. The source of these winter populations is believed to be colonies in South Carolina and on the Florida east coast (Schreiber and Schreiber 1973). Fluctuations in winter populations probably result in part from annual variation in production of young in South Carolina.

Florida - Keys Although only scanty information is available, a few pairs of Brown Pelicans evidently bred on the Dry Tortugas in the mid-1800's; they apparently did not breed on the Keys again until 1974, when five nests were found in white mangroves (*Laguncularia racemosa*) on Bush Key (Schreiber et al. 1975a). Observations made when the nests were found (14 June) and subsequently indicated that eggs were laid between 8 and 19 June; Schreiber et al. (1975a) suggested that this nesting consisted of renesting attempts by birds that had failed elsewhere earlier in the breeding season. We know of no subsequent nesting at the Tortugas.

Schreiber and Schreiber (1973) pointed out that there are wide variations in the numbers of birds wintering in the Keys. They also noted an apparent increase in winter populations since the early 1950's, but had no explanation for the change.

Florida - Gulf Coast In 1968, 18 colonies on the Florida Gulf Coast contained an average of 261 nests (range = 10-900)(Williams and Martin 1968). In 1976 this area harbored 17 colonies averaging 231 nests (range = 1-1,200) (Nesbitt et al. 1977), and in 1978 there were 20 colonies that held an average of 263 nests (range = 20-900)(Williams, pers. comm.). The five largest colonies in 1978 were at Bird Key, Lee County (900 nests), Tarpon Key, Pinellas County (680), Seahorse Key, Gulf County (650 nests), Hemp Key, Lee County (450), and Florida Bay, Collier County (440)(Williams, pers. comm.); together, these constituted 59% of the population nesting along the Gulf of Mexico and 40% of the number breeding within the state.

Populations wintering along the peninsula are substantial, but relatively

few birds winter along the Florida Panhandle (Map 14). According to Schreiber and Schreiber (1973), numbers wintering along the west coast have been very consistent since about 1950.

Alabama Small numbers of Brown Pelicans occur along the Alabama coast throughout the year and birds are more numerous from May through August (Imhof 1976b, Table 68). Maximum numbers seen at any one time in recent years are in the low hundreds (Table 68), but formerly as many as 1,800 birds had been seen off Dauphin Island. Many of the birds seen now are immatures (Imhof 1976b) that are evidently from colonies located elsewhere in the Gulf. This species may once have bred in Alabama, but there is no certain record of its having done so (Imhof 1976b).

Mississippi Brown Pelicans occur on the Mississippi coast throughout the year, but only in small numbers. The species does not breed in Mississippi and is not known to have done so. Formerly, it was scarcest from February to early June and most abundant from early August through winter, when flocks of 100 or more could be observed (Burleigh 1944). Recent records extend from 12 February through 13 September (Jackson et al. 1979 ms), but few data are available on present numbers and seasonal abundance. Our data indicate that the species is considerably less common along the coast than formerly and reaches peak abundance during the same months as in Alabama (Table 68). Jackson et al. (1979 ms) suggest that many of the birds seen along the Mississippi coast are from the introduced population in Louisiana.

Louisiana The Brown Pelican was formerly an abundant permanent resident along the Louisiana coast; Oberholser (1938) recorded some 11,500 breeding birds in 1933 in what was probably less than a half-dozen colonies. Even earlier, birds evidently numbered in the tens of thousands, perhaps as many as 50,000 to 85,000 birds (King et al. 1977b). There is little documentation of the subsequent drastic decline in the population, but evidently thousands were still breeding on North Island in the Chandeleurs in 1958 (Lowery 1974); the last known nesting by native Louisiana birds was recorded there in 1961 when Van Tets found 200 pairs of nesting adults and 100 nestlings (Williams and Martin 1968).

Beginning in 1968, the Louisiana Wildlife and Fisheries Commission and the Florida Game and Fresh Water Fish Commission cooperated in an attempt to re-establish a breeding population by introducing young birds from colonies on the Atlantic coast of Florida (Nesbitt et al. 1978). During the first 2 years, young were transported to Rockefeller Refuge and to Grand Terre Island in Barataria Bay. Young pelicans at Rockefeller Refuge did not survive, so subsequent introductions were all to Grand Terre Island. A total of 767 young pelicans were transplanted to both localities by 1976 (Nesbitt et al. 1978). Breeding began in 1971 when 13 nests resulted in the production of 8 young; from then through 1976 an average of 46 nests have fledged an average of 37 young (Nesbitt et al. 1978, Blus et al. 1979a). Only twice in 7 years (1974, 1976) have enough young been produced to maintain the population and in another year (1975), an estimated 35-40% of the population (Nesbitt et al. 1978) was lost primarily to pesticide (endrin) poisoning (Blus at al. 1979a); Blus et al. (1979a) suggested that the extirpation of the original population was also due to endrin poisoning.

Louisiana populations of wintering Brown Pelicans also decreased drastically. From 1950 through 1956, numbers seen on the Cameron-Sabine NWR Christmas Count varied from 90 to 978 birds (mean = 241)(Norman and Purrington 1970); this species has not been seen since the 1956 count (Map 14; Lowery 1974).

Texas Early estimates place the number of breeding Brown Pelicans in Texas at about 5,000 birds. Populations began declining there in the 1920's and 1930's, far earlier than in Louisiana, apparently largely as a result of human interference (i.e., shooting by hunters and fisherman and willful destruction of colonies; King et al. 1977b). The species is now a rare resident on the coast (Blacklock 1978 ms), with a maximum of 15-25 breeding pairs (Blacklock et al. 1978 ms). Recently, Brown Pelicans have nested only along the central coast on isolated islands; there they nest on the ground or in low vegetation (Blacklock et al. 1979). About half of the breeding population regularly nests at Pelican Island in Corpus Christi Bay (Map 13); other recent nesting localities have been Deadman's Reef, north of Rockport in 1978 (Webster 1978c), Long Reef in Aransas Bay in 1977 (Webster 1977d, Chaney et al. 1978), and on Caroll Island, Second Chain of Islands in San Antonio Bay in 1976 (Webster 1976d). All of these localities lie in the 32 miles between Aransas NWR and Corpus Christi (King et al. 1977b).

The number of post-breeding and wintering birds (Map 14, Table 68) is too great to be accounted for by the breeding population; some portion of the nonbreeding season birds is believed to be from Mexican colonies to the south (King et al. 1977b, Webster 1977d).

SYNOPSIS OF PRESENT DISTRIBUTION AND ABUNDANCE

Breeding Brown Pelicans breed only in the New World and primarily along coasts; on the Pacific side of the Americas they breed from southern California south to central Chile and in the Galapagos. On the Atlantic side they breed from North Carolina south to Florida, and in the Gulf of Mexico south to northern South America and as far east as Trinidad and Tobago. They also breed on islands in the Caribbean.

The numerical status and distribution of this species is poorly known in most of its range except for the United States and certain parts of Mexico. Precipitous declines during the late 1950's and 1960's in many populations in the United States (and Mexico) led to its being placed on the endangered species list, but substantial numbers of breeding Brown Pelicans still remain in parts of the southeastern United States; populations breeding elsewhere than the southeastern United States are much larger. Colonies on the San Lorenzo Islands in the Gulf of California contained more breeding Brown Pelicans from 1970 to 1972 than any others in North America. That population has been decreasing since 1970, when about 32,000 birds bred there; only about 8,200 nested in 1977 (Keith 1978). D. W. Anderson (1972) believed that there were about 2,100 resident Brown Pelicans off the California coast in 1971 and estimated that at least 30,900 pairs produced 50,800 young that year in the Gulf of California and along the Pacific coast of Mexico. In 1974, the U.S. Fish and Wildlife Service estimated that about 95% of the Pacific coast colonies contained about 25,000 pairs and estimated a total population of 70,000 (USNFWL 1980).

Numbers occurring elsewhere are essentially unknown. Some of those in South America must be very large, because 30,000 were banded in Peru in 1956 and 1957.

Considerable effort has recently been expended by the U.S. Fish and Wildlife Service and other agencies in censusing populations of Brown Pelicans. Consequently, information on U.S. breeding populations is probably more accurate and more complete than for many species treated in this report. Recent estimates (rounded to the nearest 10) of the number breeding in each of the southeastern states are listed below:

North Carolina	200	(1977 data from Parnell and Soots 1979 ms)
South Carolina	4,940	(mean, 1975-76; Mendenhall and Prouty 1979)
	6,730	(mean, 1977-78; Mendenhall and Prouty 1979)
Florida	3,490	(mean, 1975-76; Nesbitt et al. 1977)
-Atlantic Coast	4,520	(mean, 1977-78; L. Williams, pers. comm.)
Florida	7,950	(mean, 1975-76; Nesbitt et al. 1977)
-Gulf Coast	9,790	(mean, 1977-78; L. Williams, pers. comm.)
Louisiana	ca. 100	(mean, 1975-76; Blus et al. 1979a)
Texas	20	(mean, 1973-76; Blacklock et al. 1978 ms)
	40	(mean, 1977-78; Blacklock et al. 1979)

Winter and Migration Northern populations of Brown Pelicans appear to be more migratory, most moving south to winter. Movements of other populations are poorly known; those in the Galapagos are presumed to be rather sedentary but those in Peru evidently exhibit considerable movement (Palmer 1962). Palmer (1962) summarized early information on migration by Brown Pelicans, indicating that birds from Atlantic colonies moved south along the coast and some to Cuba; a very few recoveries of birds banded in Louisiana and Texas suggested that most remained in the Gulf, with some moving southward into Mexican waters. Five recoveries of birds banded as young in Alabama (Imhof 1976b) suggest that winter populations there may be made up of birds dispersing from colonies to both the east and west.

Schreiber (1976c) provided additional information on dispersal of young Brown Pelicans in the southeast. He based his report on extensive color-tagging of young birds at colonies in South Carolina and on the Gulf Coast of Florida; a small number was also tagged on the east coast of Florida. Large numbers of young that fledged in South Carolina wintered along the Florida Atlantic coast south to the Keys; many of these were present from October through January or February. Young banded on both coasts of Florida dispersed primarily south along the respective coastlines. Schreiber noted that the young-of-the-year are almost completely segregated into two groups; only rarely do individuals from one area disperse into the other.

Young birds from these populations occasionally straggle far to the north. Some birds fledged at Cape Romain NWR, South Carolina, were recorded

north to Ocracoke, Oregon, and Hatteras inlets in North Carolina.

Brown Pelicans regularly disperse northward in late summer and autumn along the west coast of the U.S., with many birds coming from Mexican colonies. Anderson and Anderson (1976) thought that large numbers of birds breeding in the Gulf of California regularly disperse into the waters of the California Current as well as south along the Mexican west coast; many others remain within the Gulf.

Table 68 indicates where recent peak numbers of nonbreeding birds have been seen and may provide some information on seasonal variation in abundance.

HABITAT

Nesting Brown Pelicans nest colonially both on the ground and in trees or shrubbery. Most colonies are found on offshore islands (Palmer 1962).

All birds in North and South Carolina nest on islands (Mendenhall and Prouty 1979, Parnell and Soots 1979 ms); none of the South Carolina sites rises more than 6 m above mean high tide (Mendenhall and Prouty 1979). Most pelicans in the Carolinas nest on the ground, but a few nest in low shrubs (Blus et al. 1974a, Parnell and Soots 1979 ms). Most colonies have been on natural islands, but the colony in the Cape Fear River in North Carolina is on a large eroding dredge-spoil island (Parnell and Soots 1979 ms).

Brown Pelicans also nest only on coastal islands in Florida; there, most nests are 2-35 ft above high tide line in mangroves (Schreiber 1978). Only rarely are birds found nesting on the ground. Williams and Martin (1971) reported that only 2 of 21 colonies censused 1968-1970 were entirely on the ground. Both of these were on small, nearly treeless, spoil islands and even here pelicans nested in small Australian pines (*Casuarina equisetifolia*) during one breeding season (1970)(Williams and Martin 1971).

On the east coast of Florida most Brown Pelicans nest in black mangrove (*Avicennia nitida*). Red mangrove (*Rhizopora mangle*) was used most frequently for sites on the west coast, but black mangrove was also important. Other plants occasionally used as nest sites in Gulf Coast colonies included red cedar (*Juniperus silicicola*), redbay (*Persea borbonia*), seagrape (*Coccolobis uvifera*), and live oak (*Quercus virginiana*)(Williams and Martin 1971).

The introduced colony in Louisiana has used several sites including a low shell bank and black mangrove (in 1976)(Blus et al. 1979a). Texas birds also nest on small islets either on the ground in open sandy areas or in dense, low shrubs (Chaney et al. 1978).

Populations on the west coast of the United States and Mexico prefer to nest on small offshore islands, but have also been found nesting in mangrove in Sinaloan estuaries (USNFWL 1980). Orr (1966) reported that most nesting islands in the Gulf of California are small but usually have at least some vegetation. On these islands the pelicans often nest on steep, rocky slopes. Nests are usually found on the middle or upper portion of slopes and sites

Table 68. Peak concentrations of nonbreeding Brown Pelicans in the coastal southeastern United States (a).

Date seen		Number seen	Locality	Source
			NORTH CAROLINA	
1974	15 Sep.	250	in one flock at Oregon Inlet	Teulings 1975a
1976	24 Sep.	600	counted from Ocracoke Ferry	LeGrand 1977a
1965	11 Nov.	54	Oregon Inlet	Parnell 1966a
1979	24 Nov.	40	Oregon Inlet	C. Wilds (pers. comm.)
1954	18 Jan.	300+	Wilmington	Chamberlain 1954a
1971	22 Jan.	55	Smith Island near Southport	Teulings 1971b
1967	24 Jan.	70	feeding inshore at Hatteras Village	Parnell 1967b
1968	28 Jun.	17	in one flock, Wrightsville Beach	Parnell 1968c
			SOUTH CAROLINA	
1970	27 Dec.	77	Charleston	Teulings 1971b
1974-75	winter	100	seen in one flock, Hilton Head Island	Teulings 1975b
			GEORGIA	
1966	14 Oct.	100	near Little St. Simons Island	Peake and Dopson 1968
1973-74	winter	50	seen almost daily in one flock at Cumberland Island	Teulings 1974b
1902	12-14 Apr.	150-200	Cumberland Island	Burleigh 1958
1921	1 May	60	flock over Ossabaw Sound	Burleigh 1958
			FLORIDA-ATLANTIC COAST	
1967	20 Oct.	2,000	near Pelican Island, Indian River	Robertson and Ogden 1968
			FLORIDA-UPPER GULF COAST	
1968	fall	to 60	Franklin Co. coast	Robertson and Ogden 1969

Table 68. Continued.

Date seen		Number seen	Locality	Source
			FLORIDA-UPPER GULF COAST (continued)	
1977	4 Sep.	200	Cape San Blas	Purrington 1978
1976	10 Oct.	90	St Joseph Bay	Purrington 1977
1971	15 Oct.	330	St. Joseph peninsula	Purrington 1972
1972	16 Nov.	48	between Port St. Joe and Mexico Beach	Purrington 1973a
1975	17 Feb.	50	Port St. Joe	Hamilton 1975
1976	27 Mar.	105	Port St. Joe	Hamilton 1976
1974	24 Apr.	85	Port St. Joe	Imhof 1974
1976	16 May	175	Port St. Joe	Imhof 1976a
1970	17 May	11	Pensacola	Imhof 1970
1971	24 May	20	near Pensacola	Imhof 1971a
1974	25 May	55	Port St. Joe	Kennedy 1974
1974	15 Jun.	19	Pensacola	Kennedy 1974
1974	17 Jul.	41	Destin	Kennedy 1974
			ALABAMA	
1969	11 Nov.	25	Petit Bois Island	Purrington 1970
1971	19 Dec.	26	Mobile	F. James 1972
1972	30 Dec.	63	Dauphin Island	Imhof 1976b
1968	26 Feb.	30	off Dauphin Island	F. James 1968
1967	22 Apr.	30	off Dauphin Island	Imhof 1967
1970	25 Apr.	50	Sand Island	Imhof 1970
1972	25-27 Apr.	55	Fort Morgan	Imhof 1972
1977	12 May	36	Dauphin Island	Imhof 1977a
1974	18 May	60	Sand Island	Imhof 1974
1973	23 May	112	Dauphin Island	Imhof 1976b
1976	25 May	100	Dauphin Island	Imhof 1976a
1972	6 Jun.	60	Fort Morgan	Imhof 1972
1976	10 Jun.	348	Dauphin Island	Stewart 1976
1973	17 Jun.	400	Dauphin Island	Imhof 1976b
1973	30 Jul.	265+	Dauphin Island	Imhof 1976b
1977	late Jul.-early Aug.	100	mouth of Mobile Bay	Purrington 1978
1978	3 Aug.	94	Fort Morgan	Jackson and Cooley 1978b
1972	7 Aug.	26	near E end Dauphin Island	Gunter 1972
1970	12 Aug.	65	Fort Morgan	J. Stewart 1970
			MISSISSIPPI	
1979	12 Mar.	24	Horn Island	Jackson et al. 1979 ms

Table 68. Continued.

Date seen		Number seen	Locality	Source
			MISSISSIPPI (continued)	
1977	early May	12	spoil island W Petit Bois Island	Jackson et al. 1979 ms
1979	13 May	7	Horn Island	Imhof 1979
1967	24 May	44	Mississippi City	J. Stewart 1967
1967	29 May	89	S of Pascagoula	J. Stewart 1967
1976	10 Jun.	16	Petit Bois Island	J. Stewart 1976
1965	Jul.	60	Horn Island	Jackson et al. 1979 ms
1972	early Aug.	26	Round Island area	Gunter 1972
			LOUISIANA	
1973	15 Jan.	16	Calcasieu Lake, Sabine Par.	Purrington 1973b
1978	11 Apr.	40+	Grand Isle	Imhof 1978
1960	7 Sep.	300+	near Chandeleur Islands	Newman 1961a
			TEXAS	
1977	5 Nov.	85	near Pelican Island	Webster 1978a
1977	3 Jul.	105	central coast	Webster 1977d
1972	Aug.	27	Corpus Christi area	Webster 1972d
1968	16 Aug.	20	off Pelican Island, in Corpus Christi ship channel	Webster 1968b
1965	3 Sep.	41	on Pelican Island	Webster 1966b

(a) Within states, records are arranged chronologically by season.

near the shoreline are usually avoided. The bulky nests are placed on the ground in flatter areas or against a rock or fallen cactus.

Colony sizes range from very small to very large; most of those in the southeastern United States contain about 50-500 pairs.

Feeding and Offshore Palmer (1962) reported that these birds occur almost exclusively on salt water "on small inlets, tidal rivers, open beaches", with western birds also found along rocky coasts and offshore islands. Birds also congregate about wharves and piers to scavenge food from tourists and offal from fishermen. Roosting birds are often found in large flocks on coastal sand bars and mud flats (Howell 1932).

Schreiber (1978) stated that Brown Pelicans in Florida feed primarily in

shallow estuarine waters, but may be seen as much as 20 to 40 miles offshore, rarely farther. Kale (1979 ms a) added that most feeding takes place within 5 miles of the coast and noted that breeding birds may feed a considerable distance from the colony; he noted one instance in which birds were foraging about 45 miles from the nesting area.

FOOD AND FEEDING BEHAVIOR

Palmer (1962) summarized more than 14 earlier reports on food habits of the Brown Pelican and concluded that the diet was mainly fishes unimportant as sources of human food. He noted that menhaden (*Brevoortia* sp.) was an especially important food fish from South Carolina to Texas, where it might form as much as 90-95% of the diet. Other fish listed in the diet included pigfish (*Orthopristes*), pinfish (*Diplodus*), thread herring (*Opisthonema oglinum*), top minnow (*Gambusia*), crevalle (*Paratractus*), silversides (*Menidia*), sheepshead (*Archosargus probatocephalus*), mullet (*Mugil cephalus*), and grass minnows. Relatively little has been published on the food habits of the Brown Pelican since Palmer (1962). A brief summary of subsequent information is given below.

Blus et al. (1979b) agreed with Palmer, stating that breeding Brown Pelicans in South Carolina fed almost exclusively on young-of-the-year menhaden that hatch off the coast and migrate into the estuaries. On the other hand, Fogarty et al. (*in prep.*) suggest that menhaden are not as important as previously supposed in the diet of young Brown Pelicans on the Atlantic and Gulf coasts of Florida. Schreiber's (1978) comment that most of the diet in Florida consists of *Brevoortia*, *Mugil*, *Sardinella*, and *Lagodon* also suggests the diet is more varied there than elsewhere.

Fogarty et al. (in press) record at least 31 different species of fish eaten by Florida Brown Pelicans and report that menhaden totaled only 21.1% of the fishes eaten in 1970-72 (n = 304 regurgitations); in 1972, these fish constituted only 14% of the diet by weight. Other fish frequently eaten were Atlantic threadfin *Polydactylus octonemus* (12.8%), mullet (11.7%), pinfish (*Lagodon rhomboides*) (9.7%), seatrout (*Cynoscion* sp.) (9.7%), spot (*Leiostomus xanthurus*) (6.3%), bay anchovy (*Anchoa mitchilli*) (6.1%), and Spanish sardine (*Sardinella anchovia*) (4.0%); those that occurred with the greatest frequency in the diet generally were also the most important constituents when calculated on the basis of weight.

Little has been written about the food habits of the California Brown Pelican (*P. o. californicus*); Palmer's (1962) summary of information indicated only that these Brown Pelicans has been recorded feeding on surf fish (*Amphistichus argenteus*), stranded carp and suckers, and schools of young smelt. Since then, Anderson et al. (1975) reported that northern anchovy (*Engraulis mordax*) was the primary food of adults and young in southern California. Anderson and Anderson (1976) added that birds in the Gulf of California fed on a large variety of fish, but primarily on representatives of the Clupeidae, Engraulidae, and Scombridae. In addition to the anchovy, Pacific sardine (*Sardinops sagax*) and Pacific mackerel (*Scomber japonicus*) were particularly important in the diet.

Bostic and Banks (1966) recorded the first known instance of predation on cartilaginous fish (Chondrichthyes) by Brown Pelicans. They reported that the throat pouch of a bird found dead along the Gulf of California contained a tonguefish (Symphurus) and five stingrays (Gymnura sp., Urolophus halleri, and Urotrygon asterias) and suggested that these bottom-dwelling fish had been fed on by the pelicans after being discarded by Mexican fishermen.

The diet elsewhere in the range is apparently similar. Voous (1957) examined the stomachs of six birds collected in the Netherlands Antilles and reported that they had fed upon herring (Clupea), anchovies (Engraulis), Sardinella, Jenkinsia lamprotaenia, and two species of horse mackerel (Caranx). Murphy (1936) related that Engraulis made up a large portion of the diet of Peruvian Brown Pelicans.

Brown Pelicans feed primarily by plunge-diving. Birds dive from heights up to 20 m and may fully or partially submerge, capturing their prey in the large pouch. They almost always dive downwind and re-emerge into the wind to take flight (Palmer 1962). Schreiber et al. (1975b) provided further details on prey capture in this species.

These pelicans also sometimes scoop-feed, i.e., swim along the surface scooping up fish from the water (Dinsmore 1974, Rodgers 1978). In many areas scoop-feeding is evidently uncommon (e.g., Texas [Gunter 1958]) or rare (e.g., Florida [Dinsmore 1974]), but Tomkins (1958) stated that the Brown Pelicans in the Savannah River Delta "...will often gather in groups on the water surface, and dabble for food in the manner of the White Pelican "; this remark may have been based largely on pelicans scavenging fish at docks and marinas where the behavior pattern is apparently more common (Schreiber in Dinsmore 1974).

Rarely, Brown Pelicans may kleptoparasitize other birds. Bildstein (1980) noted an instance in Georgia where a pelican landed on the head of a Great Blue Heron (Ardea herodias), forcing it to drop a fish it held in its bill; the pelican then dropped to the ground, seized the fish, and swallowed it. Forbes (1914) reported instances in which pelicans stole fish from Olivaceaous Cormorants.

These pelicans, particularly recently fledged young, are notable scavengers of offal from boats and cleaning stations onshore (Schreiber 1978); these birds will also readily scavenge from vessels at sea (Palmer 1962) and will accept "handouts" from tourists. The relationship between numbers occurring at marinas in Florida and feeding opportunities offered by fishermen suggests that some Brown Pelicans may alter their daily activity patterns to use this food resource (Herbert and Schreiber 1975, Lincer et al. 1979).

Brown Pelicans feed both during the day and at night (Schreiber 1977a); they usually feed in the early morning and late afternoon or on a rising tide (Palmer 1962).

Orians (1969) pointed out that adult Brown Pelicans were sometimes more efficient at catching prey than were immatures; observations made in Costa Rica during the nonbreeding season revealed that adults were successful in

68.6% (n = 357) of their dives, while immatures were successful only 48.9% (n = 962) of the time. During the breeding season, however, the rates of success of adults (56.8%, n = 146) and immatures (61.0%, n = 410) were not significantly different.

IMPORTANT BIOLOGICAL PARAMETERS

Egg Laying Schreiber (1980a) recently summarized data on nesting chronology for the Eastern Brown Pelican (*Pelecanus o. carolinensis*), the form nesting in the southeastern United States. He reported that the northernmost populations (between 30°-35° N latitude) nested on an annual cycle with a spring-summer nesting season and that those somewhat farther south (20°-30° N latitude) bred primarily on a winter-spring cycle. Those still farther south (10°-20° N latitude) had irregular breeding cycles occurring over prolonged periods.

Schreiber also presented information on laying for each of the southeastern states. He noted that pelicans nesting near Ocracoke in North Carolina recently have laid eggs from mid-March through May and occasionally into late July; those on the Cape Fear River were laying in late May and June in 1978. Pelicans in South Carolina lay primarily in April and May, with occasional laying from as early as mid- or late March to as late as June.

Birds at Pelican Island NWR on the east coast of Florida sometimes begin nesting in October but usually begin in late November or December, with few eggs laid after March or April. The peak of laying in the Florida Keys usually occurs from February to April. On Tarpon Key on the Florida Gulf Coast, nesting was initiated from early February to mid-March in the 7 years from 1970 to 1976. Other west coast colonies mainly follow a similar spring laying cycle.

The period of egg laying in Louisiana and Texas is similar to that in the Carolinas. Peak laying is in April and May but eggs have also been laid in March, occasionally in June, and only rarely in July; Schreiber (1980a) noted that at Corpus Christi, Texas, laying is always one or two months later than at other colonies in Texas.

Laying in other portions of the range may be quite variable, occurring in all months at some tropical localities but less from May through September (Murphy 1936). Birds from the western U.S. and Baja California are on a spring breeding cycle, with most laying in March-April. Brown Pelicans on Isla San Lorenzo in the Gulf of California exhibited peak laying in mid-April. Studies conducted thereafter (1974-76) in that area were all made on San Lorenzo Norte, where laying periods varied from colony to colony and from year to year. Over the entire period laying occurred from about late February through early May, but the bulk of the eggs were laid in March and early April (Keith 1978).

Mean Clutch Size Brown Pelicans usually lay two or three eggs; clutches of four and five have been reported (Schreiber 1979) but are very uncommon. Reports for clutches still larger (to 8 eggs--Coker 1919) may represent the

efforts of more than one female.

During eight breeding seasons from 1969 to 1976, mean clutch size for initial nesting attempts at Tarpon Key, Pinellas County, Florida, varied from 2.5 to 2.8 (Schreiber 1979); the composite mean for all 8 years was 2.62 (n = 328). Schreiber (1979) examined seasonal variation in clutch size and found that clutches laid during the early and mid-portions of the season were significantly larger than those laid late in the season. Blus and Keahey (1978) reported that adults in South Carolina laid larger clutches (mean = 2.85, n = 89) than did birds in immature plumage (mean = 2.16, n = 37).

Keith (1978) reported that clutch sizes for 3 successive years 1974-1976 on Isla San Lorenzo Norte in the Gulf of California averaged 2.86 (n = 44), 2.83 (n = 138), and 2.95 (n = 123), respectively. The overall average clutch size was 2.88, and three-egg clutches were most frequently laid; only one four-egg clutch was observed.

Incubation Period Schreiber (1979) stated that "the normal incubation period is 30 days" and noted (1977a) that incubation begins with the first egg.

Hatching Success Hatching success (expressed as proportion of eggs laid) varied from 53% to 89%, 1969-1976, at Tarpon Key (Schreiber 1979); the overall hatching success was 70.93% (n = 860). Hatching success was related to clutch size; a significantly larger proportion of eggs in three-egg clutches hatched than of those in one-egg clutches. Among 669 eggs in three-egg clutches, 74.3% hatched; only 27.8% of 18 eggs hatched in one-egg clutches. Hatching success was also significantly less for late season clutches than it was for clutches laid in early and mid-season (Schreiber 1979). Blus and Keahey (1978) did not find a significant difference in the proportion of nests in which some young hatched for parent birds in adult and immature plumages.

Fledging Success Fledging success (expressed as a percent of eggs laid) of Brown Pelicans at Tarpon Key, 1969-1971, varied from 12% to 59% (Schreiber 1979); overall, 318 of 860 eggs laid (37.0%) produced fledglings. Among eggs that hatched, the annual variation in the proportion that produced young ranged from 16% to 77%; overall, 52.1% (n = 610) produced young.

Fledging success in this species is often expressed as the number of fledglings produced per nest (= productivity), although the means by which these data are obtained may vary from study to study and complicate a comparative interpretation of results. Schreiber (1979) discussed this matter at some length and remarked that he believed that "the data are now overwhelming that 'normal' nesting success of the Brown Pelican fluctuates, with the mean centering around or slightly below one young fledged per nesting pair per year". We briefly summarize recent productivity data (young per nest) for different populations in Table 69.

Age at Fledging Schreiber (1976a) reported that age of fledging for young at Tarpon Key, Florida, ranged from 71 to 88 days (n = 36); the mean age of fledging varied from 74 days in 1972 to 77 days in 1971.

Age at First Breeding Palmer (1962) reported that Brown Pelicans first

Table 69. Productivity (young/nest) in the Brown Pelican (a).

Locality	Period	Mean	Range	Mean	Range	Source
South Carolina (b)	1969-78	1.00	0.75-1.66	----	1.23-ca. 1.4	Mendenhall and Prouty 1979, Blus et al. 1979b
Florida-Tampa Bay	1969-76	0.93	0.33-1.69	0.69	0.38-1.29	Schreiber 1979
Louisiana	1971-76	0.81	0.16-1.47	0.95	0.16-1.47	Blus et al. 1979a
Texas-Corpus Christi Bay	1967-75	0.89	0.11-2.00 (c)	0.88	0.14-1.22	King et al. 1977a, 1977b
California-Anacapa Island (d)	1969-75	0.22	0.002-0.88	0.62	0.14-0.88	Anderson and Anderson 1976, Anderson et al. 1977b
Mexico-Los Coronados Islands	1969-74	0.55	0.00-1.01	0.77	0.60-1.01	Anderson and Anderson 1976
Mexico-Gulf of California	1973-76	0.30	0.23-0.43	----	---------	Keith 1978
Mexico-Gulf of California, San Lorenzo Islands	1974-76	0.35	0.29-0.43	----	---------	Keith 1978

(a) These figures are not all satisfactorily comparable with each other because of varying and unknown degrees of human disturbance of colonies and because the basis for the figures given was not always adequate; Schreiber (1979) pointed out that "comparison of Florida and South Carolina data is virtually impossible because of the lack of control on bias caused by human disturbance." We note that the figures for Louisiana are from a colony from which 171 eggs were collected for pesticide analysis. The second set of figures in the table is for most recent 3 years.

(b) Number of nests or number of young fledged or both estimated in part in 1969, 1970, 1976 (Blus et al. 1979b), and 1977 (Mendenhall and Prouty 1979); our calculated mean from these papers does not include 1977 and 1978 because Mendenhall and Prouty did not present data for these 2 years.

(c) Maximum productivity was in a year when the colony held only two nests.

(d) Figures for Anacapa and Los Coronados are mostly based on Table 1 in Anderson and Anderson 1976. Data for Anacapa includes some information for Santa Cruz in 1972, 1974, and 1975; the figures for Los Coronados are based on the median of an estimated range for the number of young produced in 1970, 1971, and 1973; these colonies are among those that showed great reduction in production due to egg-shell thinning.

breed at about 2 years. More recent information suggests that most birds begin breeding later, and that the average age of first breeding may vary from area to area in relation to age structure of individual colonies. Blus and Keahey (1978) suggested that birds breeding in immature plumage in South Carolina were 1-4 years old; the earliest substantial evidence of first breeding there, however, was a 2-year-old bird found incubating an egg. At a newly established colony in Louisiana, birds first nested, all in an advanced subadult plumage, when nearly 3 years old (Williams and Joanen 1974); Anderson and Anderson (1976) commented that "a majority of Brown Pelicans do not breed successfully until 4-7 years of age...", when populations are stable.

Mortality of Eggs and Young The principal causes of nesting failure vary from area to area and from year to year. In South Carolina, a primary source of egg loss on low lying Marsh Island is tidal flooding; on more elevated Deveaux Bank, several hundred downy young may have starved in 1974 (Blus et al. 1979b). Flooding caused considerable nest failure during several years in the introduced population in Louisiana, but cold weather and pesticides (particularly endrin) have also contributed to nest loss (Blus et al. 1979a). Keith (1978) considered the primary causes of nest failure in the Gulf of California to be the loss of young and nest desertion. In the 1969 breeding season, starvation was believed the cause of death for thousands of young birds (Keith 1978), while infestations of ticks (*Ornithodoros denmarki*) are thought to have caused much nest desertion there in 1976 (King et al. 1977c, Keith 1978). The effect of tick infestation has been noted elsewhere; King et al. (1977a) suggested that *O. capensis* probably caused desertion during a recent nesting attempt near Aransas NWR, Texas.

Schreiber and Risebrough (1972) reported that two major sources of egg loss at a Florida colony were breakage of eggs by pelicans disturbed from their nests and predation on eggs by Fish Crows (*Corvus ossifragus*) following the pelicans' departure from their nests; at such times, mortality may also be induced by temperature stress on eggs and young. Avian predation on eggs and young may occur even when nests have not been temporarily deserted by the adults. Keith (1978) reported several instances in which ravens and Western Gulls (*Larus occidentalis*) stole eggs from under sitting birds in the Gulf of California. Few instances (7) of this form of predation were seen, and in only one instance was a nestling seized by a gull. Avian predators of eggs and young in South American colonies include *Larus dominicanus*, *L. belcheri*, and the Turkey Vulture (*Cathartes aura*)(Murphy 1936).

In several areas (e.g., California, Louisiana), serious egg loss has resulted from pollution by pesticides. The relationship between pollutants and nesting success in the Brown Pelican has been repeatedly investigated (e.g., Anderson et al. 1975, 1977b; Schreiber 1977b, Thompson 1977a, 1977b; Blus et al. 1979a, 1979b; Mendenhall and Prouty 1979). Because this is not a normal cause of mortality in eggs and young we do not treat it further here but refer the reader to the papers cited and to others in the species bibliography following this account.

It seems evident from a number of reports and summaries (e.g., Palmer 1962, Schreiber 1978) that human interference, either through direct disturbance or through the indirect effects of environmental degradation, starvation,

and flooding have been the principal source of nesting failure in colonies in the southeastern United States.

Renesting Several authors (e.g., Sprunt and Chamberlain 1949, Blus et al. 1979b) have reported that Brown Pelicans will replace lost eggs, but apparently only Schreiber (1979) has presented quantitative data on the prevalence of second layings. He reported that the amount of replacement laying by Brown Pelicans in Tampa Bay after eggs or nestlings were lost varied from none in 1970 to as high as 26% of the nests in 1973. Laying of second clutches occurred throughout the season but was more frequent in nests begun early; 25 of 30 nests in which eggs were laid again had been started during the first 4 weeks of the season. Replacement laying usually occurred in nests that had lost eggs but occurred four times when one or more nestlings died within 10 days of hatching. Second clutches were about the same size (2.5 eggs) as first clutches (2.4), but fledged a significantly larger proportion of young than did initial clutches.

Maximum Natural Longevity The oldest Brown Pelican known to us is a bird banded as an immature at Pelican Island, Florida, that was recovered in Cuba at an estimated minimum age of 19 years and 2 months (Clapp et al. 1979 ms). The record of a bird with an estimated minimum age of 31 years and 5 months (Kennard 1975) has proven to be unacceptable.

Weight (in grams) Weights of Brown Pelicans vary greatly from area to area; birds from the West Indies are smaller than those in the southeastern United States and those from the Galapagos and South America are larger (Palmer 1962). Few published weights are available for birds from other areas, however; those which we have found are given in Table 70.

Table 70. Weights of Brown Pelicans (in grams).

Mean weight	Range	N	Sample and season	Area	Source
3,636	-----	53	males	Florida	Hartman 1955
7,030	-----	1	male in January	Peru	Murphy 1936
3,148	-----	42	females	Florida	Hartman 1955
2,900	-----	30	females	Florida	Schreiber 1979
5,055	-----	1	female in January	Peru	Murphy 1936
-----	45-80	--	hatching young	Florida	Schreiber 1976a
97.8	-----	51	fresh eggs	Florida	Schreiber 1975b
92	78-105	6	fresh eggs	Florida	Lawrence and Schreiber 1974

SUSCEPTIBILITY TO OIL POLLUTION

We have found very little evidence of direct mortality of Brown Pelicans by oiling. Some were killed by oil in early 1969 as the result of an oil well blowout in the Santa Barbara Channel (California Department of Fish and Game 1969a in Vermeer and Vermeer 1974), and E. Payne (pers. comm.) found an oiled bird in Texas. Many of the habits of this species (gregariousness, diving for food, preference for shallow coastal waters for both feeding and nesting, considerable sensitivity to disturbance while nesting) suggest that it should be relatively highly vulnerable to oiling and to the effects of oil development. It is considered endangered in several areas, and in most southeastern states breeding is confined to one or two sites. Consequently, we believe that in planning the development of oil resources considerable attention should be paid to potential effects on this species.

BIBLIOGRAPHY

In Press

Fogarty, M. J., S. A. Nesbitt and C. R. Gilbert. in press. Diet of nestling Brown Pelicans in Florida. 6 pp. (typescript).

1981

Briggs, K. T., D. B. Lewis, W. B. Tyler and G. L. Hunt, Jr. 1981. Brown Pelicans in Southern California: habitat use and environmental fluctuations. Condor 83: 1-15.

Taylor, G. J. and S. A. Dawson. 1981. Brown Pelican in Maryland in winter. Md. Birdlife 37: 4.

1980

Bildstein, K. L. 1980. Adult Brown Pelican robs Great Blue Heron of fish. Wilson Bull. 92: 122-123.

Duffy, D. C. 1980. Comparative reproductive behavior and population regulation of seabirds of the Peruvian Coastal Current. Ph. D. thesis, Princeton Univ. 106 pp.

Henny, C. J. and J. A. Collins. 1980. Early concentrations of Brown Pelicans along southern Oregon coast. Murrelet 61: 99-100.

Nesbitt, S. A., B. A. Harris, S. A. Fenelon and D. M. King. 1980. Reproduction of Brown Pelicans in captivity. Wildl. Soc. Bull. 8: 259-262.

Schreiber, R. W. 1980a. Nesting chronology of the Eastern Brown Pelican. Auk 97: 491-508.

Schreiber, R. W. 1980b. The Brown Pelican: an endangered species? BioScience 30: 742-747

USNFWL [U.S. National Fish and Wildlife Laboratory] 1980. Selected vertebrate endangered species of the seacoast of the United States: Brown Pelican. Eastern and California subspecies. U.S. Fish & Wildlife Serv., Biol. Serv. Program; FWS/OBS-80/01.40; March 1980. 16 pp.

1979

Blus, L. J., E. Cromartie, L. McNease and T. Joanen. 1979a. Brown Pelican: population status, reproductive success, and organochlorine residues in Louisiana, 1971-1976. Bull. Environ. Contam. Toxicol. 22: 128-135.

Blus, L. J., T. G. Lamont and B. S. Neely, Jr. 1979b. Effects of organochlorine residues on eggshell thickness, reproduction, and population status of Brown Pelicans (Pelecanus occidentalis) in South Carolina and Florida, 1969-76. Pest. Monit. J. 12: 172-184.

Carlton, B. 1979. A Brown Pelican in central Oklahoma. Bull. Okla. Ornithol. Soc. 12: 11-13.

King, K. A., S. Macko, P. L. Parker and E. Payne. 1979. Resuspension of oil: probable cause of Brown Pelican fatality. Bull. Environ. Contamn. Toxicol. 23: 800-805.

Lincer, J. L., D. Krivit and J. E. Shaw. 1979. People and "pan-handling" pelicans. Fla. Field Nat. 7: 13-18.

Mendenhall, V. M. and R. M. Prouty. 1979. Recovery of breeding success in a population of Brown Pelicans. Pp. 65-70 in W. E. Southern (comp.) Proc. Conf. Colonial Waterbird Group, Am. Mus. Nat. Hist., New York, New York, 20-23 October 1978. xi and 213 pp.

Nesbitt, S. A. and R. D. Barber. 1979. An albinistic Brown Pelican. Fla. Field Nat. 7: 6.

Schreiber, R. W. 1979. Reproductive performance of the Eastern Brown Pelican Pelecanus occidentalis. Los Angeles Co. Nat. Hist. Mus. Contrib. Sci. 317: 1-43.

Schreiber, R. W. and E. A. Schreiber. 1979 ms. The Brown Pelican (Pelecanus occidentalis): a bibliography. Unpubl. ms., Los Angeles County Nat. Hist. Mus. Contrib. Sci. 317. 43 pp.

Seager, K. A. 1979. Brown Pelican at Cape May. Cassinia 57: 52.

Smith, M. 1979. Seventy five years of pelicans. Fla. Wildl. 33: 28-31.

Young, R. L. 1979. Brown Pelican breeding success up--but. Outdoor Calif. 40: 25-27.

1978

Below, T. H. and R. W. Schreiber. 1978. Meteorological biases in censuses of roosting Brown Pelicans in Florida. Fla. Field Nat. 6: 9-12.

Blus, L. J. and J. A. Keahey. 1978. Variation in reproductivity with age in the Brown Pelican. Auk 95: 128-134.

Dickson, D. 1978. Brown Pelican threat to space shuttle. Nature 274: 304.

Humphrey, S. R., C. H. Courtney and D. J. Forester. 1978. Community ecology of the helminth parasites of the Brown Pelican. Wilson Bull. 90: 587-598.

Keith, J. O. 1978. Synergistic effects of DDE and food stress on reproduction in Brown Pelicans and Ringdoves. Ph. D. thesis, Ohio St. Univ. xii and 172 pp.

Nesbitt, N. A., L. E. Williams, Jr., L. McNease and T. Joanen. 1978. Brown Pelican restocking efforts in Louisiana. Wilson Bull. 90: 443-445.

Ortego, B. 1978. Brown Pelicans reported at Eufaula National Wildlife Refuge. Ala. Birdlife 26: 10-11.

Rodgers, J. A., Jr. 1978. Feeding association between Brown Pelicans and Wood Storks. Fla. Field Nat. 6: 44-45.

Schnell, G. D. and J. J. Hellack. 1978. Flight speeds of Brown Pelicans, Chimney Swifts, and other birds. Bird-Banding 49: 108-112.

Schreiber, R. W. 1978. Eastern Brown Pelican. Pp. 23-24 in H. W. Kale, II (ed.) Rare and Endangered Biota of Florida. Vol. 2: Birds. Univ. Presses of Florida, Gainesville, FL. xix and 121 pp.

1977

Anderson, D. W., L. R. DeWeese and D. V. Tiller. 1977a. Passive dispersal of California Brown Pelicans. Bird-Banding 48: 228-238.

Anderson, D. W., R. M. Jurek and J. O. Keith. 1977b. The status of Brown Pelicans at Anacapa Island in 1975. Calif. Fish Game 63: 4-10.

Blus, L. J., B. S. Neely, Jr., T. G. Lamont and B. Mulhern. 1977. Residues of organochlorines and heavy metals in tissues and eggs of Brown Pelicans, 1969-73. Pest. Monit. J. 11: 40-53.

Burton, P. J. K. 1977. Lower jaw action during prey capture by pelicans. Auk 94: 785-786.

King, K. A., D. R. Blankenship, R. T. Paul and R. C. A. Rice. 1977a. Ticks as a factor in the 1975 nesting failure of Texas Brown Pelicans. Wilson Bull. 89: 157-158.

King, K. A., E. L. Flickinger and H. H. Hildebrand. 1977b. The decline of Brown Pelicans on the Louisiana and Texas Gulf Coast. Southwest. Nat. 21: 417-431.

King, K. A., J. O. Keith and C. A. Mitchell. 1977c. Ticks as a factor in nest desertion of California Brown Pelicans. Condor 79: 507-509.

Nesbitt, S. A., M. J. Fogarty and L. E. Williams, Jr. 1977. Status of Florida nesting Brown Pelicans, 1971-1976. Bird-Banding 48: 138-144.

Onuf, C. P., J. M. Teal and I. Valiela. 1977. Interactions of nutrients, plant growth and herbivory in a mangrove ecosystem. Ecology 58: 514-526.

Paul, R. T. 1977. Pelican comeback. Increase in Brown Pelican (Pelecanus occidentalis) population on the lower Texas coast. Texas Parks & Wildl. 35: 12-15.

Schreiber, R. W. 1977a. Maintenance behavior and communication in the Brown Pelican. AOU Ornithol. Monogr. No. 22. 78 pp.

Schreiber, R. W. 1977b. Shell thickness in Brown Pelican eggs from Tampa Bay, Florida. Fla. Field Nat. 5: 31-34.

Sivak, J. G., J. L. Lincer and W. Bobier. 1977. Amphibious visual optics of the eyes of the Double-crested Cormorant (Phalacrocorax auritus) and the Brown Pelican (Pelecanus occidentalis). Can. J. Zool. 55: 782-788.

Thompson, N. P., C. H. Courtney, D. J. Forrester and F. H. White. 1977a. Starvation pesticide interactions in juvenile Brown Pelicans. Bull. Environ. Contam. Toxicol. 17: 485-489.

Thompson, N. P., P. W. Rankin, P. E. Cowan, L. E. Williams, Jr. and S. A. Nesbitt. 1977b. Chlorinated hydrocarbon residues in the diet and eggs of the Florida Brown Pelican. Bull. Environ. Contam. Toxicol. 18: 331-339.

Zink, R. M. 1977. Winter observations of Brown Pelicans in Veracruz, Mexico. Auk 94: 588.

1976

Anderson, D. W. and I. T. Anderson. 1976. Distribution and status of Brown Pelican in the California Current. Am. Birds 30: 3-12.

Florida Committee on Rare and Endangered Plants and Animals. 1976. Pp. 723-728 in J. N. Layne (ed.) Inventory of Rare and Endangered Biota of Florida.

Parnell, J. F. and R. F. Soots, Jr. 1976. The Brown Pelican--an endangered species. Wildl. N.C. 40: 4-7.

Schreiber, R. W. 1976a. Growth and development of nestling Brown Pelicans. Bird-Banding 47: 19-39.

Schreiber, R. W. 1976b. Movements of color marked Brown Pelicans. Bird-Banding 47: 101-111.

Schreiber, R. W. 1976c. Paradox of the pelican. Animal Kingdom 79: 9-13.

Williams, L. E., Jr. 1976. Recovery plan for the Eastern Brown Pelican (Pelecanus occidentalis carolinensis). (Draft copy) U.S. Fish & Wildl. Serv. 48 pp.

1975

Anderson, D. W., J. R. Jehl, Jr., R. W. Risebrough, L. A. Woods, Jr., L. R. DeWeese and W. G. Edgecomb. 1975. Brown Pelicans: improved reproduction of the southern California coast. Science 190: 806-808.

Blus, L. J., T. Joanen, A. A. Belisle and R. M. Prouty. 1975. The Brown Pelican and certain environmental pollutants in Louisiana. Bull. Environ. Contam. Toxicol. 13: 646-655.

Courtney, C. and J. V. Ernst. 1975. Eimeria pelecani Sp. N. from the Brown Pelican, Pelecanus occidentalis carolinensis, from Florida. J. Parasitol. 61: 1081-1082.

Herbert, N. G. and R. W. Schreiber. 1975. Diurnal activity of Brown Pelicans at a marina. Fla. Field Nat. 3: 11-12.

Ruppell, G. 1975. Die Stosstauchmanover des Blaufusstolpels (Sula nebouxii) und des Meerespelikans (Pelecanus occidentalis). [Diving-manoeuvres of the Brown Pelican (Pelecanus occidentalis) and the Bluefooted Booby (Sula nebouxii).] J. Ornithol. 116: 168-180. [In German with English summary.]

Schreiber, R. W. 1975a. Bad days for the Brown Pelican. Natl. Geogr. 147: 111-123.

Schreiber, R. W. 1975b. Unusually small egg of the Brown Pelican. Fla. Field Nat. 3: 20.

Schreiber, R. W. 1975c. [Letter on] Singular Brown Pelican behavior. Fla. Field Nat. 3: 30.

Schreiber, R. W. 1975d. The maintenance activities and communicatory behavior of the Brown Pelican Pelecanus occidentalis. Ph. D. thesis, Univ. South Florida. 154 pp.

Schreiber, R. W., T. H. Below and W. B. Robertson. 1975a. Nesting of Brown Pelicans (Pelecanus occidentalis) on the Dry Tortugas, Florida. Fla. Field Nat. 3: 47-48.

Schreiber, R. W., G. E. Woolfenden and W. E. Curtsinger. 1975b. Prey capture by the Brown Pelican. Auk 92: 649-654.

Winn, B. 1975. Pesticides decimate transplanted pelicans. Audubon 75: 127-129.

1974

Anon. 1974. The plight of the pelicans. Sea Secrets 18: 8-9.

Blus, L. J., A. A. Belisle and R. M. Prouty. 1974a. Relations of the Brown Pelican to certain environmental pollutants. Pest. Monit. J. 7: 181-194.

Blus, L. J., B. S. Neeley, Jr., A. A. Belisle and R. M. Prouty. 1974b. Organochlorine residues in Brown Pelican eggs: relation to reproductive success. Environ. Pollut. 7: 81-91.

Courtney, C. H., III and D. J. Forrester. 1974. Helminth parasites of the Brown Pelican in Florida and Louisiana. Proc. Helminthol. Soc. Wash. 41: 89-93.

Dinsmore, J. J. 1974. White and Brown pelicans feeding together. Fla. Field Nat. 2: 11.

Golub, M. 1974. Plight of the Brown Pelican. Travel 1974 (Feb): 64-65, 82.

Joanen, T. and L. McNease. 1974. Re-establishment of the Louisiana Brown Pelican. Southern Zoo Workshop, Monroe, Louisiana, 7 May, 1974.

Kumerloeve, H. 1974. Intensiver Nahrungsparasitismus der Noddiseeschwalbe (Anous stolidus) beim Braunpelikan (Pelecanus occidentalis). [Intensive feeding parasitism of the Brown Pelican (Pelecanus occidentalis) by the Brown Noddy (Anous stolidus).] Ornithol. Mitt. 26: 186. [In German.]

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: 2-17.

Maxwell, G. R., II and H. W. Kale, II. 1974. Population estimate of breeding birds on a spoil island in the Indian River, Indian River County, Florida. Fla. Field Nat. 2: 32-39.

Schreiber, R. W. 1974a. Maintenance activities and communicatory behavior of the Brown Pelican. Ph. D. thesis, Univ. S. Florida/Tampa.

Schreiber, R. W. 1974b. The importance of helping pelicans. Span 1974: 6-9.

Simmons, G. 1974. Brown Pelican on the brink. Natl. Parks Conserv. Mag. 48: 21-28.

Stedman, S. J. 1974. Singular Brown Pelican feeding behavior. Fla. Field Nat. 2: 44.

Williams, L. E., Jr. and T. Joanen. 1974. Age of first nesting in the Brown Pelican. Wilson Bull. 86: 279-280.

1973

Baldridge, A. 1973. The status of the Brown Pelican in the Monterey region of California: past and present. West. Birds 4: 93-100.

Courtney, C. H., III. 1973. Helminth parasites of the Brown Pelican in Florida and Louisiana. M. S. thesis, Univ. Florida/Gainesville.

Jehl, J. R., Jr. 1973. Studies of a declining population of Brown Pelicans in northwestern Baja California. Condor 75: 69-79.

Lawson, R. S. 1973. Notes on Pelecaniformes in Nevada. West. Birds 4: 23-30.

Leck, C. F. 1973. Pelicans in the city of Lima, Peru. Condor 75: 357.

Lincer, J. L. and D. Salkind. 1973. A preliminary note on organochlorine residues in the eggs of fish-eating birds of the west coast of Florida. Fla. Field Nat. 1: (would be pp. 3-6--no pagination.)

Schreiber, R. W. and E. A. Schreiber. 1973. Florida's Brown Pelican population: Christmas Bird Count analyses. Am. Birds 27: 711-715.

Schreiber, R. W. and L. E. Williams. 1973. Color-marked Brown Pelicans. Fla. Nat. 46: 26-27.

1972

Ainley, D. G. 1972. Brown Pelicans in north-central coastal California. Calif. Birds 3: 59-64.

Anderson, D. W. (prep.) 1972. Brown Pelicans--status of *P. o. californicus*. U.S. Bureau of Sport Fisheries & Wildlife, Denver Wildlife Research Center, Annu. Progress Rept. No. 2, April 1972. 28 pp.

Anderson, D. W. and L. R. DeWeese. 1972. Post-breeding dispersal of Brown Pelicans and other waterbirds into southwestern United States. U.S. Bureau of Sport Fisheries and Wildlife, Denver Wildlife Research Center, Annu. Progress Rept. No. 3, December 4, 1972.

Anderson, D. W., J. O. Keith, K. A. King and L. R. DeWeese. 1972. Field ecology investigations of selected pesticides on wildlife populations. Post-breeding dispersal of Brown Pelicans and other waterbirds into the southwestern United States. U.S. Bureau of Sport Fisheries & Wildlife, Denver Wildlife Research Center, Annu. Progress Rept. No. 4, 4 December 1972.

Blus, L. J., C. D. Gish, A. A. Belisle and R. M. Prouty. 1972. Logarithmic relationship of DDE residues to eggshell thinning. Nature 235: 376-377.

Connors, P. G., V. C. Anderlini, R. W. Risebrough, R. W. Schreiber and D. W. Anderson. 1972. Heavy metal concentrations in Brown Pelicans from Florida and California. Calif.-Nev. Wildl. 56-64

Gunter, G. 1972. Brown Pelicans reported again. MOS Newsl. 17: 4.

Hazeltine, W. 1972. Disagreement on why Brown Pelican eggs are thin. Nature 239: 410-411.

Schreiber, R. W. and R. W. Risebrough. 1972. Studies of the Brown Pelican. Wilson Bull. 84: 119-135.

Williams, L. E., Jr. 1972. Pelican's progress. Fla. Wildl. 26: 4-6.

1971

Anon. 1971. Brown Pelicans nest again in Louisiana. La. Ornithol Soc. News 60: 2-3.

Blus, L. J. , R. G. Heath, C. D. Gish, A. A. Belisle and R. M. Prouty. 1971. Egg-shell thinning in the Brown Pelican: implication of DDE. BioScience 21: 1213-1215.

Hallman, R. C. 1971. Brown Pelican (Pelecanus occidentalis) at St. Joe Island Sanctuary. Fla. Nat. 44: 122.

Joanen, T. and D. A. Neal. 1971. The return of the Brown Pelican. La. Conserv. May-June: 10-13.

Risebrough, R. W., F. C. Sibley and M. N. Kirven. 1971. Reproductive failure of the Brown Pelican on Anacapa Island in 1969. Am. Birds 25: 8-9.

Williams, L. E., Jr. and L. L. Martin. 1971. Nesting populations of Brown Pelicans in Florida. Proc. 24th Annu. Conf. Southeastern Assoc. Game and Fish Commissioners: 154-169.

1970

Anderson, D. W. and J. J. Hickey. 1970. Oological data on egg and breeding characteristics of Brown Pelicans. Wilson Bull. 82: 14-28.

Blus, L. J. 1970. Measurements of Brown Pelican eggshells from Florida and South Carolina. BioScience 20: 867-869.

Gress, F. 1970. Reproductive status of the California Brown Pelican in 1970, with notes on breeding biology and natural history. Calif. Dept. Fish Game, Wildl. Manage. Br. Admin. Rept. 70-6. 21 pp. mimeo.

Jehl, J. R., Jr. 1970. Is thirty million years long enough? Pac. Discovery 23: 16-23.

Keith, J. O., L. A. Woods, Jr. and E. G. Hunt. 1970. Reproductive failure in Brown Pelicans on the Pacific coast. Trans. N. Am. Wild. Nat. Resourc. Conf. 35: 56-64.

Lamont, T. G., G. E. Bagley and W. L. Reichel. 1970. Resideues of o,p-DDD and o,p DDT in Brown Pelican eggs and Mallard Ducks. Bull. Environ. Toxicol. 5: 231-236.

McCaskie, G. 1970. The occurrences of four species of Pelecaniiformes in the southwestern United States. Calif. Birds 1: 117-142.

Norman, D. and R. D. Purrington. 1970. The demise of the Brown Pelican in Louisiana. La. Ornithol. Soc. News 55: 3-6.

1969

Jehl, J. R., Jr. 1969a. A wonderful bird was the pelican. Oceans 2: 11-19.

Jehl, J. R., Jr. 1969b. The Brown Pelican, a vanishing American. Environ. Southwest (June): 4.

Joanen, T. and H. H. Dupuie. 1969. The case of the vanishing Brown Pelican. Forests & People 19: 23-24, 38, 40-41.

Orians, G. H. 1969. Age and hunting success in the Brown Pelican (*Pelecanus occidentalis*). Anim. Behav. 17: 316-319.

Perlman, D. 1969. Pesticide causing rapid extinction of the Brown Pelican. Can. Field Nat. 83: 173-174.

Schreiber, R. W. and R. L. DeLong. 1969. Brown Pelican status in California. Aud. Field Notes 23: 57-59.

Williams, L. E., Jr. and L. Martin. 1969. Can we solve the Brown Pelican's problems? Fla. Nat. 43: 107-110.

1968

Sprunt, A. 1968. Brown Pelican newsletter. Natl. Aud. Soc. Res. Dept., Tavernier, Florida 1: 1-9.

Williams, L. E., Jr. and L. Martin 1968. Nesting status of the Brown Pelican in Florida in 1968. Q. J. Fla. Acad. Sci. 31: 130-140.

Winckler, S. 1968. Brown Pelican epitaph. Texas Parks & Wildl. 26: 24-28.

1967

Anon. 1967. Can pelicans be raised in captivity? Game Bird Breeders, Avic., Zool. & Conserv. Gazette (Nov.) 1967: 16, 30.

Mason, C. R. 1967. Brown Pelican lives to good old age. Fla. Nat. 40: 152.

1966

Abbott, W. G. 1966. The California Brown Pelican. Museum Talk 41: 1-7.

Beckett, T. A., III. 1966. Devaux Bank--1964 and 1965. Chat 30: 93-100.

Bostic, D. L. and R. C. Banks. 1966. A record of stingray predation by the Brown Pelican. Condor 68: 515-516.

Orr, R. T. 1966. Brown Pelicans. Pac. Discovery 19: 24-29.

1965

Turcotte, W. H. (comp.) 1965. Brown Pelican extirpated on Gulf Coast? MOS Newsl. 10: 2-4.

1958

Gunter, G. 1958. Feeding behavior of Brown and White pelicans on the Gulf Coast of the United States. Proc. La. Acad. Sci. 21: 34-39.

Schmidt-Nielsen, K. and R. Fange. 1958. The function of the salt gland in the Brown Pelican. Auk 75: 282-289.

1956

Cook, F. A. 1956. Trip to the Brown Pelican rookery on North Island. MOS Newsl. 1: 4-5.

1954

Bartholomew, G. A., Jr. and W. R. Dawson. 1954. Temperature regulation in young pelicans, herons and gulls. Ecology 35: 466-472.

1950

Musselmann, T. E. 1950. Three Brown Pelicans in Illinois. Auk 67: 233.

Sefton, J. W., Jr. 1950. The Brown Pelican as a scavenger. Condor 52: 136-137.

1949

Haverschmidt, F. 1949. Brown Pelican on the coast of Surinam, Dutch Guiana. Auk 66: 77-78.

Stullken, D. E. 1949. Death of a Brown Pelican (Pelecanus occidentalis). Auk 66: 76-77.

1948

Bond, R. M. 1948. Returns of banded California Brown Pelicans. Condor 50: 89.

1947

Wolff, B. 1947. Brown Pelicans nesting in Pamlico Sound. Chat 11: 72.

1946

Baldwin, W. P. 1946a. Laughing Gull robs Brown Pelican. Auk 63: 96-97.

Baldwin, W. P. 1946b. Brown Pelican colony on Cape Romain Refuge increases. Auk 63: 103-104.

1945

Longstreet, R. J. 1945b. Second pelican banding report (1936-44), Mosquito Lagoon Rookery (Brevard Reserve). Fla. Nat. 18: 26-35.

Mason, C. R. 1945. Pelican travels. Bird-Banding 16: 134-143.

Wetmore, A. 1945. A review of the forms of the Brown Pelican. Auk 62: 577-586.

1944

Fisher, H. I. 1944. Brown Pelicans and breaking waves. Condor 46: 124.

Longstreet, R. J. 1944. The movements of the Florida East Coast Brown Pelicans. Proc. Fla. Acad. Sci. 7: 185-189.

1943

Walker, L. W. 1943. Pelican profiles. Nat. Geogr. Mag. 84: 589-598.

1942

Bond, R. M. 1942. Banding records of California Brown Pelicans. Condor 44: 116-121.

1939

Richardson, F. 1939. Functional aspects of the pneumatic system of the California Brown Pelican. Condor 41: 13-17.

1937

Anon. 1937. The Brown Pelican--a plea for fair play. Texas Fed. Nat. Clubs (Dec.) 1937: 5 pp.

Vorhies, C. T. and A. R. Phillips. 1937. Brown Pelicans invade Arizona. Condor 39: 175.

Woodbury, A. M. 1937. A Brown Pelican record from Utah. Condor 39: 225.

1936

Longstreet, R. J. and E. M. Davis. 1936. Movements of the Eastern Brown Pelican. Fla. Nat. 9: 68-76.

1935

Anon. 1935. Brown Pelicans, falsely accused, killed in Texas. Seattle Wren 3: 3-4.

Allen, R. P. 1935. Notes on some bird colonies on the Gulf Coast. Auk 52: 198-200.

1934

Brooks, W. D. 1934. Brown Pelican in Massachusetts. Auk 51: 77.

Tatum, J. W. 1934. Brown Pelican in Delaware. Auk 51: 508.

1933

Shannon, W. E. 1933. The Eastern Brown Pelican at Brevard Reserve. Fla. Nat. 6: 41-44.

1932

Sprunt, A., Jr. 1932. Eastern Brown Pelican on the South Carolina coast in winter. Auk 49: 212.

1931

Longstreet, R. J. 1931. The case of the Brown Pelican. Fla. Woods Waters (Spring): 19-20.

Mills, H. R. 1931. The Florida Brown Pelican. Fla. Nat. 4: 31-36.

Svihla, A. 1931. The fishing plunge of the Brown Pelican. Auk 48: 413.

1929

Anon. 1929. Brown Pelican makes nest on island along North Carolina coast. Conserv. & Ind. 6: 9-10.

1927

Bailey, A. M. 1927. The pelicans at home. Am. For. & Forest Life 33: 87-92.

Burt, W. H. 1927. Three new birds for Kansas. Auk 44: 262.

Nichols, J. T. 1927. Brown Pelican and summering Bonaparte's Gulls at Newport, R.I. Auk 44: 555.

Nicholson, D. J. 1927. Florida notes. Auk 44: 115.

Williams, L. 1927. California Brown Pelicans nesting at Point Lobos, Monterey County, California. Condor 29: 246-249.

1926

Snyder, L. L. 1926. The Brown Pelican (Pelecanus occidentalis) in Ontario--a correction. Auk 43: 88.

1925

Snyder, L. L. 1925. The Brown Pelican (Pelecanus occidentalis) in Ontario. Auk 42: 124-125.

1924

Longstreet, R. J. 1924. The new Brown Pelican rookery on the Florida east coast. Wilson Bull. 36: 65-68.

1923

Allen, W. E. 1923. Fishing activities of the California Brown Pelican. Condor 25: 107-108.

1922

Bowles, J. H. 1922. The California Brown Pelican in the state of Washington. Condor 24: 32.

Brannon, P. A. 1922. Pelicans in the interior of Alabama. Auk 39: 411.

1921

Pearson, T. G. 1921. Notes on the bird-life of southeastern Texas. Auk 38: 515-516.

Pernie, M. D. 1921. Brown Pelican in Oswego County, N.Y. Auk 38: 597.

1920

Bailey, A. M. 1920. The Brown Pelicans. Nat. Hist. 20: 197-201.

1919

Pearson, T. G. 1919. The case of the Brown Pelican. Am. Rev. of Reviews 59: 509-511.

1918

Bailey, A. M. 1918. The Brown Pelican--a good citizen. Wilson Bull. 30: 65-68.

Florida Audubon Society. 1918. A defense of the pelican. (Unpubl.) 12 pp.

1917

Peyton, S. B. 1917. Early nesting of california Brown Pelican on Anacapa Island, California. Condor 19: 102.

1914

Forbes, H. O. 1914. Notes on Molina's Pelican (Pelecanus thagus). Ibis 2: 403-420.

1902

Daniel, J. W., Jr. 1902. Pelicans of Tampa Bay. Wilson Bull. 14: 5-7.

1901

Chapman, F. M. 1901. Pelican Island revisited. Bird-Lore 3: 1-9.

1894

Gibbs, M. 1894. Nesting habits of the Brown Pelican in Florida. Oologist 11: 81-84.

1893

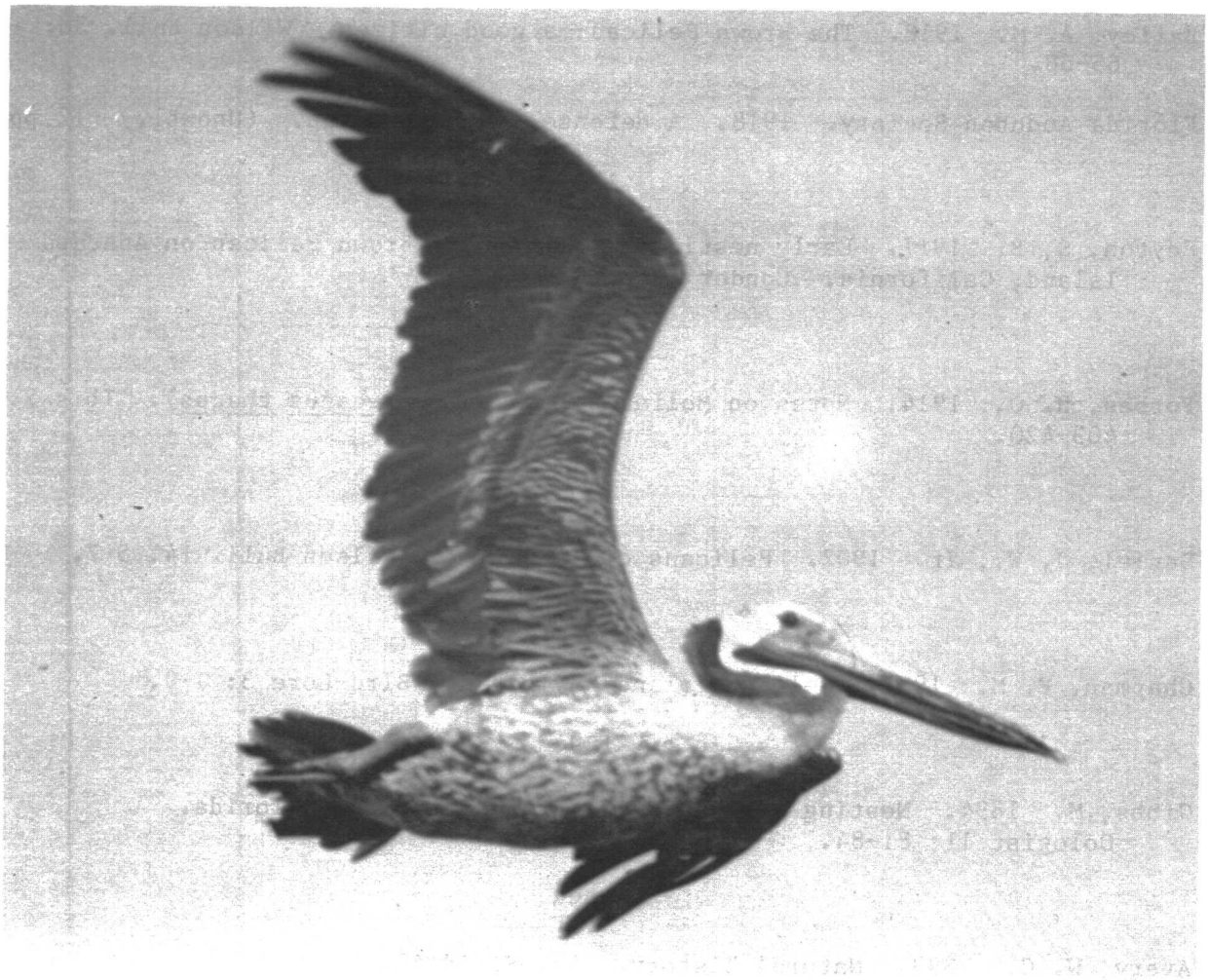
Avery, W. C. 1893. Natural history. Am. Field 40: 7.

1889

Anthony, A. W. 1889. Nesting habits of the California Brown Pelican (Pelecanus californicus). Proc. Calif. Acad. Sci., 2nd Ser. 2: 83.

1874

Holder, J. B. 1874. The Brown Pelican and its home. Am. Sportsman 3: 390.



Brown Pelican over Beacon Island, North Carolina, August 1981
Photograph by Roger B. Clapp

LITERATURE CITED

ABA (American Birding Association). 1975. ABA checklist: birds of continental United States and Canada. American Birding Association, Inc., Austin, TX. viii and 64 pp.

Able, K.P. 1969. The changing seasons; the winter season: December 1, 1968-March 31, 1969; Central Southern Region. Aud. Field Notes 23: 488-492.

Abramson, I.J. 1961. Observations on terns in the Miami area. Fla. Nat. 34: 23-24.

Abramson, I.J. and H.M. Stevenson. 1961. The changing seasons; the spring migration: April 1-May 31, 1961; Florida Region. Aud. Field Notes 15: 402-405.

Adams, D.A. 1953. Frigate-bird on the North Carolina coast. Chat 17: 70.

Agey, H.N. 1967. Notes on sightings of what appears to be the Least Grebe (Colymbus dominicus). Fla. Nat. 40: 101.

Ainley, D.G. 1976. Beached bird survey. Rept. No. 5. Point Reyes Bird Observ. Newsl. 37: 1-3.

_____. 1977. Feeding methods in seabirds: a comparison of polar and tropical nesting communities in the eastern Pacific Ocean. Pp. 669-685 in Adaptations within Antarctic ecosystems. Proc. 3rd SCAR Symp. on Antarctic Biology.

Ainley, D.G. and G.A. Sanger. 1979. Trophic relationships in the northeastern Pacific Ocean and Bering Sea. Pp. 95-122 in J.C. Bartonek and D.N. Nettleship (eds.). Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

Ainley, D.G., S. Morrell and T.J. Lewis. 1974. Patterns in the life histories of storm-petrels on the Farallon Islands. Living Bird 13: 295-312.

Ainslie, J.A. and R. Atkinson. 1937. On the breeding habits of Leach's Fork-tailed Petrel. Brit. Birds 30: 234-248, 276-277.

Albers, P.H. 1977. Effects of oil on aquatic birds. Pp. 61-68 in P.L. Fore, (ed.). Proceedings 1977 Oil Spill Response Workshop. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS/77-24. 153 pp.

Aldrich, E.C. 1938. A recent oil pollution and its effect on the waterbirds in the San Francisco Bay area. Bird Lore 40: 110-114.

Alexander, K.A., A.T. Nicholson and Mr. and Mrs. W.P. Grant. 1977. White Pelican at Carolina Beach, N.C. Chat 41: 95.

Allan, R.G. 1962. Madeiran Storm Petrel, Oceanodroma castro. Ibis 103b: 274-275.

Allen, A.A. 1934. A new bird for North America. St. Univ. N.Y. Bull. to Schools 20: 134-135.

Amerson, A.B., Jr. 1969. Ornithology of the Marshall and Gilbert Islands. Atoll Res. Bull. 127. 348 pp.

_____. 1971. The natural history of French Frigate Shoals, northwestern Hawaiian Islands. Atoll Res. Bull. 150. 383 pp.

Amerson, A.B., Jr. and P.C. Shelton. 1976. The natural history of Johnston Atoll, central Pacific Ocean. Atoll Res. Bull. 192. 479 pp.

Anderson, B.H. 1972. Some uncommon avian records for central Florida. Fla. Nat. 45: 192.

Anderson, D.W. (prep.). 1972. Brown Pelicans--status of P. o. californicus. U.S. Bur. Sport Fish. Wildl., Annu. Progress Rept. No. 2, April 1972. 28 pp.

Anderson, D.W. and I.T. Anderson. 1976. Distribution and status of Brown Pelican in the California Current. Am. Birds 30: 3-12.

Anderson, D.W. and J.J. Hickey. 1970. Oological data on egg and breeding characteristics of Brown Pelicans. Wilson Bull. 82: 14-28.

Anderson, D.W., J.R. Jehl, Jr., R.W. Risebrough, L.A. Woods, Jr., L.R. DeWeese and W.G. Edgecomb. 1975. Brown Pelicans: improved reproduction of the southern California coast. Science 190: 806-808.

Anderson, D.W., R.M. Jurek and J.O. Keith. 1977b. The status of Brown Pelicans at Anacapa Island in 1975. Calif. Fish Game 63: 4-10.

Anon. 1960. Briefs for the files. Chat 24: 104-105.

Anon. 1970. White Pelicans in Charleston area. Chat 34: 45.

AOU (American Ornithologists' Union). 1957. Checklist of North American birds. Fifth ed. AOU, Baltimore, MD. 691 pp.

Appleberry, E.L. 1950. Wilmington, N.C. Migration reports, Aug. 1, 1949-Nov. 30, 1949. Chat 14: 31.

Arbib, R. 1979. The Blue List for 1980. Am. Birds 33: 830-835.

Arnold, K.A. 1975. First record of the Greater Shearwater from the Gulf of Mexico. Auk 92: 394-395.

Arnow, I.F. 1904. Holboell's Grebe and the White Pelican at St. Mary's, Georgia. Auk 21: 277.

Ashmole, M.J. and N.P. Ashmole. 1967. Notes on the breeding season and food of the Red-footed Booby (Sula sula) on Oahu, Hawaii. Ardea 55: 265-267.

Ashmole, N.P. 1971. Sea bird ecology and the marine environment. Pp. 223-286 in D.S. Farmer and J.R. King (eds.). Avian biology. Vol. 1. Academic Press, New York, NY. xix and 586 pp.

Austin, O.L., Jr. and N. Kuroda. 1953. The birds of Japan--their status and distribution. Bull. Mus. Compar. Zool., Harvard College. Vol. 109, No. 4. Cambridge, MA. 637 pp.

Baganel, T.B. 1951. Birds of the North Atlantic and Newfoundland Banks in July and August, 1950. Brit. Birds 44: 187-195.

Bailey, R. 1966. The sea-birds of the southeast coast of Arabia. Ibis 108: 224-264.

Baird, S.F. 1858. Birds. Pp. i-lvi and 1-1005 in Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean. Vol. 9, Part 2. Washington, DC.

_____. 1887. Occurrence of Cory's Shearwater (Puffinus borealis) and several species of jaegers in large numbers in the vicinity of Gayhead, Mass., during the autumn of 1886. Auk 4: 71-72.

Ball, W.H. 1948. Sooty Shearwater in western North Carolina. Auk 65: 143.

Baltz, D.M. and G.V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. Auk 94: 526-543.

Bangs, O. 1902. The occurrence of boobies in numbers on the east coast of Florida, during a storm. Auk 19: 395-396.

Bartonek, J.C. and C.J. Lensink. 1978. A review of the literature and a selected bibliography of published and unpublished literature on marine birds of Alaska. U.S. Fish & Wildl. Serv., Office Biol. Serv./Coastal Ecosystems. NOAA-OCSEAP Contract 01-06-022-11437. Anchorage, AK. 95 pp.

Bartsch, P. 1919. The bird rookeries of the Tortugas. Smithsonian Rept. 1917: 469-500.

_____. 1922. An inland record for the Man-O'-War bird. Auk 39: 249-250.

Bauer, K.M. and U.N. Glutz von Blotzheim. 1966. Handbuch der Vogel Mitteleuropas, Vol. 1: Gaviiformes - Phoenicopteriformes. Akademische Verlagsgesellschaft, Frankfort am Main. 483 pp. [In German.]

Beck, J.R. and D.W. Brown. 1972. The biology of Wilson's Storm Petrel, Oceanites oceanicus (Kuhl), at Signy Island, South Orkney Islands. Brit. Antarct. Surv. Sci. Rept. No. 69. 54 pp.

Beckett, T.A., III. 1966. Devaux Bank--1964 and 1965. Chat 30: 93-100.

Behle, W.H. 1958. The bird life of Great Salt Lake. Utah Univ. Press, Provo, UT. 230 pp.

Belterman, T. 1972. The Amer oil spill. Rept. 2-71 in Center for Short-lived Phenomena. 1971 Annual Rept. Office Environmental Sciences, Smithsonian Institution, Washington, DC. xii and 310 pp.

Bent, A.C. 1919. Life histories of North American diving birds. Bull. U.S. Natl. Mus. No. 107: 47-62.

_____. 1922. Life histories of North American petrels and pelicans and their allies. Order Tubinares and Order Steganopodes. Bull. U.S. Natl. Mus. No. 121. xii and 343 pp.

Berger, A.J. 1972. Hawaiian birdlife. Univ. Press of Hawaii, Honolulu, HI. 270 pp.

Beven, G. 1946. Feeding behaviour of North Atlantic shearwater. Brit. Birds 39: 122-123.

Bierregaard, R.O., Jr. 1974. Manx Shearwater breeds in North America. Am. Birds 28: 135.

Bierregaard, R.O., Jr., A.B. David, III, T.D. Baird and R.E. Woodruff. 1975. First northwestern Atlantic breeding record of the Manx Shearwater. Auk 92: 145-147.

Bildstein, K.L. 1980. Adult Brown Pelican robs Great Blue Heron of fish. Wilson Bull. 92: 122-123.

Birkhead, T.R., C. Lloyd and P. Corkhill. 1973. Oiled seabirds successfully cleaning their plumage. Brit. Birds 66: 535-537.

Blacklock. G.W. 1978 ms. Birds of Padre and Mustang Islands and adjacent waters. Annotated checklist. viii and 140 pp.

Blacklock, G.W., D.R. Blankenship, A.H. Chaney, S. Kennedy, K.A. King, R.T. Paul, R.D. Slack, J.C. Smith and R.C. Telfair (eds.). 1978 ms. Texas colonial waterbird survey, 1973-1976. Welder Wildlife Foundation, Sinton, TX. 60 pp.

Blacklock, G.W., R.D. Slack, D.R. Blankenship, A.H. Chaney, K.A. King, J.C. Smith and L. Mullins. 1979. Texas colonial waterbird census, 1977-78. Welder Wildlife Foundation. Sinton, TX. 15 pp.

Blake, E.R. 1977. Manual of neotropical birds. Vol. 1. Univ. Chicago Press, Chicago, IL. xix and 674 pp.

Bleich, V.C. 1975. Diving times and distances in the Pied-billed Grebe. Wilson Bull. 87: 278-280.

Blem, C.R. and D.W. Sonneborn. 1972. Leach's Petrel in North Carolina. Chat 36: 29.

Blem, C.R., W.H.N. Gutzke and C. Filemyr. 1980. First breeding record of the Double-crested Cormorant in Virginia. Wilson Bull. 92: 127-128.

BLM (Bureau of Land Management). 1978a. Final Environmental Impact Statement. Proposed 1978 Outer Continental Shelf oil and gas lease sale. Offshore western and central Gulf of Mexico. OCS Sale #51. Vol. I. BLM, U.S. Dept. Interior, New Orleans, LA vi and 451 pp.

_____. 1978b. Draft Environmental Impact Statement. Proposed 1978 Outer Continental Shelf oil and gas lease sale. Offshore eastern Gulf of Mexico. OCS Sales #65. Vol. I. BLM, U.S. Dept. Interior, New Orleans, LA. vi and 466 pp.

Blus, L.J. and J.A. Keahey. 1978. Variation in reproductivity with age in the Brown Pelican. Auk 95: 128-134.

Blus, L.J., A.A. Belisle and R.M. Prouty. 1974a. Relations of the Brown Pelican to certain environmental pollutants. Pest. Monit. J. 7: 181-194.

Blus, L.J., E. Cromartie, L. McNease and T. Joanen. 1979a. Brown Pelican: population status, reproductive success, and organochlorine residues in Louisiana, 1971-1976. Bull. Environ. Contam. Toxicol. 22: 128-135.

Blus, L.J., T.G. Lamont and B.S. Neely, Jr. 1979b. Effects of organochlorine residues on eggshell thickness, reproduction, and population status of Brown Pelicans (Pelecanus occidentalis) in South Carolina and Florida, 1969-76. Pest. Monit. J. 12: 172-184.

Bochenski, Z. 1961. Nesting biology of the Black-necked Grebe. Bird Study 8: 6-15.

Boeker, E.L. 1972. A survey of White Pelican nesting colonies in 1971. Am. Birds 26: 24, 125.

Bond, G.M. 1964. An additional record of the Yellow-billed Tropicbird (Phaethon lepturus catesbyi) from Pennsylvania. Auk 81: 552.

Bond, J. 1956. Checklist of the birds of the West Indies. Fourth ed. Philadelphia Acad. Nat. Sci., Philadelphia, PA. 214 pp.

_____. 1971. Birds of the West Indies. Second ed. Collins, London. 256 pp.

_____. 1978. Twenty-second supplement to the checklist of birds of the West Indies. Philadelphia Acad. Nat. Sci., Philadelphia, PA. 20 pp.

Borden, R.W. 1946. Man-O'-War bird at Morehead City, N.C. Chat 10: 71.

Bostic, D.L. and R.C. Banks. 1966. A record of stingray predation by the Brown Pelican. Condor 68: 515-516.

Boswall, J. 1978. The birds of Alacran Reef, Gulf of Mexico. Bull Brit. Ornithol. Club 98: 99-109.

BOU (British Ornithological Union). 1971. The status of birds in Britain and Ireland. BOU Prep. Records Committee and D.W. Snow (eds.). Blackwell Scientific Publications, Oxford. xviii and 333 pp.

Bourne, W.R.P. 1955. The birds of the Cape Verde islands. Ibis 97: 508-556.

_____. 1968a. Oil pollution and bird populations. Pp. 99-121 in J.D. Carthy and D.R. Arthur (eds.). The biological effects of oil pollution on littoral communities. Proc. symp. held at Pembroke, Wales, 17-19 February 1968. Suppl. to Vol. 2 of Field Studies. Field Studies Council, London. vii and 198 pp.

_____. 1968b. Observation of an encounter between birds and floating oil. Nature 219: 632.

_____. 1971. The threat of oil pollution to North Scottish seabird colonies. Mar. Pollut. Bull. 2: 117-120.

_____. 1976. Seabirds and pollution. Pp. 403-502 in R. Johnston (ed.). Marine pollution. Academic Press, London, England. xiv and 729 pp.

_____. 1979a. Birds and gas flares. Mar. Pollut. Bull. 10: 124-125.

_____. 1979b. Seabird pollution research has gone astray. Mar. Pollut. Bull. 10: 149-150.

Bourne, W.R.P. and C.J. Bibby. 1975. Temperature and the seasonal and geographical occurrence of oiled birds on West European beaches. Mar. Pollut. Bull. 6: 77-80.

Bourne, W.R.P. and T.R.E. Devlin. 1969. Birds and oil. Birds 2: 176-178.

Bourne, W.R.P., J.D. Parrack and G.R. Potts. 1967. Birds killed in the TORREY CANYON disaster. Nature 215: 1123-1125.

Bradley, J.T. 1974. The climate of Florida. Pp. 45-70 in National Oceanic and Atmospheric Administration, U.S. Dept. Commerce. Climates of the states. Vol. I--eastern states. Water Information Center, Inc., Port Washington, NY. 486 pp.

Bradstreet, M.S.W. 1978. The pelagic, summer, feeding ecology of Northern Fulmars in Lancaster Sound. Ibis 120: 124.

Brewster, W. 1886. Occurrence of the Yellow-billed Tropic-bird in Florida. Auk 3: 481.

Brigham, D. (comp.). 1977. Merritt Island Nat'l Wildlife Refuge, Fla. The 77th Audubon Christmas Bird Count. Am. Birds 31: 606-607.

Brimley, C.S. 1937. Additions, corrections to North Carolina birds. Chat 1: 1-6.

Brimley, H.H. 1941. Unusual North Carolina records. Auk 58: 106-108.

Brodkorb, P., R.B. Gonzalez and D. Empeso. 1969. White-tailed Tropic-bird, an addition to the Philippine avifauna. Auk 86: 357.

Broekhuysen, G.J. and P.G.H. Frost. 1968b. Nesting behavior of the Black-necked Grebe Podiceps nigricollis in southern Africa. II. Laying, clutch size, egg sizes, incubation and nesting success. Ostrich 39: 242-252.

Brookfield, C.M. 1950. The changing seasons; the winter season: December 1, 1949-March 31, 1950; Florida Region. Aud. Field Notes 4: 198-199.

_____. 1951. The changing seasons; the winter season: December 1, 1950-March 31, 1951; Florida Region. Aud. Field Notes 5: 200-201.

_____. 1953. The changing seasons; the fall migration: August 16-November 30, 1952; Florida Region. Aud. Field Notes 7: 12-13.

Brown, D.M. and B. Ortego. 1979. Alabama's first Leach's Storm-Petrel. Am. Birds 33: 808.

Brown, R.G.B., D.I. Gillespie, A.R. Lock, P.A. Pearce and G.H. Watson. 1973. Bird mortality from oilslicks off eastern Canada, February-April 1970. Can. Field Nat. 87: 225-234.

Brown, R.G.B., D.N. Nettleship, P. Germain, C.E. Tull and T. Davis. 1975. Atlas of eastern Canadian seabirds. Can. Wildl. Serv. 220 pp.

Brown, R.G.B., W.R.P. Bourne and T.R. Wahl. 1978. Diving by shearwaters. Condor 80: 123-125.

Brown, R.G.B., S.P. Barker, D.E. Gaskin and M.R. Sandeeman. 1981. The foods of Great and Sooty Shearwaters Puffinus gravis and P. griseus in eastern Canadian waters. Ibis 123: 19-30.

Brown, S.R. 1973. First record of White-tailed Tropic Bird in New Zealand. Notornis 20: 380-381.

Browne, M.M. 1976. An Eared Grebe collected in North Carolina. Chat 40: 44.

Browne, M.M. and G.S. Grant. 1970. Sooty Tern and Audubon's Shearwater off South Carolina in September. Chat 34: 102-103.

Brun, E. 1979. Present status and trends in population of seabirds in Norway. Pp. 289-301 in J.C. Bartonek and D.N. Nettleship (eds.). Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

Buckley, P.A. 1968a. The status of the Eared Grebe on the eastern Great Lakes and the Atlantic coast. Aud. Field Notes 22: 536-542.

_____. 1968b. An Eared Grebe specimen from coastal Virginia. Wilson Bull. 80: 487.

_____. 1970. Brown Booby, Magnificent Frigatebird and Sabine's Gull new to Virginia. Aud. Field Notes 24: 650-652.

Buckley, P.A. 1973. A massive spring movement, including three species new to North Carolina, at Cape Hatteras National Seashore. Am. Birds 27: 8-10.

Buckley, P.A. and F.G. Buckley. 1976. Guidelines for the protection and management of colonially nesting waterbirds. National Park Service, Boston, MA. 54 pp.

_____. 1977. Human encroachment on barrier islands of the northeastern U.S. and its impact on coastal birds. Pp. 68-76 in J.H. Noyes and E.H. Zube (eds.). A symposium on coastal recreation resources in an urbanizing environment: a monograph. University of Massachusetts, Amherst, MA.

Buckley, P.A. and C.F. Wurster. 1970. White-faced Storm Petrels Pelagodroma marina in the North Atlantic. Bull. Brit. Ornithol. Club 90: 35-38.

Buhrman, C.B. and L.A. Hopkins. 1978. Eleven pelagic trips into the eastern Gulf of Mexico. Fla. Field Nat. 6: 30-32.

Bull, J.L. 1964. Red-billed Tropicbird on Long Island, New York. Auk 81: 433-434.

_____. 1974. Birds of New York state. Doubleday/Natural History Press. Garden City, NY. 655 pp.

Bundy, G. 1976. Breeding biology of the Red-throated Diver. Bird Study 23: 249-256.

_____. 1978a. Possible polygamy by Red-throated Divers. Brit. Birds. 71: 179-181.

_____. 1978b. Breeding Red-throated Divers in Shetland. Brit. Birds 71: 199-208.

Burger, J. 1974. Breeding adaptations of Franklin's Gull (Larus pipixcan) to a marsh habitat. Anim. Behav. 22: 521-567.

Burleigh, T.D. 1944. The bird life of the gulf coast of Mississippi. Occas. Pap. Mus. Zool., La. St. Univ. 20: 324-490.

_____. 1958. Georgia birds. Univ. Oklahoma Press, Norman, OK. xxix and 746 pp.

Burton, E.M. 1970. South Carolina bird life by A. Sprunt, Jr. and E.B. Chamberlain (1949). Revised ed. Univ. South Carolina Press, Columbia, SC. xx and 658 pp.

Butler, J.N., B.F. Morris and J. Sass. 1973. Pelagic tar from Bermuda and the Sargasso Sea. Bermuda Biol. Sta. Spec. Rept. No. 10.

Bystrak, D. (ed.). 1974. Wintering areas of bird species potentially hazardous to aircraft. A special report jointly prepared by the National Audubon Society and the U.S. Fish & Wildl. Serv. National Audubon Society. iii and 156 pp.

Cadbury, J.M. 1966. 23-year-old cormorant. Eastern Bird Banding Association News 29: 18.

Campbell, L.H., K.T. Standring and C.J. Cadbury. 1978. Firth of Forth oil pollution incident, February 1978. Mar. Pollut. Bull. 9: 335-339.

Carden, R. 1960. Duration of dives of Black-necked Grebes. Brit. Birds 53: 127.

Carlton, B. 1979. A Brown Pelican in central Oklahoma. Bull. Okla. Ornithol. Soc. 12: 11-13.

Carson, R.D. 1966. Destruction of colonial birds on an island on Suggi Lake. Blue Jay 24: 96-97.

Carter, H.S. 1974. The climate of Georgia. Pp. 71-89 in National Oceanic and Atmospheric Administration, U.S. Dept. Commerce. Climates of the states. Vol. I--eastern states. Water Information Center, Inc., Port Washington, NY. 486 pp.

Casement, M. 1966. Seabirds avoiding oil patches. Sea Swallow 18: 79.

Castenholz, R.W. 1954. Observations of sea birds off the southeastern Florida coast. Wilson Bull. 66: 140-141.

Chabreck, R.H. 1963. Breeding habits of the Pied-billed Grebe in an impounded coastal marsh in Louisiana. Auk 80: 447-452.

Chamberlain, B.R. 1952. The changing seasons; the spring migration: April 1-May 31, 1952; Southern Atlantic Coast Region. Aud. Field Notes 6: 241-243.

_____. 1953a. The changing seasons; the spring migration: April 1-May 31, 1953; Southern Atlantic Coast Region. Aud. Field Notes 7: 267-268.

_____. 1953b. Briefs for the files. Chat 17: 26, 50-51, 76, 96.

_____. 1954a. The changing seasons; the winter season: December 1, 1953-March 31, 1954; Southern Atlantic Coast Region. Aud. Field Notes 8: 244-246.

_____. 1954b. The changing seasons; the spring migration: April 1-May 31, 1954; Southern Atlantic Coast Region. Aud. Field Notes 8: 305-307.

_____. 1955a. The changing seasons; the spring migration: April 1-May 31, 1955; Southern Atlantic Coast Region. Aud. Field Notes 9: 324-326.

_____. 1955b. Briefs for the files. Chat 19: 29, 49, 71.

_____. 1956a. The changing seasons; the fall migration: August 16-November 30, 1955; Southern Atlantic Coast Region. Aud. Field Notes 10: 15-18.

_____. 1956b. Briefs for the files. Chat 20: 21, 42, 62-63, 83.

Chamberlain, B.R. 1957. The changing seasons; the spring migration: April 1-May 31, 1957; Southern Atlantic Coast Region. Aud. Field Notes 11: 333-337.

_____. 1959a. The changing seasons; the fall migration: August 16-November 30, 1958; Southern Atlantic Coast Region. Aud. Field Notes 13: 19-21.

_____. 1959b. Briefs for the files. Chat 23: 20, 39, 68-69, 90.

_____. 1960a. The changing seasons; the winter season: December 1, 1959-March 31, 1960; Southern Atlantic Coast Region. Aud. Field Notes 14: 299-301.

_____. 1960b. The changing seasons; the spring migration: April 1-May 31, 1960; Southern Atlantic Coast Region. Aud. Field Notes 14: 377-379.

_____. 1961a. The changing seasons; the spring migration: April 1-May 31, 1961; Southern Atlantic Coast Region. Aud. Field Notes 15: 399-402.

_____. 1961b. Briefs for the files. Chat 25: 21, 41-42, 74-75, 96.

_____. 1962a. The changing seasons; the fall migration: August 16-November 30, 1961; Southern Atlantic Coast Region. Aud. Field Notes 16: 18-21.

_____. 1962b. Briefs for the files. Chat 26: 25, 49-50, 81-82, 102-103.

_____. 1963. Briefs for the files. Chat 27: 24-25, 34, 58, 82-83.

_____. 1964. Briefs for the files. Chat 28: 32-33, 55, 100-101, 143.

_____. 1965. Briefs for the files. Chat 29: 30, 36, 57-58, 90, 116-117.

Chamberlain, B.R. and E.B. Chamberlain. 1952. The changing seasons; the winter season: December 1, 1951-March 31, 1952; Southern Atlantic Coast Region. Aud. Field Notes 6: 190-192.

Chamberlain, E.B. 1936. Western Grebe in South Carolina. Auk 53: 438.

Chamberlain, E.B. and B.R. Chamberlain. 1947. The changing seasons; the nesting season: June 1-July 31, 1947; Carolina Region. Aud. Field Notes 1: 174-175.

_____. 1948. The changing seasons; the fall migration: August 1-November 30, 1947; Carolina Region. Aud. Field Notes 2: 7-9.

Chamberlain, N.A. 1967. A sight record of the Western Grebe at Charleston. Chat 31: 24.

Chamberlin, M.L. 1977. Observations on the Red-necked Grebe nesting in Michigan. Wilson Bull. 89: 33-46.

Chandler, F. (comp.). 1977. Gulf shores, Ala. The 77th Audubon Christmas Bird Count. Am. Birds 31: 650-651.

Chandler, F. and B. Duncan (comps.). 1979. Gulf shores, Ala. The 79th Audubon Christmas Bird Count. Am. Birds 33: 506.

Chaney, A.H., B.R. Chapman, J.P. Karges, D.A. Nelson, R.R. Schmidt and L.C. Thebeau. 1978. Use of dredged material islands by colonial seabirds and wading birds in Texas. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. Tech. Rept. D-78-8. [170] and 146 pp.

Chatwin, S.L. 1956. The Western Grebe taken on hook and line. Condor 58: 73-74.

Clapp, R.B. 1980. Occurrence of Central Pacific Blue-faced Booby and Sooty Tern in Southeast Asia. Tori 29: 95-96.

Clapp, R.B. and P.W. Woodward. 1968. New records of birds from the Hawaiian Leeward Islands. Proc. U.S. Natl. Mus., Smithsonian Instit., Washington, DC. 39 pp.

Clapp, R.B., E. Kridler and R.R. Fleet. 1977. The natural history of Nihoa Island, northwestern Hawaiian Islands. Atoll Res. Bull. 207. v and 147 pp.

Clapp, R.B., M.K. Klimkiewicz and J.H. Kennard. 1979 ms. Longevity records of North American birds--Suppl. Part 1.

Clark, R.B. 1973. Impact of acute and chronic oil pollution on sea birds. Pp. 619-634 in Background papers for a workshop on inputs, fates, and effects of petroleum in the marine environment II. Oceanic Affairs Board, Nat. Acad. Sci., Washington, DC. xi and 107 pp.

Clase, H.J., F. Cooke, T.A. Hill and W.J. Roff. 1960. A survey of the Slavonian Grebe at Myvatn, Iceland. Bird Study 7: 76-81.

Cobey, F. 1961. Magnificent Frigate-bird on the upper South Carolina coast. Chat 25: 68.

Coffey, J., Jr. 1944. Man-O'-War birds at Wrightsville Beach. Chat 8: 60.

Coker, R.E. 1919. Habits and economic relations of the guano birds of Peru. Proc. U.S. Natl. Mus. No. 56: 449-511.

Coles, R.J. 1925. Sea-birds at Cape Lookout, North Carolina. Auk 42: 123-124.

Collett, R. 1972. Brown Booby (Sula leucogaster) sighted at Venice. Fla. Nat. 45: 192.

Condon, H.T. 1975. Checklist of the birds of Australia Part I: Non-Passerines. Royal Austr. Ornithol. Union, Melbourne, Australia. xx and 311 pp.

Cook, F.W. 1945. Two unusual records for North Carolina. Auk 62: 465.

Cooley, C.D., J.A. Jackson and D.K. Cavin. 2979. Blue-faced Booby near Horn Island, Mississippi. Mississippi Kite 9:42.

Cottam, C. and P. Knappen. 1939. Food of some uncommon North American birds. Auk 56: 138-169.

Coues, E. 1862. Synopsis of the North American forms of the Colymbidae and Podicipidae. Proc. Acad. Natl. Sci. Philadelphia 14 No. 5: 226-233.

Cramp, S., W.R.P. Bourne and D. Saunders. 1974. The seabirds of Britain and Ireland. Collins, London and Taplinger Publ. Co., New York, NY. 287 pp.

Cramp, S., K.E.L. Simmons, J.J. Ferguson-Lees, R. Gillmor, P.A.D. Hollom, R. Hudson, E.M. Nicholson, M.A. Ogilvie, P.J.S. Olney, K.H. Voous and J. Wattel. 1977. Handbook of the birds of Europe, the Middle East and North Africa: the birds of the western Palearctic. Vol. 1. Ostrich to ducks. Oxford Univ. Press, Oxford, England. 722 pp.

Crossin, R.S. 1974. The Storm Petrels (Hydrobatidae). Pp. 154-205 in W.B. King (ed.). Pelagic studies of seabirds in the central and eastern Pacific Ocean. Smithsonian Contrib. to Zool. No. 158. iv and 277 pp.

Croxall, J.P. 1975. The effect of oil on nature conservation, especially birds. Pp. 93-101 in H.A. Cole (ed.). Petroleum and the Continental Shelf of NW Europe. Vol. 2 (Environmental protection). Applied Science Publ., Ltd., Essex, England.

_____. 1977. The effects of oil on seabirds. Rapp. P.-V. Reun. Cons. Int. Explor. Mer 171: 191-195.

CSLP (Center for Short-lived Phenomena). 1969. Annual progress report 1968. Center for Short-lived Phenomena, Smithsonian Institution, Cambridge, MA. xi and 152 pp.

_____. 1971. Annual Progress Report 1970. Center for Short-lived Phenomena, Smithsonian Institution, Cambridge, MA. x and 296 pp.

Cunningham, R.L. 1964a. The changing seasons; the fall migration: August 16-November 30, 1963; Florida Region. Aud. Field Notes 18: 24-28.

_____. 1964b. The changing seasons; the spring migration: April 1-May 31, 1964; Florida Region. Aud. Field Notes 18: 443-446.

_____. 1965a. The changing seasons; the fall migration: August 16-November 30, 1964; Florida Region. Aud. Field Notes 19: 28-33.

_____. 1965b. The changing seasons; the spring migration: April 1-May 31, 1965; Florida Region. Aud. Field Notes 19: 462-466.

_____. 1966a. The changing seasons; the winter season: December 1, 1965-March 31, 1966; Florida Region. Aud. Field Notes 20: 412-416.

_____. 1966b. The changing seasons; the spring migration: April 1-May 31, 1966; Florida Region. Aud. Field Notes 20: 496-501.

Davis, R.A. 1972. A comparative study of the use of habitat by Arctic Loons and Red-throated Loons. Ph.D. thesis, Univ. W. Ontario/Guelph, ON. xix and 290 pp.

Dawn, W. 1959. Eared Grebe in South Carolina. Auk 76: 521.

Dement'ev, G.P. and N.A. Gladkov (eds.). 1951a. Birds of the Soviet Union. Vol. I. Israel Program for Scientific Translation, Jerusalem. xix and 704 pp. [1966 translation from Russian].

_____. 1951b. Birds of the Soviet Union. Vol. II. Israel Program for Scientific Translation, Jerusalem. xi and 553 pp. [1968 translation from Russian].

Denton, J.F. and B.R. Chamberlain. 1950. The changing seasons; the fall migration: August 16-November 30, 1949; Southern Atlantic Coast Region. Aud. Field Notes 4: 9-11.

Denton, J.F., W.W. Baker, L.B. Davenport, Jr., M.N. Hopkins, Jr. and C.S. Robbins. 1977. Annotated checklist of Georgia birds. Georgia Ornithol. Soc. Occas. Publ. 6. iii and 57 pp.

Deusing, M. 1939. Nesting habits of the Pied-billed Grebe. Auk 56: 367-373.

Diamond, A.W. 1972. Sexual dimorphism in breeding cycles and unequal sex ratio in Magnificent Frigate-birds. Ibis 114: 395-398.

_____. 1973. Notes on the breeding biology and behavior of the Magnificent Frigatebird. Condor 75: 200-209.

_____. 1974. The Red-footed Booby on Aldabra Atoll, Indian Ocean. Ardea 62: 196-218.

_____. 1975. The biology of tropicbirds at Aldabra Atoll, Indian Ocean. Auk 92: 16-39.

Dickerman, R.W. 1969. Nesting records of the Eared Grebe in Mexico. Auk 86: 144.

Dilley, W.E. 1950. The terns of the Dry Tortugas, June 1949. Fla. Nat. 23: 67-68.

Dinsmore, J.J. 1974. White and Brown Pelicans feeding together. Fla. Field Nat. 2: 11.

Dodd, D. and H.M. Stevenson (comps.). 1971. Panacea, Fla. The 71st Christmas Bird Count. Am. Birds 25: 293-294.

Doe, C.E. and J.C. Russell. 1936. Tortugas colonies again visited. Fla. Nat. 10: 6-8.

Dorst, J. and J.L. Mougin. 1979. Order Pelecaniformes. Pp. 155-193 in E. Mayr and G.W. Cottrell (eds.). Checklist of birds of the world. Vol. I. Second ed. Mus. Comp. Zool., Harvard Univ. xvii and 547 pp.

Dorward, D.F. 1962a. Comparative biology of the White Booby and the Brown Booby Sula spp. at Ascension. Ibis 103b: 174-220.

Drent, R., G.F. van Tets, F. Tompa and K. Vermeer. 1964. The breeding birds of Mandarte Island, British Columbia. Can. Field Nat. 78: 208-263.

Drury, W.H., Jr. 1961. Observations on some breeding water birds on Bylot Island. Can. Field Nat. 75: 84-101.

DuBois, A.D. 1919. An experience with Horned Grebes (Colymbus auritus). Auk 36: 170-180.

DuMont, P.G. 1973. Black-browed Albatross sightings off the United States east coast. Am. Birds 27: 739-740.

DuMont, P.G. and P.A. DuMont. 1973. Birds of the season. March through May 1973. Atl. Nat. 28: 169-178.

Dunbar, J., S. Curtis and R. Cardno. 1979. Pied-billed Grebe in Grampion. Brit. Birds 72: 329.

Duncan, C.D. 1978. Bridled Tern and Audubon's Shearwater in Alabama. Ala. Birdlife 26: 16-17.

Duncan, C.D. and R.W. Havard. 1979 ms. Pelagic birds of the northern Gulf of Mexico. A preliminary survey. 25 pp.

_____. 1980. Pelagic birds of the northern Gulf of Mexico. A preliminary summary of distribution and abundance with comments on field identification. Am. Birds 34: 122-132.

Duncan, R. 1973. A Great Cormorant in west Florida. Fla. Field Nat. 1: 13.

Dunn, E.H. 1975a. Caloric intake of nestling Double-crested Cormorants. Auk 92: 553-565.

_____. 1975b. Growth, body components and energy content of nestling Double-crested Cormorants. Condor 77: 431-438.

Dusi, J.L. 1968. Feeding interaction between Bonaparte's Gulls and Horned Grebes. Auk 85: 129.

Dwight, J., Jr. 1897. A species of shearwater (Puffinus assimilis Gould), new to the North American fauna. Proc. Biol. Soc. Wash. 11: 69-70.

Eastin, W.C. and D.J. Hoffman. 1978. Biological effects of petroleum on aquatic birds. Pp. 561-582 in C.C. Bates (chairman). Proc. conf. assessment of ecological impacts of oil spills. Am. Instit. Biol. Sci., Arlington, VA. viii and 936 pp.

Eckert, J. 1969. Notes on the Wilson Storm Petrel. S. Austr. Ornithol. 25: 110.

Edscorn, J.B. 1974. The changing seasons; the fall migration: August 1-November 30, 1973; Florida Region. Am. Birds 28: 40-44.

_____. 1975. The changing seasons; the fall migration: August 1-November 30, 1974; Florida Region. Am. Birds 29: 44-48.

_____. 1976. The changing seasons; the fall migration: August 1-November 30, 1975; Florida Region. Am. Birds 30: 54-58.

_____. 1977. The changing seasons; the autumn migration: August 1-November 30, 1976; Florida Region. Am. Birds 31: 166-169.

_____. 1978. The changing seasons; the fall migration: August 1-November 30, 1977; Florida Region. Am. Birds 32: 193-197.

_____. 1979. The changing seasons; the autumn migration: August 1-November 30, 1978; Florida Region. Am. Birds 33: 169-171.

Edwards, E.P. 1972. A field guide to the birds of Mexico. E.P. Edwards, Sweet Briar, VA. vi and 300 pp.

Eichhorn, K. (comp.). 1975. Merritt Island N.W. Refuge, Fla. The 75th Audubon Christmas Bird Count. Am. Birds 29: 342-343.

_____. 1976. Merritt Island Nat'l. Wildlife Refuge, Fla. The 76th Audubon Christmas Bird Count. Am. Birds 30: 354.

Elliott, B.G. 1976. Blue-footed Booby in northern California. West. Birds 7: 155-157.

Elliott, C.C.H. 1971. Ecological considerations and the possible significance of weight variations in the chicks of the Great Shearwater on Gough Island. Ostrich Suppl. 8: 385-396.

Elliott, H.F.I. 1957. A contribution to the ornithology of the Tristan da Cunha group. Ibis 99: 544-586.

Ellison, L.N. and L. Cleary. 1978. Effects of human disturbance on breeding of Double-crested Cormorants. Auk 95: 510-517.

Ely, C.A. and R.B. Clapp. 1973. The natural history of Laysan Island, northwestern Hawaiian Islands. Atoll Res. Bull. 171. 361 pp.

Enders, F. 1972. Early records for pelagic birds off the North Carolina coast. Chat 36: 30-31.

Erskine, A.J. 1972. The Great Cormorant of eastern Canada. Can. Wildl. Serv. Occas. Pap. 14. 23 pp.

Erwin, R.M. 1979. Coastal waterbird colonies: Cape Elizabeth, Maine to Virginia. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-79/10. 212 pp.

Erwin, R.M. and C.E. Korschgren. 1979. Coastal waterbird colonies: Maine to Virginia, 1977: An atlas showing colony locations and species compositions. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-79-08. 647 pp.

Evans, R.M. 1969. Specific gravity of White Pelican eggs. Auk 86: 560-561.

_____. 1972. Some effects of water level on the reproductive success of the White Pelican at East Shoal Lake, Manitoba. Can. Field Nat. 86: 151-153.

Eyles, D. 1938a. White Pelican at mouth of the Savannah River. Oriole 3: 29-33.

_____. 1938b. Wilson's Petrel in Georgia. Oriole 3: 35-36.

Eyster, M.B. 1978. Least Grebe in Louisiana. La. Ornithol. Soc. News 81: 3.

Faaborg, J. 1976. Habitat selection and territorial behavior of the small grebes of North Dakota. Wilson Bull. 88: 390-399.

Falla, R.A. 1954. Distribution and breeding habits of petrels in northern New Zealand. Rec. Auckl. Inst. Mus. 1: 245.

FAO (Food and Agricultural Organization of the United Nations). 1977. IMCO/FAO/UNESCO/WMO/WHO/LAEA/UN Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), Impact of oil on the marine environment. Rept. Stud. GESAMP 6. 250 pp.

Fatora, J.R. and E.K. Fatora. 1967. Observations on the diving abilities of some common species of diving birds. Chat 31: 31-36.

Feare, C.J. 1978. The decline of the booby (Sulidae) populations in the western Indian Ocean. Biol. Conserv. 14: 295-305.

Fernandez, O. 1979. Observations sur le Puffin cendre Calonectris diomedea nicheur sur les Iles Marseillaises. [Observations of Cory's Shearwater Calonectris diomedea - breeding bird of the islands of Marseilles.] Alauda 47: 65-72. [In French with German and English summaries.]

ffrench, R. 1973. A guide to the birds of Trinidad and Tobago. Livingston Publ. Co., Wynnewood, PA. xix and 470 pp.

Finch, D.W. 1973. The changing seasons; the nesting season: June 1-July 31, 1973; Northeastern Maritime Region. Am. Birds 27: 1020-1025.

Finley, W.L. 1907. Among the pelicans. Condor 9: 34-41.

Fisher, J. 1952a. The fulmar. Collins, London, England. xv + 496 pp.

_____. 1966. The fulmar population of Britain and Ireland, 1959. Bird Study 13: 5-76.

Fjeldsa, J. 1973b. Distribution and geographical variation of the Horned Grebe Podiceps auritus (Linnaeus, 1758). Ornis Scand. 4: 55-86.

_____. 1973c. Feeding and habitat selection of the Horned Grebe, Podiceps auritus (Aves) in the breeding season. Vidensk Medd. Dan. Naturhist. Foren. 136: 57-95.

_____. 1973d. Territory and the regulation of population density and recruitment in the Horned Grebe (Podiceps auritus auritus Boje 1922). Vidensk. Medd. Dan. Naturhist. Foren. 136: 117-189.

Flahaut, M.R. 1947. Red-billed Tropic-bird taken at Westport, Washington. Murrelet 28: 6.

Fletcher, O.K. 1946. Sight record of a White Pelican at Cordele. Oriole 11: 44.

Forbes, H.O. 1914. Notes on Molina's Pelican (Pelecanus thagus). Ibis 2: 403-420.

Fogarty, M.J., S.A. Nesbitt and C.R. Gilbert. In press. Diet of nestling Brown Pelicans in Florida. 6 pp. (typescript).

Friley, C.E., Jr. and G.O. Hendrickson. 1937. Eared Grebes nesting in northwest Iowa. Iowa Bird Life 7: 2-3.

Forsythe, D.M. 1980. Cory's Shearwaters off the South Carolina coast. Wilson Bull. 92: 265-266.

Fugle, G.N. and S.I. Rothstein. 1977. Clutch size determination, egg size and egg-shell thickness in the Pied-billed Grebe. Auk 94: 371-373.

Fussell, J. 1974. Specimen of Harcourt's Storm-petrel found in North Carolina. Chat 38: 23.

_____. (comp.). 1978. Christmas Bird Count--1977. Compiler's comments: Morehead City, N.C. Chat 42: 49.

Gade, S. and M. Mattis. 1979. The Audubon Christmas Bird Count 1979-1980. Fort Morgan, Alabama. Am. Birds 33: 505-506.

Gaillard, M.W. (comp.). 1971. Dauphin Island, Ala. The 71st Audubon Christmas Bird Count. Am. Birds 25: 330-331.

Gandy, D.E. and W.H. Turcotte. 1970. Catalog of Mississippi bird records. Vol. I. Mississippi Game & Fish Commiss. xix and 105 pp.

Garrido, O.H. and F.G. Montana. 1967. Nuevo Oceanodroma (Aves: Hydrobatidae) para Las Antillas. Mus. Felipe Poey Acad. Cienc. Cuba Trab. Divulg. 48. 4 pp. [In Spanish.]

Gates, L. and J.R. Moore. 1978. A Red-necked Grebe in Hattiesburg, Mississippi. Mississippi Kite 8: 40.

Gault, B.T. 1902. [Letter from Cayene, French Guiana]. Wilson Bull. (N.S.) 9: 140-143.

Gibson, R. 1966. Oil pollution and its effect on birds in southeast Kent. Seabird Bull. 2: 67-69.

Gibson-Hill, C.A. 1947. The normal food of tropic-birds (Phaethon spp.). Ibis 89: 658-661.

Gill, F.B., C. Jouanin and R.W. Storer. 1970. Notes on the seabirds of Round Island, Mauritius. Auk 87: 514-521.

Gillham, M.E. 1963. Breeding habitats of the White-faced Storm Petrel (Pelagodroma marina) in eastern Bass Strait. Pap. Proc. R. Soc. Tasmania 97: 33-41.

Glover, F.A. 1953. Nesting ecology of the Pied-billed Grebe in northwestern Iowa. Wilson Bull. 65: 32-39.

Godfrey, W.E. 1966. The birds of Canada. Publ. Natl. Mus. Can., Bull. No. 203, Biol. Ser. No. 73. 428 pp.

Goldman, L.C. and F. Watson. 1952. The changing seasons; the fall migration: August 16-November 30, 1951; South Texas Region. Aud. Field Notes 6: 26-29.

_____. 1953. The changing seasons; the nesting season: June 1-August 15, 1953; South Texas Region. Aud. Field Notes 7: 316-320.

Goodman, J. and P. Klose. 1978. Environmental planning for offshore oil and gas. Vol. V: Regional status reports, Part 2: mid and south Atlantic. The Conservation Foundation, Washington, DC. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-77/162. 93 pp.

Goodwin, C.E. and R.C. Rosche. 1974. The changing seasons; the nesting season: June 1-July 31, 1974; Ontario--Western New York Region. Am. Birds 28: 896-900.

Gorski, W., B. Jakuczun, C. Nitecki and A. Petryna. 1977. Badania smiertelnosci ptakow wodnych z powodu zanieczyszczen ropopochodnych na polskim wybrzezu Baltyku w sezonie 1974/1975. [The investigation of the oil pollution on the Polish Baltic coast in 1974/1975.] Przeglad Zool. 12: 20-23. [In Polish.]

GOS (Georgia Ornithological Society). Checklist committee. 1977. Species recently accepted in the official list of Georgia birds. Oriole 42: 1-4.

Gould, P.J. and W.B. King. 1967. Records of four species of Pterodroma from the central Pacific Ocean. Auk 84: 591-594.

Grant, G.S. 1970. Decline of the Double-crested Cormorant as a breeding bird in North Carolina. Chat 34: 34-36.

Grant, G.S. and S.S. Grant. 1975. Great Cormorant photographed at Pea Island National Wildlife Refuge, N.C. Chat 39: 39-40.

Grant, R.H. 1963. Bridled Terns off the North Carolina coast. Chat 27: 21-22.

Green, D. 1961. Manx Shearwater found on beach at Juno. Fla. Nat. 34: 9.

Greene, E.R. 1930. White Pelican (Pelecanus erythrorynchus) in Georgia. Auk 47: 415-416.

Greene, E.R., W.W. Griffen, E.P. Odum, H.C. Stoddard and I.R. Tomkins. 1945. Birds of Georgia. Univ. Georgia Press, Athens, GA. 111 pp.

Greenwood, J.J.D. and J.P.F. Keddie. 1968. Birds killed by oil in the Tay Estuary, March and April 1968. Scott. Birds 5: 189-196.

Greenwood, J.J.D., R.J. Donally, C.J. Feare, N.J. Gordon and G. Waterston. 1971. A massive wreck of oiled birds: northeast Britain, winter 1970. Scott. Birds 6: 235-250.

Grey, J. 1940. Unusual records in 1939. Chat 4: 1-5.

Grey, J.H., Jr. and L. Mackenzie. 1944. Pea Island [Man-O'-War bird.] Chat 8: 63.

Griffin, W.W. 1940. Sight record of a Yellow-billed Tropic Bird at Atlanta. Oriole 5: 32.

Griffith, S.J. and H.W. Kale, II. 1961. Wilson's Petrel off Sapelo Island, Georgia. Oriole 26: 58.

Grinnell, J., J. Dixon and J.M. Linsdale. 1930. Vertebrate natural history of the section of northern California through the Lassen Peak region. Univ. Calif. Publ. Zool. No. 35. v and 594 pp.

Griscom, L. 1943. Notes on the Pacific Loon. Bull. Mass. Aud. Soc. 27: 106-109.

Gross, A.O. 1912. Observations on the Yellow-billed Tropic-bird (Phaethon americana Grant) at the Bermuda Islands. Auk 29: 49-71.

_____. 1935. The life history cycle of Leach's Petrel (Oceanodroma leucorhoa leucorhoa) on the outer sea islands of the Bay of Fundy. Auk 52: 382-399.

_____. 1947. Recoveries of banded Leach's Petrels. Bird-Banding 18: 117-126.

_____. 1949. The Antillean Grebe at central Soledad, Cuba. Auk 66: 42-52.

Gunter, G. 1958. Feeding behavior of Brown and White pelicans on the Gulf Coast of the United States. Proc. La. Acad. Sci. 21: 34-39.

_____. 1972. Brown Pelicans reported again. Mississippi Ornithol. Soc. Newsl. 17: 4.

Gutsell, J.S. 1931. Sooty Shearwater and Audubon's Shearwater in North Carolina. Auk 48: 105-106.

Hagen, Y. 1952. Norwegian Scientific Expeditions to Tristan da Cunha, 1937-38. Results No. 20. 248 pp.

Hailman, J.P. 1962. Frigate-bird off Gull Island, Dare County, North Carolina. Chat 26: 96.

Hainard, R. 1959. Les canards savent eviter l'huile. Nos Oiseaux 25: 62. [In French.]

Hall, E.R. 1925a. Pelicans versus fishes in Pyramid Lake. Condor 27: 147-160.

Hamilton, R.B. 1969. Summary of Christmas Bird Counts on Sapelo Island, 1958-68. Oriole 34: 33-34.

_____. 1971. The changing seasons; the winter season: December 1, 1970-March 31, 1971; Central Southern Region. Am. Birds 25: 588-593.

_____. 1975. The changing seasons; the winter season: December 1, 1974-March 31, 1975; Central Southern Region. Am. Birds 29: 700-705.

_____. 1976. The changing seasons; the winter season: December 1, 1975-March 31, 1976; Central Southern Region. Am. Birds 30: 728-732.

_____. 1977. The changing seasons; the winter season: December 1, 1976-February 28, 1977; Central Southern Region. Am. Birds 31: 339-343.

_____. 1978. The changing seasons; the winter season: December 1, 1977-February 28, 1978; Central Southern Region. Am. Birds 32: 361-365.

_____. 1979. The changing seasons; the winter season: December 1, 1978-February 28, 1979; Central Southern Region. Am. Birds 33: 287-290.

Hampton, G.C. 1969. Brown Booby, Sula leucogaster, at Fort Lauderdale. Fla. Nat. 42: 171.

Hancock, C.G. and P.J. Bacon. 1970. Diving times of Red-necked Grebe. Brit. Birds 63: 299-300.

Hardy, A.V. 1974. The climate of North Carolina. Pp. 281-299 in National Oceanic and Atmospheric Administration, U.S. Dept. Commerce. Climates of the states. Vol. I--eastern states. Water Information Center, Inc., Port Washington, NY. 486 pp.

Harrington, B.A., R.W. Schreiber and G.E. Woolfenden. 1972. The distribution of male and female Magnificent Frigatebirds, Fregata magnificans, along the gulf coast of Florida. Am. Birds 26: 927-931.

Harrington-Tweit, B. 1979. A seabird die-off on the Washington coast in mid-winter 1976. West. Birds 10: 49-56.

Harris, M.P. 1966b. Breeding biology of the Manx Shearwater Puffinus puffinus. Ibis 108: 17-33.

_____. 1969a. Factors influencing the breeding cycle of the Red-billed Tropicbird in the Galapagos Islands. Ardea 57: 149-157.

_____. 1969b. Food as a factor controlling the breeding on Puffinus lherminieri. Ibis 111: 139-156.

_____. 1975. Unusual feeding by Blue-footed Booby. Auk 92: 601-602.

_____. 1979. Survival and ages of first breeding of Galapagos seabirds. Bird-Banding 50: 56-61.

Harris, M.P. and T. de Vries. 1968. White-faced Storm Petrels (Pelagodroma marina) near the Galapagos Islands. Ardea 56: 193.

Harris, S.W. 1974. Status, chronology and ecology of nesting storm-petrels in north-western California. Condor 76: 249-261.

Harrison, J. (comp.). 1977. Charleston, S.C. The 77th Audubon Christmas Bird Count. Am. Birds 31: 585.

Harte, J. 1959. Tropic-bird, a sight record and a capture. Chat 23: 34.

Hartman, F.A. 1955. Heart weights in birds. Condor 57: 221-238.

_____. 1961. Locomotor mechanisms of birds. Smithsonian Misc. Coll. No. 143. 91 pp.

Hartung, R. and G.S. Hunt. 1966. Toxicity of some oils to waterfowl. J. Wildl. Manage. 30: 564-570.

Haverschmidt, F. 1964. Wilson's Petrel (Oceanites oceanicus) near the coast of Surinam. Ardea 52: 118.

Hay, K.G. 1979. Petroleum industry's role in marine bird conservation. Pp. 251-258 in J.C. Bartonek and D.N. Nettleship (eds.). Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

Hayward, T. (comp.). 1971. Mobile, Ala. The 71st Audubon Christmas Bird Count. Am. Birds 25: 331-332.

Hebard, F.W. 1948. European Cormorants seen at Fernandina. Fla. Nat. 28: 59.

Heintzelman, D.S. and C.J. Newberry. 1964. Some waterfowl diving times. Wilson Bull. 76: 291.

Herbert, N.G. and R.W. Schreiber. 1975. Diurnal activity of Brown Pelicans at a marina. Fla. Field Nat. 3: 11-12.

Herman, S.G., R.L. Garrett and R.L. Rudd. 1969. Pesticides and the Western Grebe. Pp. 24-53 in M.W. Miller and G.C. Berg (eds.). Chemical fallout/ current research on persistent pesticides. Charles C. Thomas, Springfield, IL. 531 pp.

Hetrick, W. and G. McCaskie. 1965. Unusual behavior of a White-tailed Tropicbird in California. Condor 67: 186-187.

Holm, S.F., H.D. Irby and J.M. Inglis. 1978. First nesting record of Double-crested Cormorant in Texas since 1939. Bull. Texas Ornithol. Soc. 11: 50-51.

Holman, J.P. 1952. West Indian Black-capped Petrel, Pterodroma hasitata, picked up on Fairfield beach, Connecticut. Auk 69: 459-460.

Holmes, R.P. 1965a. Sooty Shearwater at Bogue Banks, North Carolina. Chat 29: 85.

_____. 1966. Atlantic Blue-faced Booby off Bogue Banks, North Carolina. Chat 30: 107.

Holmes, W.N. and J. Cronshaw. 1977. Biological effects of petroleum on marine birds. Pp. 359-398 in D.C. Malins (ed.) Effects of petroleum on arctic and subarctic marine environments and organisms. Academic Press, New York, NY. 500 pp.

Hope-Jones, P. 1980. Seabirds at sea recording project. Brit. Trust for Ornithol. News 108: 5.

Hope-Jones, P., J.-Y. Monnat, C.J. Cadbury and T.J. Stowe. 1978. Birds oiled during the AMOCO CADIZ incident--an interim report. Mar. Pollut. Bull. 9: 307-310.

Hopkins, L. and G.E. Woolfenden. 1977. Fourth record of the Arctic Loon from Florida. Fla. Field Nat. 5: 12.

Hosford, H. 1965. Breeding success of the White Pelican in two colonies in Manitoba. Blue Jay 23: 21-24.

Houston, C.S. 1967. Saskatchewan bird banders: Judge J.A.M. Patrick (1873-1943). Blue Jay 25: 172-174.

_____. 1968. Saskatchewan bird banders: William I. Lyon and H.E. McArthur. Blue Jay 26: 185-194.

_____. 1970. Saskatchewan bird banders: Fred G. Bard. Blue Jay 28: 150-156.

_____. 1971. Recent Saskatchewan banding of the Double-crested Cormorant. Blue Jay 29: 74-79.

_____. 1972. Recent Saskatchewan banding of the White Pelican. Blue Jay 30: 24-27.

Howe, B., Jr. 1947. The White Pelican at Tybee Island, Georgia. Oriole 12: 11.

Howe, M.A., R.B. Clapp and J.S. Weske. 1978. Marine and coastal birds. Mar. Ecosyst. Anal. New York Bight Atlas Monogr. 31. New York Sea Grant Institute, Albany, NY. 87 pp.

Howell, A.H. 1928. Birds of Alabama. Ala. Dept. Game & Fish., Montgomery, AL. 383 pp.

_____. 1932. Florida bird life. Fla. Dept. Game & Freshwater Fish. 597 pp.

Hoxie, W.J. 1911. The Greater Shearwater on the coast of Georgia. Auk 28: 481-482.

Huber, H.R. 1975. Red-footed Booby, another Farallon "first." Point Reyes Bird Observ. Newsl. 36: 5.

Huber, L.N. 1971. Notes on the migration of the Wilson's Storm Petrel Oceanites oceanicus near Eniwetok Atoll, western Pacific Ocean. Notornis 18: 38-42.

Hudson, R.D. 1963. Cory's Shearwater at Ormond Beach. Fla. Nat. 36: 27.

Huey, L.M. 1959. The second occurrence of a Brown Booby near Parker Dam on the Colorado River. Condor 61: 223.

Hundertmark, C.A. 1974. First record of Olivaceous Cormorants nesting in New Mexico. Wilson Bull. 86: 65.

Hundley, M.H. and F. Hames. 1960-62. Birdlife of the Lower Florida Keys. Fla. Nat. 33: 14-24, 56, 91-94, 149-155, 209-214; 34: 25-34, 74-80, 128-135, 164, 203-207; 35: 17-19, 30, 55-56, 78-81, 123-128.

Huntington, C.E. 1963. Population dynamics of Leach's Petrel. Proc. XIII Internatl. Ornithol. Congr., Ithaca 1962 Vol. 2: 701-705.

Huntington, C.E. and E.H. Burtt. 1972. Breeding age and longevity in Leach's Petrel (Oceanodroma leucorhoa). (Abstract) Proc. XV Internatl. Ornithol. Congr., The Hague, 30 August-5 September 1970: 653.

ICBP (International Council for Bird Protection, British Section). 1960. Pp. 16-21 in Annual Report for 1960. London, England.

Imhof, T.A. 1962a. The changing seasons; the fall migration: August 16-November 30, 1961; Central Southern Region. Aud. Field Notes 16: 473-475.

_____. 1962b. Alabama birds. Univ. Ala. Press, University, AL. xxx and 591 pp.

_____. 1963. The changing seasons; the spring migration: April 1-May 31, 1963; Central Southern Region. Aud. Field Notes 17: 409-412.

Imhof, T.A. 1966. The changing seasons; the spring migration: April 1-May 31, 1966; Central Southern Region. Aud. Field Notes 20: 515-519.

_____. 1967. The changing seasons; the spring migration: April 1-May 31, 1967; Central Southern Region. Aud. Field Notes 21: 514-517.

_____. 1968. The changing seasons; the spring migration: April 1-May 31, 1968; Central Southern Region. Aud. Field Notes 22: 533-544.

_____. 1969. The changing seasons; the spring migration: April 1-May 31, 1969; Central Southern Region. Aud. Field Notes 23: 597-601.

_____. 1970. The changing seasons; the spring migration: April 1-May 31, 1970; Central Southern Region. Am. Birds 24: 615-619.

_____. 1971a. The changing seasons; the spring migration: April 1-May 31, 1971; Central Southern Region. Am. Birds 25: 753-758.

_____. 1971b. The season, spring 1971. Ala. Birdlife 19: 1-6.

_____. 1972. The changing seasons; the spring migration: April 1-May 31, 1972; Central Southern Region. Am. Birds 26: 769-774.

_____. 1973. The changing seasons; the spring migration: April 1-May 31, 1973; Central Southern Region. Am. Birds 27: 782-785.

_____. 1974. The changing seasons; the spring migration: April 1-May 31, 1974; Central Southern Region. Am. Birds 28: 810-814.

_____. 1975a. The changing seasons; the spring migration: April 1-May 31, 1975; Central Southern Region. Am. Birds 29: 862-867.

_____. 1975b. Arctic Loon, new species for Alabama. Ala. Birdlife 23: 16.

_____. 1976a. The changing seasons; the spring migration: April 1-May 31, 1976; Central Southern Region. Am. Birds 30: 851-855.

_____. 1976b. Alabama birds. Second ed. Univ. Alabama Press, University, AL. xv and 445 pp.

_____. 1977a. The changing seasons; the spring migration: March 1-May 31, 1977; Central Southern Region. Am. Birds 31: 1010-1013.

_____. T.A. 1977b. Arctic Loon, a new species for Alabama. Am. Birds 31: 378.

_____. 1978. The changing seasons; the spring migration: March 1-May 31, 1978; Central Southern Region. Am. Birds 32: 1017-1021.

_____. 1979. The changing seasons; the spring migration: March 1-May 31, 1979; Central Southern Region. Am. Birds 33: 779-781.

Imhof, T.A. and J.V. Peavy. 1972. The Great (or European) Cormorant, a new bird species for Alabama. Ala. Birdlife 20: 17-18.

Irvine, J.M., Jr. 1971. Sight record of Western Grebe at Carolina Beach, N.C., with comments on its occurrence in the southeast. Chat 35: 27-29.

Irving, L. 1960. Birds of Anatuvuk Pass, Kobuk, and Old Crow. Bull. U.S. Natl. Mus. No. 217. 409 pp.

Jackson, J.A. and C.D. Cooley (comps.). 1978a. Birds around the state - December 1977 through November 1978. Mississippi Kite 8: 48-64.

_____. 1978b. The changing seasons; the nesting season: June 1-July 31, 1978; Central Southern Region. Am. Birds 32: 1171-1175.

Jackson, J.A. and W.C. Weber (comps.). 1976. Birds around the state. Mississippi Kite 6: 47-54.

Jackson, J.A., B.J. Schardien and C.D. Cooley. 1979 ms. Status review of endangered and threatened species of Gulf Islands National Seashore, Mississippi. 16 pp.

James, D. 1965. The changing seasons; the fall migration: August 16-November 30, 1964; Central Southern Region. Aud. Field Notes 19: 46-48.

_____. 1966. The changing seasons; the fall migration: August 16-November 30, 1965; Central Southern Region. Aud. Field Notes 20: 55-61.

James, F.C. 1960. The changing seasons; the winter season: December 1, 1959-March 31, 1960; Central Southern Region. Aud. Field Notes 14: 314-318.

_____. 1963. The changing seasons; the winter season: December 1, 1962-March 31, 1963; Central Southern Region. Aud. Field. Notes 17: 329-333.

_____. 1967. The changing seasons; the winter season: December 1, 1966-March 31, 1967; Central Southern Region. Aud. Field Notes 21: 426-430.

_____. 1968. The changing seasons; the winter season: December 1, 1967-March 31, 1968; Central Southern Region. Aud. Field Notes 22: 445-448.

_____. 1970. The changing seasons; the winter season: December 1, 1969-March 31, 1970; Central Southern Region. Am. Birds 24: 511-515.

_____. 1972. The changing seasons; the winter season: December 1, 1971-March 31, 1972; Central Southern Region. Am. Birds 26: 614-619.

Jehl, J.R., Jr. 1974. Aerial feeding by a shearwater. Auk 91: 188-189.

Jenni, D.A. 1969. Diving times of the Least Grebe and Masked Duck. Auk 86: 355-356.

Jeter, H.H. 1956. Shreveport, La. The 56th Audubon Christmas Bird Count. Aud. Field Notes 10: 181.

Jewett, S.G. 1935. The Man-O'-War bird off the Oregon coast. Condor 37: 212-213.

Joensen, A.H. 1972a. Oil pollution and seabirds in Denmark 1935-1968. Dan. Rev. Game Biol. 6, No. 8: 1-24.

_____. 1972b. Studies on oil pollution and seabirds in Denmark 1968-1971. Dan. Rev. Game Biol. 6, No. 9: 1-32.

_____. 1973. Danish seabird disasters in 1972. Mar. Pollut. Bull. 4: 117-118.

Joensen, A.H. and E.B. Hansen. 1977. Oil pollution and seabirds in Denmark 1971-1976. Dan. Rev. Game Biol. 10, No. 5. 31 pp.

Johnson, A.S. and H.O. Hillestad. 1974. An ecological survey of the coastal region of Georgia. U.S. Natl. Park Serv., Sci. Monogr. Ser. No. 3. 233 pp.

Johnson, R.A. and H.S. Johnson. 1935. A study of the nesting and family life of the Red-throated Loon. Wilson Bull. 47: 97-103.

Johnson, R.F., Jr. and N.F. Sloan. 1976. The effects of human disturbance on the White Pelican colony at Chase Lake National Wildlife Refuge, North Dakota. Inl. Bird-Banding News 48: 163-170.

_____. 1978. White Pelican production and survival of young at Chase Lake National Wildlife Refuge, North Dakota. Wilson Bull. 90: 346-352.

Jones, H.L. 1965. Seabirds off the North Carolina coast in late April. Chat 29: 86-87.

_____. 1971. Olivaceous Cormorant record for California. Calif. Birds 2: 134.

Jones, W.E. 1975. Manx Shearwater plunge-diving. Brit. Birds 68: 119-120.

Jorgensen, H.I. 1958. Nomina avium europaearum. Ejnar Munksgaard, Copenhagen. xi and 283 pp. [In Danish, German, English, French and Russian.]

Jouanin, C. 1964. Le comportement en juillet des Petits Puffins, Puffinus assimilis baroli (Bonaparte), de l'ile Selvagen Grande. Bol. Mus. Munic. Funchal 18: 142-157. [In French with English summary.]

Jouanin, C. and J.-L. Mougin. 1979. Order Procellariiformes. Pp. 48-121 in E. Mayr and G.W. Cottrell (eds.). Checklist of birds of the world. Vol. I. Second ed. Mus. Compar. Zool., Cambridge, MA. xvii and 547 pp.

Jouanin, C., F. Roux and A. Zino. 1977. Sur les premiers resultats du baguage des Puffins cendres aux Iles Selvagens. Oiseau Rev. Fr. Ornithol. 47: 351-358. [In French with English summary.]

Junor, F.J.R. 1969. Aspects of the biology of piscivorous birds of Lake Kyle, Rhodesia. M.Sc. thesis, Rhodes Univ./Georgetown, South Africa.

Kale, H.W., II. 1962. Greater Shearwaters washed ashore on Sapelo Island, Georgia. Oriole 27: 53-54.

Kale, H.W., II. 1970. The changing seasons; the spring migration: April 1-May 31, 1970; Florida Region. Aud. Field Notes 24: 591-595.

_____. 1971. The changing seasons; the spring migration: April 1-May 31, 1971; Florida Region. Am. Birds 25: 723-735.

_____. 1972. The changing seasons; the spring migration: April 1-May 31, 1972; Florida Region. Am. Birds 26: 751-754.

_____. 1973. The changing seasons; the spring migration: April 1-May 31, 1973; Florida Region. Am. Birds 27: 761-765.

_____. 1974. The changing seasons; the spring migration: April 1-May 31, 1974; Florida Region. Am. Birds 28: 790-794.

_____. 1975. The changing seasons; the spring migration: April 1-May 31, 1975; Florida Region. Am. Birds 29: 839-843.

_____. 1976. The changing seasons; the spring migration: April 1-May 31, 1976; Florida Region. Am. Birds 30: 828-832.

_____. 1977. The changing seasons; the spring migration: March 1-May 31, 1977; Florida Region. Am. Birds 31: 988-992.

_____. 1978. The changing seasons; the spring migration: March 1-May 31, 1978; Florida Region. Am. Birds 32: 993-997.

_____. 1979. The changing seasons; the spring migration: March 1-May 31, 1979; Florida Region. Am. Birds 33: 762-765.

_____. 1979 ms a. Data on selected groups of birds on the Atlantic coast of Florida. Rept. to Shell Oil Corp., Environmental Affairs, and Florida Audubon Society. 50 [and 25] pp.

_____. 1979 ms b. Data on selected groups of birds on the gulf coast of Florida. Rept. to Shell Oil Corp., Environmental Affairs, and Florida Audubon Society. 50 pp.

Kale, H.W., II and P.A. Hyypio. 1966. Additions to the birds of Sapelo Island and vicinity. Oriole 31: 1-11.

Kazama, T. 1968. On the mass destruction of Rissa tridactyla and Calonectris leucomelas and their migration at Kashiwazaki, Niigata Prefecture. Tori 18: 260-266.

Keith, D.B. 1937. The Red-throated Diver in North East Land. Brit. Birds 31: 66-81.

Keith, J.O. 1978. Synergistic effects of DDE and food stress on reproduction in Brown Pelicans and Ringdoves. Ph.D. thesis, Ohio St. Univ., Columbus, OH. xii and 172 pp.

Kennard, J.H. 1975. Longevity records of North American birds. Bird-Banding 46: 55-73.

Kennedy, R.S. 1973. The changing seasons; the nesting season: June 1-July 31, 1973; Central Southern Region. Am. Birds 27: 878-882.

_____. 1974. The changing seasons; the nesting season: June 1-July 31, 1973; Central Southern Region. Am. Birds 28: 911-915.

Kepler, C.B. 1969. Breeding biology of the Blue-faced Booby Sula dactylatra personata on Green Island, Kure Atoll. Publ. Nuttall Ornithol. Club 8. 97 pp.

Kepler, C.B., J. Jeffrey and J.M. Scott. 1979. Possible breeding colonies of Manx Shearwaters on the island of Hawaii. Elepaio 39: 115-116.

King, B. 1971. Group feeding by Slavonian Grebes. Brit. Birds 64: 372.

_____. 1974a. "Foot-paddling" behavior of Pied-billed Grebes. Brit. Birds 67: 439.

_____. 1974b. Aerial plunge-diving by Shags and Manx Shearwaters. Brit. Birds 67: 77.

_____. 1976. Winter feeding behavior of Great Northern Divers. Brit. Birds 69: 497-498.

King, J., Jr. (comp.). 1978. Dade County, Fla. The 78th Audubon Christmas Bird Count. Am. Birds 32: 610-611.

King, J.G. and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. Pp. 227-239 in J.C. Bartonek and D.N. Nettleship (eds.). Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

King, K.A., D.R. Blankenship, R.T. Paul and R.C.A. Rice. 1977a. Ticks as a factor in the 1975 nesting failure of Texas Brown Pelicans. Wislon Bull. 89: 157-158.

King, K.A., E.L. Flickinger and H.H. Hildebrand. 1977b. The decline of Brown Pelicans on the Louisiana and Texas Gulf Coast. Southwest. Nat. 21: 417-431.

King, K.A., J.O. Keith and C.A. Mitchells. 1977c. Ticks as a factor in nest desertion of California Brown Pelicans. Condor 79: 507-509.

King, W.B. (ed.). 1967. Seabirds of the tropical Pacific Ocean. Preliminary Smithsonian identification manual. U.S. Natl. Mus., Smithsonian Instit., Washington, DC. xxxii and 126 pp.

King, W.B. and P.J. Gould. 1967. The status of Newell's race of the Manx Shearwater. Living Bird 6: 163-186.

Kingery, H.E. 1976. The changing seasons; the nesting season: June 1-July 31, 1976; Mountain West Region. Am. Birds 30: 982-985.

Kinnear, P.K. 1978. Diving times of Great Northern Diver on the sea. Brit. Birds 71: 126-127.

Kirkpatrick, C.M. 1948. Gannet in eastern Indiana. Wilson Bull. 60: 240.

Kittleson, B.C. 1976. Third record of the Arctic Loon from Florida. Fla. Field Nat. 4: 17.

Knopf, F.L. 1975b. Spatial and temporal aspects of colonial nesting of the White Pelican, Pelecanus erythrorhynchos. Ph.D. thesis, Utah St. Univ., Logan, UT. 77 pp.

_____. 1979. Spatial and temporal aspects of colonial nesting of White Pelicans. Condor 81: 353-363.

Kolstoe, S.O. 1966. The White Pelican. N. Dak. Outdoors 29: 16-20.

Korschgren, C.E. 1979. Coastal waterbird colonies. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-79-09. 83 pp.

Kramer, E.Y. and Q. Kramer. 1945. Long-tailed Jaeger and other birds at Island Beach, New Jersey. Auk 62: 635.

Kuerzi, R.G. 1938. Some notes on the birds of St. Lucie County, Florida. Fla. Nat. 12: 11-15.

Kury, C.R. 1968. Difference in weight of male and female cormorants. Auk 85: 513.

_____. 1969. Pesticide residues in a marine population of Double-crested Cormorants. J. Wildl. Manage. 33: 91-95.

Kury, C.R. and J.M. Cadbury. 1970. The winter distribution of Maine's Double-crested Cormorants. Auk 87: 815.

Kury, C.R. and M. Gochfeld. 1975. Human interference and gull predation in cormorant colonies. Biol. Conserv. 8: 23-34.

Kushlan, J.A. 1978. White Pelican numbers in Everglades National Park. Fla. Field Nat. 6: 16-17.

Kyle, J.L. 1941. The 1941 Florida Audubon Society expedition to the Dry Tortugas (second group). Fla. Nat. 15: 16-17.

Lacan, F. 1971. Observations ecologiques sur le Petrel de Wilson (Oceanites oceanicus) en Terre Adele. Oiseau Rev. Fr. Ornithol. 41: 65-89. [In French with English summary.]

Ladhams, D.E. 1968. Diving times of grebes. Brit. Birds 61: 27-30.

Lamb, S.H. 1944. Some unusual bird records for Mattamuskeet National Wildlife Refuge, Hyde Co., N.C. Chat 8: 35-36.

Landers, H. 1974. The climate of South Carolina. Pp. 353-369 in National Oceanic and Atmospheric Administration, U.S. Dept. Commerce. Climates of the states. Vol. I--eastern states. Water Information Center, Inc., Port Washington, NY. 486 pp.

Langridge, H.P. 1959. Cory's Shearwater at Palm Beach, Florida. Auk 76: 241.

_____. 1960. Arctic Loon at Palm Beach. Auk 77: 351.

_____. (comp.). 1978. West Palm Beach, Fla. The 78th Audubon Christmas Bird Count. Am. Birds 32: 627-628.

Larrison, E.J. 1945. Blue-footed Booby in the Pacific Northwest. Murrelet 26: 45.

Lawrence, G.E. 1950. The diving and feeding activity of the Western Grebe on the breeding grounds. Condor 52: 3-16.

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.

Lawson, C.S. 1973. Notes on Pelecaniformes in Nevada. West. Birds 4: 23-30.

Leck, C.F. 1971. Cooperative feeding in Leucophoyx thula and Podilymbus podiceps (Aves). Am. Midl. Nat. 86: 241-242.

Lee, D.S. 1979. Second record of the South Trinidad Petrel (Pterodroma arminjoniana) for North America. Am. Birds 33: 138-139.

Lee, D.S. and J. Booth. 1979. Seasonal distribution of offshore and pelagic birds in North Carolina waters. Am. Birds 33: 715-721.

Lee, D.S. and R.A. Rowlett. 1979. Additions to the seabird fauna of North Carolina. Chat 43: 1-9.

LeGrand, H.E., Jr. 1975. Spring record of Eared Grebe in northwestern South Carolina. Chat 39: 90-91.

_____. 1976. The changing seasons; the nesting season: June 1-July 31, 1976; Southern Atlantic Coast Region. Am. Birds 30: 942-945.

_____. 1977a. The changing seasons; the winter season: December 1, 1976-February 28, 1977; Southern Atlantic Coast Region. Am. Birds 31: 319-322.

_____. 1977b. The changing seasons; the nesting season: June 1-July 31, 1977; Southern Atlantic Coast Region. Am. Birds 31: 1124-1128.

_____. 1977c. Briefs for the files. Chat 41: 14-16, 74-77.

_____. 1978. The changing seasons; the winter season: December 1, 1977-February 28, 1978; Southern Atlantic Coast Region. Am. Birds 32: 335-338.

LeGrand, H.E., Jr. 1979a. The changing seasons; the autumn migration: August 1-November 30, 1978; Southern Atlantic Coast Region. Am. Birds 33: 165-168.

_____. 1979b. The changing seasons; the winter season: December 1, 1978-February 28, 1979; Southern Atlantic Coast Region. Am. Birds 33: 272-274.

_____. 1979c. The changing seasons; the spring migration: March 1-May 31, 1979; Southern Atlantic Coast Region. Am. Birds 33: 760-762.

_____. 1979d. Briefs for the files. Chat 43: 21-24, 37-43, 70-73, 96-101.

Lesley, S. 1953. White Pelicans at Lake Junaluska, Haywood County, North Carolina. Chat 17: 69-70.

Lesser, F.H. and L.E. Williams, Jr. 1967. Cory's Shearwaters (Puffinus diomedea borealis) off eastern Florida. Auk 84: 278-279.

Levy, E.M. 1980. Oil pollution and seabirds: Atlantic Canada 1976-1977 and some implications for northern environments. Mar. Pollut. Bull. 11: 51-56.

Lewis, D. 1970. Summer birds at a coastal marsh impoundment in North Carolina. Chat 34: 87-92.

Lewis, D.B. and W.B. Tyler. 1978. First record of the Blue-faced Booby from the Pacific coast of the United States. West. Birds 9: 175-176.

Lewis, H.F. 1929. The natural history of the Double-crested Cormorant (Phalacrocorax auritus auritus [Lesson]). Ru-Mi-Lou Books, Ottawa, Canada. 94 pp.

_____. 1937. Results from banding European Cormorants. Bird-Banding 8: 11-15.

_____. 1941. Breeding European Cormorants of North America. Auk 58: 360-363.

Lies, M.F. and W.H. Behle. 1966. Status of the White Pelican in the United States and Canada through 1964. Condor 68: 279-292.

Lincer, J.L., D. Kricit and J.E. Shaw. 1979. People and "pan-handling" pelicans. Fla. Field Nat. 7: 13-18.

Lindvall, M.L. 1976. Breeding biology and pesticide-PCB contamination of Western Grebe at Bear River Migratory Bird Refuge. M.S. thesis, Utah St. Univ., Logan, UT. 96 pp.

Lingle, G.R. and N.F. Sloan. 1980. Food habits of White Pelicans during 1976 and 1977 at Chase Lake National Wildlife Refuge, North Dakota. Wilson Bull. 92: 123-125.

Lloyd, C.S. 1976. Birdkill. Birds 6: 2 pp. (unpaginated).

Lloyd, C., J.A. Bogan, W.R.P. Bourne, P. Dawson and J.L.F. Parslow. 1974. Seabird mortality in the North Irish Sea and Firth of Clyde early in 1974. Mar. Pollut. Bull. 5: 136-140.

Lock, A.R. and R.K. Ross. 1973. The nesting of the Great Cormorant (Phalacrocorax carbo) and the Double-crested Cormorant (Phalacrocoras auritus) in Nova Scotia in 1971. Can. Field Nat. 87: 43-49.

Lockley, R.M. 1952. Notes on the birds of the islands of the Berlengas (Portugal), the Desertas and Baixo (Madeira) and the Salvages. Ibis 94: 144-157.

Loftin, H.G., Jr. 1950. Man-O'-War bird seen at Southport, N.C. Chat 14: 57.

Longley, W.L. and R.G. Jackson. 1980. Managing impacts of petroleum development in brackish marshes. Pp. 157-174 in P.L. Fore and R.D. Petersen (eds.). Proc. Gulf of Mexico coastal ecosystems workshop. U.S. Fish & Wildl. Serv., Albuquerque, NM. FWS/OBS-80/30. 214 pp.

Longstreet, R.J. 1930. Sooty Shearwater at Daytona Beach, Florida. Auk 47: 552.

_____. 1936. The Florida Audubon Society Tortugas expedition of 1935. Part II. Fla. Nat. 9: 22-42.

_____. 1945a. Leach's Petrel in Florida. Auk 62: 148.

_____. 1945b. Second pelican banding report (1936-44), Mosquito Lagoon Rookery (Brevard Reserve). Fla. Nat. 18: 26-35.

_____. 1953-55. Ornithology of the Mosquitos. Fla. Nat. 26: 103-104, 175-183, 186-188; 27: 9-20, 47-50, 63, 74, 82-88, 102-105; 28: 8-15.

_____. 1960. New record of White-tailed Tropic-bird. Fla. Nat. 33: 165.

Love, J.A. 1978. Leach's and Storm Petrels on North Rona: 1971-1974. Ringing and Migration 2: 15-19.

Low, J.B., L. Kay and D.I. Rasmussen. 1950. Recent observations on the White Pelican on Gunnison Island, Great Salt Lake, Utah. Auk 67: 345-356.

Lowery, G.H., Jr. 1950a. The changing seasons; the winter season: December 1, 1949-March 31, 1950; Central Southern Region. Aud. Field Notes 4: 205-207.

_____. 1950b. The changing seasons; the spring migration: April 1-May 31, 1950; Central Southern Region. Aud. Field Notes 4: 245-247.

_____. 1950c. The changing seasons; the spring migration: April 1-May 31, 1950; Central Southern Region. Aud. Field Notes 4: 245-247.

_____. 1974. Louisiana birds. Third ed. Louisiana State Univ. Press, Baton Rouge, LA. xxx and 651 pp.

Lowery, G.H., Jr. and R.J. Newman. 1950a. The changing seasons; the nesting season: June 1-August 15, 1950; Central Southern Region. Aud. Field Notes 4: 279-281.

_____. 1950b. The Mexican Grebe, Colymbus d. brachypterus, at Baton Rouge, Louisiana. Auk 67: 505-506.

_____. 1951a. The changing seasons; the fall migration: August 16-November 30, 1950; Central Southern Region. Aud. Field Notes 5: 22-24.

_____. 1951b. The changing seasons; the spring migration: April 1-May 31, 1951; Central Southern Region. Aud. Field Notes 5: 259-261.

_____. 1953. The changing seasons; the spring migration: April 1-May 31, 1953; Central Southern Region. Aud. Field Notes 7: 276-279.

Lynch, J.M. and C. Marsh. 1977. Early summer seabird migration at Cape Hatteras. Chat 41: 47-48.

Madsen, F.J. 1957. On the food habits of some fish-eating birds in Denmark. Dan. Rev. Game Biol. 32: 19-83.

Madsen, F.J. and R. Sparck. 1950. On the feeding habits of the Southern Cormorant (Phalacrocorax carbo sinensis Shaw) in Denmark. Dan. Rev. Game Biol. 1: 45-75.

Mallett, G.E. and L.J. Coghlan. 1964. Cory's Shearwater Procellaria diomedea breeding in the Azores. Ibis 106: 123-125.

Manigault, P. 1959. Tropic-bird off the South Carolina coast. Chat 23: 62.

Manuwal, D.A. and R.A. Campbell. 1979. Status and distribution of breeding seabirds of southeastern Alaska, British Columbia, and Washington. Pp. 73-91 in J.C. Bartonek and D.N. Nettleship (eds.) Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

Markgraf, V. (comp.). 1974. Jacksonville, Fla. The 74th Aubudon Christmas Bird Count. Am. Birds 28: 312-313.

Markham, B. and S. Brechtel. 1979. Status and management of three colonial waterbird species in Alberta. Pp. 56-64 in W.E. Southern (comp.). Proc. Conf. Colonial Waterbird Group, Am. Mus. Nat. Hist., New York, NY., 20-23 October, 1978. xi and 213 pp.

Marshall, W.H. and A.B. Erickson. 1945. Weights of some Minnesota birds. Flicker 17: 32-36.

Martin, P.W. 1942. Notes on some pelagic birds of the coast of British Columbia. Condor 44: 27-29.

Mason, C.R. 1938. Society conducts fourth Tortugas trip. Fla. Nat. 12: 1-5.

Mason, C.R. 1960. Brown Boobies (Sula leucogaster) off coast at Jacksonville. Fla. Nat. 33: 99.

Masters, C. 1973. Birds of coastal Georgia. Coastal Georgia Audubon Society and Sea Island Co. Unpaginated checklist. 11 pp.

Maynard, C.J. 1881. The birds of eastern North America. C.J. Maynard and Co., Newtonville, Mass. iv and 532 pp.

McAllister, N.M. 1958. Courtship, hostile behavior, nest-establishment, and egg laying in the Eared Grebe (Podiceps caspicus). Auk 75: 290-311.

McCallum, A. 1959. Tropic-bird, a sight record and a capture. Chat 23: 34.

McCrimmon, D.A., Jr. 1973. Leach's Storm Petrel and other pelagic birds seen off North Carolina coast. Chat 37: 47-48.

McCrimmon, D.A., Jr., L. Johnson and J.O. Fussell, III. 1973. Second specimen of Leach's Storm-petrel collected in North Carolina. Chat 37: 47.

McCrow, V.P. 1974a. Reproduction of White Pelicans in South Dakota in 1973. Proc. S. Dak. Acad. Sci. 53: 135-152.

McCulloch, S. 1948. Field notes and news. Wilmington and Southport, N.C. Chat 12: 16-17.

McDaniel, J.W. 1973. Vagrant albatrosses in the western North Atlantic and Gulf of Mexico. Am. Birds 27: 563-565.

McEwan, E.H. and A.F.C. Koelink. 1973. The heat production of oiled mallards and scaup. Can. J. Zool. 51: 27-31.

McIntyre, J.W. 1978a. Wintering behavior of Common Loons. Auk 95: 396-403.

_____. 1978b. The Common Loon: Part III. Population in Itasca State Park Minnesota 1957-1976. Loon 50: 38-44.

McKay, R.R. 1951. Yellow-billed Tropic Bird, Phaethon lepturus catesbyi, on the north Florida coast. Auk 68: 371.

McLeod, J.A. and G.F. Bondar. 1953. A brief study of the Double-crested Cormorant on Lake Winnepegosis. Can. Field Nat. 67: 1-11.

McMurry, F.B. 1948. Brewster's Booby collected in the United States. Auk 65: 309-310.

Mees, G.F. 1976. Mass mortality of Puffinus gravis (O'Reilly) on the coast of Surinam (Aves, Procellariidae). Zool. Meded. R. Mus. Nat. Hist. Leiden 49: 269-271.

Mendall, H.L. 1936b. Home life and status of the Double-crested Cormorant (Phalacrocorax auritus auritus Lesson). Maine Bull. 39. v and 159 pp.

Mendenhall, V.M. and R.M. Prouty. 1979. Recovery of breeding success in a population of Brown Pelicans. Pp. 65-70 in W.E. Southern (comp.). Proc. Conf. Colonial Waterbird Group, Am. Mus. Nat. Hist., New York, NY. 20-23 October 1978. xi and 213 pp.

Miller, G.C. 1978. Two-year-old White Pelicans at colony sites. Pp. 73-77 in W.E. Southern (comp.). Proc. Conf. Colonial Waterbird Group, Dekalb, IL, 20-23 October 1977. viii and 205 pp.

Miller, R.F. 1942 [1943]. The Pied-billed Grebe, a breeding bird of the Philadelphia region. Cassinia 32: 22-34.

Mitchell, R.M. 1975. The current status of the Double-crested Cormorant in Utah: a plea for protection. Am. Birds 29: 927-930.

_____. 1977. Breeding biology of the Double-crested Cormorant on Utah Lake. Great Basin Nat. 37: 1-23.

Moffitt, J. and R.T. Orr. 1938. Recent disastrous effects of oil pollution on birds in the San Francisco Bay region. Calif. Fish Game 24: 239-244.

Moisan, G. and B. Scherrer. 1973. Deplacements saisonniers des Fous de Bassan de l'Ile Bonaventure (Canada) (Sula bassana). [Seasonal displacements of Gannets Sula bassana from Bonaventure Island (Canada).] Terre Vie 27: 414-434. [In French with English summary.]

Monson, G. 1946. Brewster's Booby in Arizona. Auk 63: 96-97.

Montevecchi, W.A., E. Blundon, G. Coombes, J. Porter and P. Rice. 1978. Northern Fulmar breeding range extended to Baccalieu Island, Newfoundland. Can. Field Nat. 92: 80-82.

Moore, S.F., G.R. Chirlin, C.J. Bradley and B.P. Schrader. 1974. Potential biological effects of hypothetical oil discharges in the Atlantic Coast and Gulf of Alaska. Mass. Instit. Technol. Sea Grant Program, Rept. to Council on Environment Quality. Rept. No. MITSG 74-19. v and 120 pp.

Morgan, P.J. 1980. National Museum of Wales CHRISTOS BITAS project. The collection, storage, cleaning and research of oiled auk corpses. National Museum of Wales, Cardiff, Wales. iv and 74 pp.

Morrison, M.L. 1977 ms. Life history and status of the Olivaceous Cormorant. M.S. thesis, Texas A&M Univ., College Station, TX. 84 pp.

Morrison, M.L. and R.D. Slack. 1977a. Population trends and status of the Olivaceous Cormorant. Am. Birds 31: 954-959.

_____. 1977b. The role of flock feeding in Olivaceous Cormorants. Bird-Banding 48: 277-279.

Morrison, M.L., E. Shanley, Jr. and R.D. Slack. 1977. The food of nestling Olivaceous Cormorants. Southwest. Nat. 22: 321-326.

Morrison, M.L., R.D. Slack and E. Shanley, Jr. 1978a. Age and foraging ability relationships of Olivaceous Cormorants. Wilson Bull. 90: 414-422.

Morrison, M.L., E. Shanley, Jr. and R.D. Slack. 1979. Breeding biology and age-specific mortality of Olivaceous Cormorants. Southwest. Nat. 24: 259-266.

Morse, D.H. and C.W. Buchheister. 1979. Nesting patterns of Leach's Storm-petrels on Matinicus Rock, Maine. Bird-Banding 50: 145-158.

Morton, J.W. 1976. Ecological impacts of dredging and dredge spoil dispersal: a literature review. M.S. thesis, Cornell Univ./Ithaca, NY. 112 pp.

Morzer Bruyns, W.F.J. 1967a. Black-capped Petrels (Pterodroma hasitata) in the Atlantic Ocean. Ardea 55: 270.

Mougin, J.L. 1968. Etude ecologigue de quatre des Petrels antarctiques. Oiseau Rev. Fr. Ornithol. 38 (Special No.): 1-52. [In French with English summary.]

Mueller, H.C., M.G. Biben and H.F. Sears. 1972. Feeding interactions between Pied-billed Grebes and herons. Auk 89: 190.

Mulvihill, E.L., C.A. Francisco, J.B. Glad, K.B. Kaster and R.E. Wilson. 1980. Biological impacts of minor shoreline structures on the coastal environment: state of the art review. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-77/51. 2 vol.

Munro, J.A. 1941. Studies of waterfowl in British Columbia. The grebes. Brit. Columbia Prov. Mus. Occas. Pap. 3: 1-71.

_____. 1945. Observations of the loon in the Cariboo Parklands, British Columbia. Auk 62: 38-49.

Murphy, R.C. 1936. Oceanic birds of South America. Vols. I and II. Am. Mus. Nat. Hist., New York, NY. xxiv and 1245 pp.

Murphy, R.C. and L.S. Mowbray. 1951. New light on the Cahow, Pterodroma cahow. Auk. 68: 266-280.

Needham, F.B. (comp.). 1971. Christmas Bird Count--1970. Compiler's comments: Wilmington, N.C. Chat 35: 22.

_____. 1974. Christmas Bird Count--1973. Compiler's comments: Wilmington, N.C. Chat 38: 13.

_____. 1976. Christmas Bird Count--1975. Compiler's comments: Wilmington, N.C. Chat 40: 36.

Nelson, E.W. 1903. Notes on the Mexican Cormorant. Condor 5: 139-145.

Nelson, H.K. 1977. A philosophical approach to Fish and Wildlife Service involvement in oil spill response. Pp. 1-10 in P.L. Fore (ed.). Proc. 1977 Oil Spill Response Workshop. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-77-24. 153 pp.

Nelson, J.B. 1966. Flighting behaviour of Galapagos storm petrels. Ibis 108: 430-432.

_____. 1975. The breeding biology of frigatebirds--a comparative review. Living Bird 14: 113-155.

_____. 1978a. The Sulidae. Gannets and boobies. Oxford Univ. Press., Oxford, England. x and 1012 pp.

_____. 1978b. The gannet. Buteo Books, Vermillion, SD. 336 pp.

Nelson-Smith, A. 1973. Oil pollution and marine ecology. Plenum Press, New York, NY. ix and 260 pp.

NERC (National Environmental Research Council). 1977. The report of a working group in ecological research on seabirds. National Environmental Research Council Publ. Ser. C. No. 18. iv and 48 pp.

Nero, R.W. 1959. Western Grebe colony. Nat. Hist. 68: 291-295.

Nero, R.W., F.W. Lahrman and F.G. Bard. 1958. Dry-land nest-site of a Western Grebe colony. Auk 75: 347-349.

Nesbitt, S.A., M.J. Fogarty and L.E. Williams, Jr. 1977. Status of Florida nesting Brown Pelicans, 1971-1976. Bird-Banding 48: 138-144.

Nesbitt, S.A., L.E. Williams, Jr., L. McNease and T. Joanen. 1978. Brown Pelican restocking effects in Louisiana. Wilson Bull. 90: 443-445.

Nettleship, D.N. 1976. Gannets in North America: present numbers and recent population changes. Wilson Bull. 88: 300-313.

Nettleship, D.N. and R.D. Montgomerie. 1974. The Northern Fulmar, Fulmarus glacialis, breeding in Newfoundland. Am. Birds 28: 16.

Newell, R.G. 1968. Influx of Greater Shearwaters in autumn 1965. Brit. Birds 61: 145-159.

Newman, R.J. 1955. The changing seasons; the fall migration: August 16-November 30, 1954; Central Southern Region. Aud. Field Notes 9: 31-34.

_____. 1956a. The changing seasons; the winter season: December 1, 1955-March 31, 1956; Central Southern Region. Aud. Field Notes 10: 256-260.

_____. 1956b. The changing seasons; the spring migration: April 1-May 31, 1956; Central Southern Region. Aud. Field Notes 10: 338-341.

_____. 1957. The changing seasons; the spring migration: April 1-May 31, 1957; Central Southern Region. Aud. Field Notes 11: 350-357.

_____. 1958. The changing seasons; the nesting season: June 1-August 15, 1958; Central Southern Region. Aud. Field Notes 12: 417-421.

Newman, R.J. 1959. The changing seasons; the fall migration: August 16-November 30, 1958; Central Southern Region. Aud. Field Notes 13: 37-41.

_____. 1960a. The changing seasons; the fall migration: August 16-November 30, 1959; Central Southern Region. Aud. Field Notes 14: 41-47.

_____. 1960b. The changing seasons; the spring migration: April 1-May 31, 1960; Central Southern Region. Aud. Field Notes 14: 392-397.

_____. 1961a. The changing seasons; the fall migration: August 16-November 30, 1960; Central Southern Region. Aud. Field Notes 15: 46-50.

_____. 1961b. The changing seasons; the winter season: December 1, 1960-March 31, 1961; Central Southern Region. Aud. Field Notes 15: 334-337.

Newman, R.J. and S.L. Warter. 1959a. The changing seasons; the winter season: December 1, 1958-March 31, 1959; Central Southern Region. Aud. Field Notes 13: 298-302.

_____. 1959b. The changing seasons; the spring migration: April 1-May 31, 1959; Central Southern Region. Aud. Field Notes 13: 376-380.

Nichols, J.T. 1935. Spring migration of the Gannet in southeast Florida. Auk 52: 300.

Nicholson, D.J. 1955. Record of the Red-footed Booby on the Florida mainland. Fla. Nat. 28: 29.

_____. 1960. Brown Booby seen on the Banana River, Brevard County. Fla. Nat. 33: 165-166.

Noble, G.K. 1916. The resident birds of Guadeloupe. Bull. Mus. Compar. Zool., Harvard Coll. No. 60: 359-396.

Norman, D. and R.D. Purrington. 1970. The demise of the Brown Pelican in Louisiana. La. Ornithol. Soc. News 55: 3-6.

Norton, A.H. 1943. Yellow-billed Tropic-bird in Maine. Auk 60: 284.

Oberholser, H.C. 1938. The bird life of Louisiana. Publ. in cooperation with the Biological Survey, U.S. Dept. Agric., by the U.S. Dept. Conserv. T.J. Moran's Sons, New Orleans, LA. 834 pp.

_____. 1963 ms. The bird life of Texas. Microfilm copy of manuscript in files of the Smithsonian Institution, Washington, DC. 11,754 pp.

_____. 1974. The bird life of Texas. Vol. I. Univ. Texas Press, Austin, TX. 530 pp.

Ogden, J.C. 1969. The changing seasons; the nesting season: June 1-August 1, 1969; Florida Region. Aud. Field Notes 23: 651-655.

_____. 1970. The changing seasons; the nesting season: June 1-August 15, 1970; Florida Region. Aud. Field Notes 24: 673-677.

Ogden, J.C. 1971. The changing seasons; the nesting season: June 1-August 15, 1971; Florida Region. Am. Birds 25: 846-851.

_____. 1972. The changing seasons; the nesting season: June 1-August 15, 1972; Florida Region. Am. Birds 26: 847-852.

_____. 1973. The changing seasons; the nesting season: June 1-July 31, 1973; Florida Region. Am. Birds 27: 859-863.

_____. 1974. The changing seasons; the nesting season: June 1-July 31, 1974; Florida Region. Am. Birds 28: 892-896.

_____. 1975. The changing seasons; the nesting season: June 1-July 31, 1975; Florida Region. Am. Birds 29: 960-963.

_____. 1976. The changing seasons; the nesting season: June 1-July 31, 1976; Florida Region. Am. Birds 30: 945-948.

_____. 1977. The changing seasons; the nesting season: June 1-July 31, 1977; Florida Region. Am. Birds 31: 1128-1130.

_____. 1978. The changing seasons; the nesting season: June 1-July 31, 1978; Florida Region. Am. Birds 32: 1150-1152.

Ohlendorf, H.M., R.W. Risebrough and K. Vermeer. 1978. Exposure of marine birds to environmental pollutants. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. 9: 1-40.

O'Keeffe, C. 1978. Oil pollution and seabirds on Irish coasts. Irish Birds 1: 206-210.

Olrog, C.C. 1975. Vagrancy of neotropical Cormorant, egrets and White Ibis. Bird-Banding 46: 207-212.

Olson, C.S. and L.A. Stimson. 1966. Eared Grebe (Podiceps caspicus) near Miami. Fla. Nat. 39: 57.

Olson, S.T. and W.H. Marshall. 1952. The Common Loon in Minnesota. Univ. Minne. Mus. Nat. Hist. Occas. Pap. No. 5. vi and 77 pp.

Orians, G.H. 1969. Age and hunting success in the Brown Pelican (Pelecanus occidentalis). Anim. Behav. 17: 316-319.

Orr, R.T. 1966. Brown Pelicans. Pac. Discovery 19: 24-29.

Ortego, B. 1978. Blue-faced Boobies at an oil production platform. Auk 95: 762-763.

Owre, O.T. 1967. Adaptations for locomotion and feeding in the Anhinga and the Double-crested Cormorant. AOU Ornithol. Monogr. 6: 1-138.

Palmer, R.S. (ed.). 1962. Handbook of North America birds, Vol. I: Loons through flamingos. Yale Univ. Press, New Haven, CT, and London, England. 567 pp.

Palmer, T.S. 1912. The Man-O'-War bird (Fregata aquila) on the coast of Georgia. Auk 29: 531-532.

_____. 1931. Audubon's Shearwater in the United States. Auk 48: 198-206.

Pantelides, V.S. and H.M. Stevenson. 1969. The changing seasons; the spring migration: April 1-May 31, 1969; Florida Region. Aud. Field Notes 23: 581-583.

Parkes, K.C. 1962. A record of the Greater Shearwater in 1960 at Hatteras. Chat 26: 18.

Parkin, D.T., A.W. Ewing and H.A. Ford. 1970. Group diving in the Blue-footed Booby Sula nebouxii. Ibis 112: 111-112.

Parnell, J.F. 1965a. The changing seasons; the fall migration: August 1-November 30, 1964; Southern Atlantic Coast Region. Aud. Field Notes 19: 25-28.

_____. 1965b. The changing seasons; the winter season: December 1, 1964-March 31, 1965; Southern Atlantic Coast Region. Aud. Field Notes 19: 368-376.

_____. 1965c. The changing seasons; the nesting season: June 1-August 15, 1965; Southern Atlantic Coast Region. Aud. Field Notes 19: 533-534.

_____. 1966a. The changing seasons; the fall migration: August 16-November 30, 1965; Southern Atlantic Coast Region. Aud. Field Notes 20: 27-30.

_____. 1966b. The changing seasons; the spring migration: April 1-May 31, 1966; Southern Atlantic Coast Region. Aud. Field Notes 20: 493-495.

_____. 1966c. The changing seasons; the nesting season: June 1-August 15, 1966; Southern Atlantic Coast Region. Aud. Field Notes 20: 559-561.

_____. 1966d. Briefs for the files. Chat 30: 90-91, 110-111.

_____. 1966e. Eared Grebe in North Carolina. Chat 30: 25-26.

_____. 1967a. The changing seasons; the fall migration: August 16-November 30, 1966; Southern Atlantic Coast Region. Aud. Field Notes 21: 19-22.

_____. 1967b. The changing seasons; the winter season; December 1, 1966-March 31, 1967; Southern Atlantic Coast Region. Aud. Field Notes 21: 404-407.

_____. 1967c. Briefs for the files. Chat 31: 27-28, 50-51, 79-81, 98-99.

_____. 1968a. The changing seasons; the fall migration: August 16-November 30, 1967; Southern Atlantic Coast Region. Aud. Field Notes 22: 22-25.

_____. 1968b. The changing seasons; the winter season: December 1, 1967-March 31, 1968; Southern Atlantic Coast Region. Aud. Field Notes 22: 428-430.

Parnell, J.F. 1968c. The changing seasons; the nesting season: June 1-August 15, 1968; Southern Atlantic Coast Region. Aud. Field Notes 22: 597-599.

_____. 1968d. Briefs for the files. Chat 32: 30-32, 49-51, 79-81, 105-106.

_____. 1969a. The changing seasons; the spring migration: April 1-May 31, 1969; Southern Atlantic Coast Region. Aud. Field Notes 23: 579-581.

_____. 1969b. Briefs for the files. Chat 33: 27-29, 44, 51, 106-107.

_____. 1970. The changing seasons; the fall migration: August 16-November 30, 1969; Southern Atlantic Coast Region. Aud. Field Notes 24: 31-33.

Parnell, J.F. and R.F. Soots, Jr. 1979 ms. Atlas of colonial waterbirds of North Carolina estuaries. Univ. North Carolina Sea Grant Publ. UNC-SG-78. 269 pp.

Parnell, J.F., T.L. Quay and F.L. Roberts. 1962. Two sight records of the Western Grebe in North Carolina. Chat 26: 17-18.

Parnell, J.F., R.F. Soots and J.H. Carter, III. 1974. Eared Grebe collected at Wrightsville Beach, N.C. Chat 38: 21-22.

Parrack, J.D. 1967. The wreck of oiled birds in the north-east early in 1966. Seabird Bull. No. 3: 12-17.

Paulson, D.R. 1969. Commensal feeding in grebes. Auk 86: 759.

Paulson, D.R. and H.M. Stevenson. 1962. The changing seasons; the spring migration: April 1-May 31, 1962; Florida Region. Aud. Field Notes 16: 398-404.

Paynter, R.A., Jr. 1955. The ornithogeography of the Yucatan Peninsula. Bull. Peabody Mus. Nat. Hist. No. 9. 347 pp.

Peake, R.H., Jr. and C.W. Dopson, Jr. 1968. A gathering of Georgia waterbirds and shorebirds. Oriole 33: 18.

Pearse, T. 1946. The nesting of the Red-throated Loon on Vancouver Island, British Columbia. Condor 48: 262-264.

_____. 1950. Parasitic birds. Murrelet 31: 14.

Pearson, T.G., C.S. Brimley and H.H. Brimley. 1919. Birds of North Carolina. North Carolina Geological and Economic Survey. Vol. IV. xxiii and 380 pp.

_____. 1942. Birds of North Carolina. North Carolina Dept. Agric., Raleigh, NC. 416 pp.

Pefaur, J.E. 1974. Egg-neglect in the Wilson's Storm Petrel. Wilson Bull. 86: 16-22.

Peters, J.L. 1924. A second North American record for Puffinus assimilis. Auk 41: 337-338.

Peters, H.S. and T.D. Burleigh. 1951. The birds of Newfoundland. Prov. Newfoundland Dept. Nat. Resourc., St. John's. xix and 431 pp.

Petersen, M.R. 1976. Breeding biology of Arctic and Red-throated loons. M.S. thesis, Univ. Calif., Davis, CA. 55 pp.

Peterson, R.T. 1942. Birds and floating oil. Audubon 44: 217-225.

Phillips, A., J. Marshall and G. Monson. 1964. The birds of Arizona. Univ. Arizona Press, Tucson, AZ. 212 pp.

Phillips, E. and G.D. Carter. 1957. Winter food of Western Grebes. Murrelet 38: 5-6.

Phillips, J. 1974. Oiled seabirds successfully cleaning their plumage. Brit. Birds 67: 483.

Phillips, W.W.A. 1967. Oiled seabirds in Pagham Harbour in January and February 1967. Seabird Bull. No. 3: 17.

Plath, K. 1914. With the tropic-birds in Bermuda. Ibis 10th Ser., Vol. 2: 552-559.

Portnoy, J.W. 1977. Nesting colonies of seabirds and wading birds--coastal Louisiana, Mississippi, and Alabama. U.S. Fish & Wildl. Serv., Biol. Serv. Program. FWS/OBS-77-07. 126 pp.

Post, P.W. 1967. Manx, Audubon's, and Little shearwaters in the northwestern North Atlantic. Bird-Banding 38: 278-305.

Potter, J. and E.F. Potter. 1974. Third sight record of Great Cormorant from North Carolina. Chat 38: 22-23.

Pough, R.H. 1940. Oceanic birds in winter. Chat 4: 49.

Prince, P.A. 1980. The food and feeding ecology of Grey-headed Albatross Diomedea chrysostoma and Black-browed Albatross D. melanophris. Ibis 122: 476-488.

Probst, F.M. 1972. Reclamation of a Sooty Shearwater. Chat 36: 102-103.

_____. (comp.). 1976. Litchfield-Pawley's Island, S.C. The 76th Audubon Christmas Bird Count. Am. Birds 30: 336-337.

_____. 1978. Litchfield-Pawley's Island, S.C. The 78th Audubon Christmas Bird Count. Am. Birds 32: 600.

_____. 1979. Litchfield-Pawley's Island, S.C. The 79th Audubon Christmas Bird Count. Am. Birds 33: 464-465.

Prys-Jones, R.P. and C. Peet. 1980. Breeding periodicity, nesting success, and nest site selection among Red-tailed Tropicbirds Phaethon rubricauda and White-tailed Tropicbirds P. lepturus on Aldabra Atoll. Ibis 122: 76-81.

Purrington, R.D. 1970. The changing seasons; the fall migration: August 16-November 30, 1969; Central Southern Region. Aud. Field Notes 24: 55-61.

_____. 1971. The changing seasons; the fall migration: August 15-November 30, 1970; Central Southern Region. Am. Birds 25: 66-71.

_____. 1972. The changing seasons; the fall migration: August 16-November 30, 1971; Central Southern Region. Am. Birds 26: 73-77.

_____. 1973a. The changing seasons; the winter season: December 1, 1972-March 31, 1973; Central Southern Region. Am. Birds 27: 626-630.

_____. 1973b. The changing seasons; the fall migration: August 16-November 30, 1972; Central Southern Region. Am. Birds 27: 70-75.

_____. 1975. The changing seasons; the fall migration: August 1-November 30, 1974; Central Southern Region. Am. Birds 29: 68-74.

_____. 1976. The changing seasons; the fall migration: August 1-November 30, 1975; Central Southern Region. Am. Birds 30: 82-87.

_____. 1977. The changing seasons; the autumn migration: August 1-November 30, 1976; Central Southern Region. Am. Birds 31: 186-190.

_____. 1978. The changing seasons; the fall migration: August 1-November 30, 1977; Central Southern Region. Am. Birds 32: 215-220.

_____. 1979. The changing seasons; the autumn migration: August 1-November 30, 1978; Central Southern Region. Am. Birds 33: 185-188.

Quay, T.L. and P.H. Davis. 1954. Herring Gulls and Gannets along Hatteras Bank. Chat 18: 53.

Raffaele, H.A. 1979. Status of the genus Phalacrocorax in Puerto Rico including the first records of P. auritus. Auk 96: 204-206.

Randall, R.M., B.M. Randall and J. Bevan. 1980. Oil pollution and penguins--is cleaning justified? Mar. Pollut. Bull. 11: 234-237.

Rankin, H.J. 1952. Audubon's Shearwater off Morehead City, N.C. Chat 16: 24.

Ratti, J.T. 1979. Reproductive separation and isolating mechanisms between sympatric dark- and light-phase Western Grebes. Auk 96: 573-586.

Raynor, G.S. 1976. Brown Boobies on Long Island. Kingbird 26: 23-25.

Rees, E.I.S. 1961. Notes on the food of the Greater Shearwater. Sea Swallow 14: 54-55.

Rees, E.I.S. 1964. The Sooty Shearwater Procellaria grisea on the Newfoundland Banks. Ibis 106: 118-119.

Reimold, R.J. 1977. Mangals and salt marshes of the eastern United States. Pp. 157-166 in V.J. Chapman (ed.). Ecosystems of the world 1: wet coastal ecosystems. Elsevier Sci. Publ. Co., Amsterdam, The Netherlands. xi and 428 pp.

Richard, H. and S. Chevalier. 1978. Brown Boobies at Riis Park, Queens County. Kingbird 28: 32.

Richdale, L.E. 1944a. The Sooty Shearwater in New Zealand. Condor 46: 93-107.

_____. 1944b. The White-faced Storm Petrel or Takahi-kare-moana (Pelagodroma marina maorianna Mathews). Part III. Trans. Proc. R. Soc. N. Zeal. 73: 335-350.

_____. 1945. The nestling of the Sooty Shearwater. Condor 47: 45-62.

_____. 1963. Biology of the Sooty Shearwater Puffinus griseus. Proc. Zool. Soc. Lond. 141: 1-117.

Riisgard, H.U. 1979. Danish marine oil pollution policy. Mar. Pollut. Bull. 10: 250-253.

Robert, H. and H.M. Stevenson. 1951. Notes on the birds of the Dry Tortugas. Fla. Nat. 24: 100-105, 108.

Roberts, B. 1940. The life cycle of Wilson's Petrel. Oceanites oceanicus (Kuhl). British Graham Land Exp. 1934-1937. Brit. Mus. Nat. Hist. Sci. Rept. 1: 141-194.

Robertson, C.J.R. 1975b. Yellow-nosed Mollymawk (Diomedea chlororhynchus) [sic] recorded in the Chatham Islands. Notornis 22: 342-344.

Robertson, I. 1974. Food of nesting Double-crested and Pelagic cormorants at Mandarte Island, British Columbia, with notes on feeding ecology. Condor 76: 346-348.

Robertson, W.B., Jr. 1961. The changing seasons; the nesting season: June 1-August 15, 1961; Florida Region. Aud. Field Notes 15: 461-464.

_____. 1962. The changing seasons; the nesting season: June 1-August 15, 1962; Florida Region. Aud. Field Notes 16: 468-473.

_____. 1967. The changing seasons; the winter season: December 1, 1966-March 31, 1967; Florida Region. Aud. Field Notes 21: 407-413.

_____. 1968. The changing seasons; the spring migration: April 1-May 31, 1968; Florida Region. Aud. Field Notes 22: 516-520.

_____. 1970. The changing seasons; the fall migration: August 16-November 30, 1969; Florida Region. Aud. Field Notes 24: 33-38.

Robertson, W.B., Jr. 1971. The changing seasons; the fall migration: August 15-November 30, 1970; Florida Region. Am. Birds 25: 44-49.

_____. 1972. The changing seasons; the fall migration: August 16-November 30, 1971; Florida Region. Am. Birds 26: 50-54.

_____. 1978. Rothchild's Magnificent Frigate-bird. Pp. 25-27 in H.W. Kale, II. (ed.) Rare and endangered biota of Florida. Vol. 2: birds. Univ. Presses of Fla., Gainesville, FL. xix and 121 pp.

Robertson, W.B., Jr. and C.R. Mason. 1965. Additional bird records from the Dry Tortugas. Fla. Nat. 38: 131-138.

Robertson, W.B., Jr. and J.C. Ogden. 1968. The changing seasons; the fall migration: August 16-November 30, 1967; Florida Region. Aud. Field Notes 22: 25-31.

_____. 1969. The changing seasons; the fall migration: August 16-November 30, 1968; Florida Region. Aud. Field Notes 23: 35-41.

Robertson, W.B., Jr. and D.R. Paulson. 1961. The changing seasons; the fall migration: August 16-November 30, 1960; Florida Region. Aud. Field Notes 15: 26-35.

Robertson, W.B., Jr. and H.M. Stevenson. 1957. The changing seasons; the spring migration: April 1-May 31, 1957; Florida Region. Aud. Field Notes 11: 337-342.

Robinson, G.D. 1939. 1939 Tortugas expedition. (First group--June 5-10). Fla. Nat. 13:7-12.

_____. 1940. 1940 Tortugas expedition. Fla. Nat 14:1-6.

Rodgers, J.A., Jr. 1978. Feeding association between Brown Pelicans and Wood Storks. Fla. Field Nat. 6:44-45.

Rogers, T.M. 1977. The changing seasons; the nesting season: June 1-July 31, 1977; Northern Rocky Mountain--Intermountain Region. Am. Birds 31:1162-1166.

Rohwer, S.A. and G.E. Woolfenden. 1968. A specimen of Leach's Petrel from the Gulf Coast of Florida. Auk 85:319.

Roland, J.V., G.E. Moore and M.A. Bellanca. 1977. The Chesapeake Bay oil spill--February 2, 1976: a case history. Pp. 523-527 in Proc. Oil Spill Conf. 8-10 March 1977, New Orleans, LA.

Roney, K. 1978. Pelicans, cormorants and Great Blue Herons in Saskatchewan in 1976. Blue Jay 36:28-35.

Ross, R.K. 1974. Notes on wintering Great Cormorant in Nova Scotia. Can. Field Nat. 88:493-494.

Ross, R.K. 1977. A comparison of the feeding and nesting requirements of the Great Cormorant (Phalacrocorax carbo L.) and the Double-crested Cormorant (P. auritus Lesson) in Nova Scotia. Proc. Nova Scotia Instit. Sci. 1974-1976. Vol. 27:114-132.

Rossignol, G.R., Jr. 1913. White Pelican at Savannah, Ga. Auk 30:106.

Round, P.D. and R.L. Swann. 1977. Aspects of the breeding of Cory's Shearwater Calonectris diomedea in Crete. Ibis 119:350-353.

Roux, F. and C. Jouanin. 1968. Studies of less familiar birds. 147. Cory's Shearwater. Brit. Birds 61:163-169.

Rowan, M.K. 1952. The Greater Shearwater Puffinus gravis at its breeding ground. Ibis 94:97-121.

Rowlett, R.A. 1978. A massive flight of Cory's Shearwaters at Cape Hatteras. Chat 42:45-46.

_____. 1980. Observations of marine birds and mammals in the northern Chesapeake Bight. U.S. Fish Wildl. Serv., Biol. Serv. Progr. FWS/OBS-80/04. 87 pp.

Rusk, M.S. 1974. Great Cormorant at Oswego Harbor, New York. Kingbird 24:12-13.

Russell, J.C. 1937. Blue-faced Booby at Tortuguas. Fla. Nat. 10:41-42.

Russell, S.M. 1964. A distributional study of the birds of British Honduras. AOU Ornithol. Monogr. No. 1. 195 pp.

Rydzewski, W. 1978. The longevity of ringed birds. Ring 96-97:218-262.

Salomonsen, F. 1969. Amerikansk Fregatfugl (Fregata magnificens Mathews) truffet i Danmark. [Magnificent Frigatebird (Fregata magnificens Mathews) encountered in Denmark.] Dan. Ornithol. Foren. Tidsskr. 63: 111-114. [In Danish with English Summary.]

_____. 1979. Marine birds in the Danish monarchy and their conservation. Pp. 267-287 in J.C. Bartonek and D.N. Nettleship (eds.). Conservation of marine birds of northern North America. U.S. Fish & Wildl. Serv., Wildl. Resch. Rept. No. 11. ix and 319 pp.

Sanger, G.A., V.F. Hironaka and A.K. Fukuyama. 1978. The feeding ecology and trophic relationships of key species of marine birds in the Kodiak Island Area, May-September 1977. Appendix VIII in C.J. Lensink and K.D. Wohl (Principal Investigators) Annu. Rept. NOAA-OCSEAP Contract 01-5-022-2538. U.S. Fish & Wildl. Serv., OBS-Coastal Ecosystems, Anchorage, AK. 67 pp.

Saunders, G.B. 1969. Brown Booby, Sula leucogaster. Fla. Nat. 42:171.

Schaller, G.B. 1964. Breeding behavior of the White Pelican at Yellowstone Lake, Wyoming. Condor 66:3-23.

Scharf, W.C. 1978. Colonial birds nesting on man-made and natural sites in the U.S. Great Lakes. Tech. Rept. D-78-10, Rept. No. FWS/OBS-78/15. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 136 [and 29] pp.

Schreiber, R.W. 1975a. Bad days for the Brown Pelican. Natl. Geogr. 147:111-123.

_____. 1975b. Unusually small egg of the Brown Pelican. Fla. Field Nat. 3:20.

_____. 1976a. Growth and development of nestling Brown Pelicans. Bird-Banding 47:19-39.

_____. 1976c. Paradox of the pelican. Animal Kingdom 79:9-13.

_____. 1977a. Maintenance behavior and communication in the Brown Pelican. AOU Ornithol. Monogr. No. 22. 78 pp.

_____. 1977b. Shell thickness in Brown Pelican eggs from Tampa Bay, Florida. Fla. Field Nat. 5:31-34.

_____. 1978. Eastern Brown Pelican. Pp. 23-24 in H.W. Kale, II (ed.). Rare and endangered biota of Florida. Vol. 2: birds. Univ. Presses of Florida, Gainesville, FL. xix and 121 pp.

_____. 1979. Reproductive performance of the Eastern Brown Pelican *Pelecanus occidentalis*. Los Angeles Co. Nat. Hist. Mus. Contrib. Sci. 317:1-43.

_____. 1980a. Nesting chronology of the Eastern Brown Pelican. Auk 97:491-508.

Schreiber, R.W. and D.A. Hensley. 1976. The diets of *Sula dactylatra*, *Sula sula* and *Fregata minor* on Christmas Island, Pacific Ocean. Pac. Sci. 30: 241-248.

Schreiber, R.W. and R.W. Risebrough. 1972. Studies of the Brown Pelican. Wilson Bull. 84:119-135.

Schreiber, R.W. and E.A. Schreiber. 1973. Florida's Brown Pelican population: Christmas Bird Count analyses. Am. Birds 27:711-715.

_____. 1978. Colonial bird use and plant succession on dredged material islands in Florida. Vol. 1: sea and wading bird colonies. Dredged Material Research Program, Tech. Rept. D-78-14. Environ. Lab., U.S. Army Engineer Waterways Experiment Stat., Vicksburg, MS. Contract DACW39-76-C-0161. 63 [and 63] pp.

Schreiber, R.W., T.H. Below and W.B. Robertson. 1975a. Nesting of Brown Pelican (*Pelecanus occidentalis*) on the Dry Tortugas, Florida. Fla. Field Nat. 3: 47-48.

Schreiber, R.W., G.E. Woolfenden and W.E. Curtsinger. 1975b. Prey capture by the Brown Pelican. Auk 92: 649-654.

Sciple, G.W., Jr. 1939. Wilson's Petrel near Brunswick. Oriole 4:31.

Sciple, G.W. 1960. Wilson's Petrel off Tybee Island. Oriole 25:45.

Sealy, S.G. 1978. Clutch size and nest placement of the Pied-Billed Grebe in Manitoba. Wilson Bull. 90:301-302.

Selander, R.K., R.F. Johnston, B.F. Wilks and G.G. Raun. 1962. Vertebrates from the barrier island of Tamaulipas, Mexico. Univ. Kansas Mus. Nat. Hist. Publ. 12:309-345.

Serr, E.M. 1979. The changing seasons; the nesting season: June 1-July 31, 1979; Northern Great Plains Region. Am. Birds 33:874-875.

Serventy, D.L., V. Serventy and J. Warham. 1971. The handbook of Australian seabirds. A.H. and A.W. Reed, Sydney, Australia. 254 pp.

Shaftesbury, A.D. 1946. Man-O'-War bird at Southport, N.C. Chat 10:71.

Shannon, W.E. 1934. Notes on the bird life of Merritt's Island during the 1932 and 1933 seasons. Fla. Nat. 7:30-37.

Shuler, J. 1973. First South Carolina record of Harcourt's Storm-petrel. Chat 37:78.

_____. (comp.). 1978. Christmas Bird Count--1977. Compiler's comments: McClellanville, S.C. Chat 42:49-50.

Sims, H.W., Jr. 1970. Operation Bird Wash. Fla. Nat. 43:43-45.

Simmons, K.E.L. 1967b. Ecological adaptations in the life history of the Brown Booby at Ascension Island. Living Bird 6:187-212.

_____. 1970. Duration of dives in the Red-necked Grebe. Brit. Birds 63: 300-302.

Sloan, N.F. 1973. Status of breeding colonies of White Pelicans in the United States through 1972. Inl. Bird-Banding News 45:83-96.

Smail, J., D.G. Ainley and H. Strong. 1972. Notes on the birds killed in the 1971 San Francisco Bay oil spill. Calif. Birds 3:25-32.

Small, A. 1974. The birds of California. Winchester Press, New York, NY. xxiv and 310 pp.

Snow, D.W. 1965. The breeding of Audubon's Shearwater (Puffinus lherminieri) in the Galapagos. Auk 82:591-597.

Sowls, L.K., S.A. Hatch and C.J. Lensink. 1978. Catalog of Alaska seabird colonies. U.S. Dept. Int., U.S. Fish & Wildl. Serv. vi and 32 pp. + maps and tables.

Speirs, J.M., G.W. North and J.A. Crosby. 1944. Holboell's Grebe nesting in southern Ontario. Wilson Bull. 56:206-208.

Spencer, R. 1967. The effect on birds. Birds 1:203-204.

Spratt, N. 1936. White Pelican in Atlanta, Georgia. Oriole 1:8.

Sprunt, A., Jr. 1930. White Pelican (Pelecanus erythrorhynchos) in Georgia. Auk 47:242.

_____. 1934. The White Pelican (Pelecanus erythrorhynchos) on the South Carolina coast. Auk 51:508-509.

_____. 1936. Some observations on the bird life of Cumberland Island, Georgia. Oriole 1:1-6.

_____. 1946a. Population survey of the tern colonies of the Dry Tortugas Fort Jefferson National Monument 1946. Fla. Nat. 20:1-8.

_____. 1946b. Survey of the tern colonies of the Dry Tortugas season of 1945. Fla. Nat. 19:26-32.

_____. 1947. Population survey, tern colonies of the Dry Tortugas, Fort Jefferson National Monument, 1947. Fla. Nat. 21:16-21.

_____. 1948. Tern colonies of the Dry Tortugas Fort Jefferson National Monument--1948. Fla. Nat. 22:9-16.

_____. 1949. Wilson's Petrel in interior Florida. Auk 66:76.

_____. 1954. Florida bird life. Coward-McCann, Inc., and the National Audubon Society, New York, NY. 527 pp.

_____. 1962. Birds of the Dry Tortguas 1857-1961. Fla. Nat. 35: 34-40, 58, 82-85, 129-132; 36: 23-26, 52-53.

_____. 1963. Addendum to Florida bird-life (1954). Fla. Aud. Society, Maitland, FL. 24 pp.

Sprunt, A., Jr. and E.B. Chamberlain. 1949. South Carolina bird life. Contrib. Charleston Mus. XI, Univ. South Carolina Press, Columbia, SC. xx and 585 pp.

Stallcup, R. and J. Winter. 1976. The changing seasons; the fall migration: August 1-November 30, 1975; Middle Pacific Coast Region. Am. Birds 30: 118-124.

Stanton, P.B. 1977. Operational procedures for reducing wildlife losses: overview and future considerations. Pp. 135-138 in P.L. Fore (ed.). Proc. 1977 Oil Spill Response Workshop. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS/77-24. 153 pp.

Starkey, H.H. 1969. Wilson's Petrel, Oceanites oceanicus. Fla. Nat. 42: 171-172.

Stephen, A.C. 1953. Magnificent Frigate-bird in Scotland. Scott. Nat. 65: 193-194.

Stevenson, H.M. 1953a. The changing seasons; the winter season: December 1, 1952-March 31, 1953; Florida Region. Aud. Field Notes 7: 210-212.

_____. 1953b. The changing seasons; the nesting season: June 1-August 15, 1953; Florida Region. Aud. Field Notes 7: 304-306.

_____. 1954a. The changing seasons; the fall migration: August 16-November 30, 1953; Florida Region. Aud. Field Notes 8: 13-16.

_____. 1954b. The changing seasons; the nesting season: June 1-August 15, 1954; Florida Region. Aud. Field Notes 8: 340-342.

_____. 1955a. The changing seasons; the fall migration: August 16-November 30, 1954; Florida Region. Aud. Field Notes 9: 19-22.

_____. 1955b. The changing seasons; the winter season: December 1954-March 31, 1955; Florida Region. Aud. Field Notes 9: 250-254.

_____. 1955c. The changing seasons; the nesting season: June 1-August 15, 1955; Florida Region. Aud. Field Notes 9:373-375.

_____. 1956a. The changing seasons; the fall migration: August 16-November 30, 1955; Florida Region. Aud. Field Notes 10:18-22.

_____ 1956b. The changing seasons; the winter season: December 1, 1955-March 31, 1956; Florida Region. Aud. Field Notes 10:244-248.

_____. 1956c. The changing seasons; the spring migration: April 1-May 31, 1956; Florida Region. Aud. Field Notes 10:325-329.

_____. 1956d. The changing seasons; the nesting season: June 1-August 15, 1956; Florida Region. Aud. Field Notes 10:379-381.

_____. 1957a. The changing seasons; the winter season: December 1, 1956-March 31, 1957; Florida Region. Aud. Field Notes 11:257-263.

_____. 1957b. The changing seasons; the nesting season: June 1-August 15, 1957; Florida Region. Aud. Field Notes 11:399-402.

_____. 1958a. The changing seasons; the fall migration: August 16-November 30, 1957; Florida Region. Aud. Field Notes 12:21-26.

_____. 1958b. The changing seasons; the winter season: December 1, 1957-March 31, 1958; Florida Region. Aud. Field Notes 12:271-276.

_____. 1958c. The changing seasons; the spring migration: April 1-May 31, 1958; Florida Region. Aud. Field Notes 12:344-348.

_____. 1958d. The changing seasons; the nesting season: June 1-August 15, 1958; Florida Region. Aud. Field Notes 12:405-408.

_____. 1959a. The changing seasons; the winter season: December 1,1958-March 31, 1959; Florida Region. Aud. Field Notes 13: 285-289.

Stevenson, H.M. 1959b. The changing seasons; the spring migration: April 1-May 31, 1959; Florida Region. Aud. Field Notes 13: 363-365.

_____. 1959c. The changing seasons; the nesting season: June 1-August 15, 1959; Florida Region. Aud. Field Notes 13:426-429.

_____. 1960a. The changing seasons; the fall migration: August 16-November 30, 1959; Florida Region. Aud. Field Notes 14:25-29.

_____. 1960b. The changing seasons; the winter season: December 1, 1959-March 31, 1960; Florida Region. Aud. Field Notes 14:301-305.

_____. 1960c. The changing seasons; the spring migration: April 1-May 31, 1960; Florida Region. Aud. Field Notes 14: 379-383.

_____. 1960d. The changing seasons; the nesting season: June 1-August 15, 1960; Florida Region. Aud. Field Notes 14: 444-446.

_____. 1961. The changing seasons; the winter season: December 1, 1960-March 31, 1961; Florida Region. Aud. Field Notes 15:320-325.

_____. 1962. The changing seasons; the fall migration: August 16-November 30, 1961; Florida Region. Aud. Field Notes 16: 21-25.

_____. 1963a. The changing seasons; the fall migration: August 16-November 30, 1962; Florida Region. Aud. Field Notes 17:24-28.

_____. 1963b. The changing seasons; the winter season: December 1, 1962-March 31, 1963; Florida Region. Aud. Field Notes 17: 319-323.

_____. 1963c. The changing seasons; the spring migration: April 1-May 31, 1963; Florida Region. Aud. Field Notes 17:397-399.

_____. 1963d. The changing seasons; the nesting season: June 1-August 15, 1963; Florida Region. Aud. Field Notes 17:454-457.

_____. 1964a. The changing seasons; the nesting season: June 1-August 15, 1964; Florida Region. Aud. Field Notes 18:503-505.

_____. 1964b. Additional records and a specimen of the Eared Grebe in Alabama. Ala. Birdlife 12: 11.

_____. 1965a. The changing seasons; the winter season: December 1, 1964-March 31, 1965; Florida Region. Aud. Field Notes 19:370-374.

_____. 1965b. The changing seasons; the nesting season: June 1-August 15, 1965; Florida Region. Aud. Field Notes 19:534-537.

_____. 1966a. The changing seasons; the fall migration: August 16-November 30, 1965; Florida Region. Aud. Field Notes 20:30-35.

_____. 1966b. The changing seasons; the nesting season: June 1-August 15, 1966; Florida Region. Aud. Field Notes 20:561-565.

Stevenson, H.M. 1967a. The changing seasons; the fall migration: August 16-November 30, 1966; Florida Region. Aud. Field Notes 21: 22-25.

_____. 1967b. The changing seasons; the spring migration: April 1-May 31, 1967; Florida Region. Aud. Field Notes 21: 497-500.

_____. 1967c. The changing seasons; the nesting season: June 1-August 15, 1967; Florida Region. Aud. Field Notes 21: 558-561.

_____. 1968a. The changing seasons; the winter season: December 1, 1967-March 31, 1968; Florida Region. Aud. Field Notes 22: 430-434.

_____. 1968b. The changing seasons; the nesting season: June 1-August 15, 1968; Florida Region. Aud. Field Notes 22: 599-602.

_____. 1969. The changing seasons; the winter season: December 1, 1968-March 31, 1969; Florida Region. Aud. Field Notes 23: 468-473.

_____. 1970. The changing seasons; the winter season: December 1, 1969-March 31, 1970; Florida Region. Aud. Field Notes 24: 493-497.

_____. 1971. The changing seasons; the winter season: December 1, 1970-March 31, 1971; Florida Region. Am. Birds 25: 567-570.

_____. 1972. The changing seasons; the winter season: December 1, 1971-March 31, 1972; Florida Region. Am. Birds 26:592-596.

_____. 1973. The changing seasons; the fall migration: August 16-November 30, 1972; Florida Region. Am. Birds 27:45-49.

_____. 1974. The changing seasons; the winter season: December 1, 1973-March 31, 1974; Florida Region. Am. Birds 28:628-632.

_____. 1975. The changing seasons; the winter season: December 1, 1974-March 31, 1975; Florida Region. Am. Birds 29:679-683.

_____. 1976. The changing seasons; the winter season: December 1, 1975-March 31, 1976; Florida Region. Am. Birds 30:708-711.

_____. 1977. The changing seasons; the winter season: December 1, 1976-February 28, 1977; Florida Region. Am. Birds 31:322-325.

_____. 1978. The changing seasons; the winter season: December 1, 1977-February 28, 1978; Florida Region. Am. Birds 32:339-342.

_____. 1979. The changing seasons; the winter season: December 1, 1978-February 28, 1979; Florida Region. Am. Birds 33:274-276.

Stewart, J.R., Jr. 1962. The changing seasons; the nesting season: June 1-August 15, 1962; Central Southern Region. Aud. Field Notes 16:480-486.

_____. 1964. The changing seasons; the nesting season: June 1-August 15, 1964; Central Southern Region. Aud. Field Notes 18:512-515.

Stewart, J.R., Jr. 1967. The changing seasons; the nesting season: June 1-August 15, 1967; Central Southern Region. Aud. Field Notes 21: 578-581.

_____. 1968. The changing seasons; the nesting season: June 1-August 15, 1968; Central Southern Region. Aud. Field Notes 22: 614-617.

_____. 1969. The changing seasons; the nesting season: June 1-August 15, 1969; Central Southern Region. Aud. Field Notes 23: 666-669.

_____. 1970. The changing seasons; the nesting season: June 1-August 15, 1970; Central Southern Region. Aud. Field Notes 24: 691-693.

_____. 1971. The changing seasons; the nesting season: June 1-August 15, 1971; Central Southern Region. Am. Birds 25: 865-869.

_____. 1975. The changing seasons; the nesting season: June 1-July 31, 1975; Central Southern Region. Am. Birds 29: 983-984, 993-995.

_____. 1976. The changing seasons; the nesting season: June 1-July 31, 1976; Central Southern Region. Am. Birds 30: 965-969.

Stewart, P.A. and R.W. Skinner. 1967. Weights of birds from Alabama and North Carolina. Wilson Bull. 79:37-42.

Stewart, R.E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies. Fargo, ND. 295 pp.

Stickel, L.F. and M.P. Dieter. 1979. Ecological and physiological/toxicological effects of petroleum on aquatic birds. U.S. Fish & Wildl. Serv., Biol. Serv. Progr. FWS/OBS-79/23. 14 pp.

Stimson, L.A. 1966. A remarkable ten days at the Dry Tortugas. Fla. Nat. 39:149-150.

Stoddard, H.L., Sr. and R.A. Norris. 1967. Bird casualities at a Leon County, Florida, TV tower: an eleven-year study. Tall Timbers Res. Sta. Bull. No. 8. 104 pp.

Stonehouse, B. 1962a. Ascension Island and the British Ornithologist's Union Centenary Expedition 1957-59. Ibis 103b: 107-123.

_____. 1962b. The tropicbirds (genus Phaethon) of Ascension Island. Ibis 103b: 124-161.

Storer, R.W. 1965. The color phases of the Western Grebe. Living Bird 4: 59-63.

_____. 1969. The behavior of the Horned Grebe in spring. Condor 71: 180-205.

_____. 1976. The behavior and relationships of the Least Grebe. Trans. San Diego Soc. Nat. Hist. 18: 113-126.

_____. 1978. Systematic notes on the loons (Gaviidae: Aves). Breviora No. 44 8:1-8.

Storer, R.W. 1979a. Order Gaviiformes. Pp. 135-139 in E. Mayr and G.W. Cottrell (eds.). Check-list of birds of the world. Vol. I. Second ed. Mus. Comp. Zool., Harvard Univ. xvii and 547 pp.

_____. 1979b. Order Podicepidiformes. Pp. 140-155 in E. Mayr and G.W. Cottrell (eds.). Check-list of birds of the world. Vol. I. Second ed. Mus. Comp. Zool., Harvard Univ. xvii and 547 pp.

Stowe, T. and R. Morgan. 1979. Oil, oil, oil. Brit. Trust for Ornithol. News 98: 3.

Strait, L.E. and N.F. Sloan. 1974. Life table analysis for the White Pelican. Inl. Bird-Banding News 46: 20-28.

_____. 1975. Movement and mortality of juvenile White Pelicans from North Dakota. Wilson Bull. 87: 54-59.

Stresemann, E. and V. Stresemann. 1970. Uber Mauser und Zug von Puffinus gravis. J. Ornithol. 111: 378-393. [In German with English summary.]

Sugden, L.G. 1977. Horned Grebe breeding habitat in Saskatchewan parklands. Can. Field Nat. 91: 371-376.

Sutton, G.M. 1927. Madeira Petrel (Oceanodroma castro) in Pennsylvania. Auk 44: 556-557.

_____. 1936. Man-O'-War-bird in Oklahoma. Auk 53: 438.

_____. 1967. Oklahoma birds: their ecology and distribution, with comments on the avifauna of the southern Great Plains. Univ. Oklahoma Press, Norman, OK. 674 pp.

Swennen, D.C. and A.L. Spanns. 1970. Der Sterfte van Zeevogels dor die in Februari 1969 in het Waddengibied. Het Vogeljaar 18: 233-245.

Sykes, P.W., Jr. 1963. Some observations off the North Carolina coast. Chat 27: 77-78.

_____. 1964. Fulmar taken in Virginia. Auk 81: 437.

_____. (comp.). 1971. Christmas Bird Count--1970. Compiler's comments: Bodie-Pea Island, N.C. Chat 35: 21-22.

_____. 1972. Christmas Bird Count--1971. Compiler's comments: Bodie-Pea Island, N.C. Chat 36: 21-22.

_____. 1974. Christmas Bird Count--1973. Compiler's comments: Bodie-Pea Island, N.C. Chat 38: 12-13.

_____. 1975. Bodie-Pea Island, N.C. The 75th Audubon Christmas Bird Count. Am. Birds 29: 315-316.

_____. 1976. Bodie-Pea Island, N.C. The 76th Audubon Christmas Bird Count. Am. Birds 30: 326-327.

Sykes, P.W., Jr. 1977. Christmas Bird Count--1976. Compiler's comments: Bodie-Pea Island, NC. Chat 41: 37-38.

_____. (Comp.). 1977. Bodie-Pea Island, N.C. The 77th Audubon Christmas Count. Am. Birds 31:576-577.

_____. 1979. Bodie-Pea Island, N.C. The 79th Audubon Christmas Bird Count. Am. Birds 33: 457.

Szaro, R.C. 1977. Effects of petroleum on birds. Trans. N. Am. Wildl. Conf. 42: 347-381.

Tait, I.C., L. Knopf and J.L. Kennedy. 1978. White Pelicans nesting at Honey Lake, California. West. Birds 9: 38-40.

Tanis, J.J.C. and M.F. Morzer Bruyns. 1968. The impact of oil pollution on seabirds in Europe. Pp. 67-74 in Proc. Internatl. Conf. Oil Pollution of the Seas, 7-9 October 1968, Rome, Italy. 414 pp.

Taverner, P.A. 1934. The Madeira Petrel in Ontario. Auk 51: 77.

Taylor, J.W. 1972. Probable Bulwer's Petrel off Key West, Florida. Wilson Bull. 84: 198.

Taylor, W.K. 1976. Another Cory's Shearwater specimen from Florida. Fla. Field Nat. 4: 19.

Teal, J.M. 1959. Birds of Sapelo Island and vicinity. Oriole 24: 1-14, 17-20.

Teulings, R.P. 1970a. The changing seasons; the spring migration: April 1-May 31, 1970; Southern Atlantic Coast Region. Aud. Field Notes 24: 588-590.

_____. 1970b. The changing seasons; the nesting season: June 1-August 15, 1970; Southern Atlantic Coast Region. Aud. Field Notes 24: 670-673.

_____. 1971a. The changing seasons; the fall migration: August 15-November 30, 1970; Southern Atlantic Coast Region. Am. Birds 25: 40-44.

_____. 1971b. The changing seasons; the winter season: December 1, 1970-March 31, 1971; Southern Atlantic Coast Region. Am. Birds 25: 562-567.

_____. 1971c. The changing seasons; the spring migration: April 1-May 31, 1971; Southern Atlantic Coast Region. Am. Birds 25: 710-723.

_____. 1971d. The changing seasons; the nesting season: June 1-August 15, 1971; Southern Atlantic Coast Region. Am. Birds 25: 843-846.

_____. 1971e. Briefs for the files. Chat 35: 31-34, 56-59, 85-87, 114-115.

_____. 1972a. The changing seasons; the fall migration: August 16-November 30, 1971; Southern Atlantic Coast Region. Am. Birds 26: 45-50.

Teulings, R.P. 1972b. The changing seasons; the winter season: December 1, 1971-March 31, 1972; Southern Atlantic Coast Region. Am. Birds 26: 589-592.

_____. 1972c. The changing seasons; the spring migration: April 1-May 31, 1972; Southern Atlantic Coast Region. Am. Birds 26: 748-751.

_____. 1972d. The changing seasons; the nesting season: June 1-August 15, 1972; Southern Atlantic Coast Region. Am. Birds 26: 844-847.

_____. 1972e. Briefs for the files. Chat 36: 28, 33-37, 93-97, 111-115.

_____. 1973a. The changing seasons; the fall migration: August 16-November 30, 1972; Southern Atlantic Coast Region. Am. Birds 27: 40-45.

_____. 1973b. The changing seasons; the winter season: December 1, 1972-March 31, 1973; Southern Atlantic Coast Region. Am. Birds 27: 601-603.

_____. 1973c. The changing seasons; the spring migration: April 1-May 31, 1973; Southern Atlantic Coast Region. Am. Birds 27: 758-760.

_____. 1973d. The changing seasons; the nesting season: June 1-July 31, 1973; Southern Atlantic Coast Region. Am. Birds 27: 856-859.

_____. 1973e. Briefs for the files. Chat 37: 29-33, 52-54, 85-89, 108-110.

_____. 1974a. The changing seasons; the fall migration: August 1-November 30, 1973; Southern Atlantic Coast Region. Am. Birds 28: 37-40.

_____. 1974b. The changing seasons; the winter season: December 1, 1973-March 31, 1974; Southern Atlantic Coast Region. Am. Birds 28: 626-628.

_____. 1974c. The changing seasons; the spring migration: April 1-May 31, 1974; Southern Atlantic Coast Region. Am. Birds 28: 788-790.

_____. 1974d. The changing seasons; the nesting season: June 1-July 31, 1974; Southern Atlantic Coast Region. Am. Birds 28: 889-892.

_____. 1974e. Briefs for the files. Chat 38: 3, 25-29, 46-48, 78-81, 96-98.

_____. 1975a. The changing seasons; the fall migration: August 1-November 30, 1974; Southern Atlantic Coast Region. Am. Birds 29: 40-43.

_____. 1975b. The changing seasons; the winter season: December 1, 1974-March 31, 1975; Southern Atlantic Coast Region. Am. Birds 29: 676-679.

_____. 1975c. The changing seasons; the spring migration: April 1-May 31, 1975; Southern Atlantic Coast Region. Am. Birds 29: 837-839.

_____. 1975d. The changing seasons; the nesting season: June 1-July 31, 1975; Southern Atlantic Coast Region. Am. Birds 29: 957-960.

_____. 1975e. Briefs for the files. Chat 39: 22-29, 60-64, 95-98.

_____. 1976a. The changing seasons; the fall migration: August 1-November 30, 1975; Southern Atlantic Coast Region. Am. Birds 30: 51-54.

Teulings, R.P. 1976b. The changing seasons; the winter season: December 1, 1975-March 31, 1976; Southern Atlantic Coast Region. Am. Birds 30: 705-707.

_____. 1976c. The changing seasons; the spring migration: April 1-May 30, 1976; Southern Atlantic Coast Region. Am. Birds 30: 826-828.

_____. 1976d. Briefs for the files. Chat 40: 17-21, 46-51, 71-73, 101-105, 110.

_____. 1977a. The changing seasons; the autumn migration: August 1-November 30, 1976; Southern Atlantic Coast Region. Am. Birds 31: 163-166.

_____. 1977b. The changing seasons; the spring migration: March 1-May 31, 1977; Southern Atlantic Coast Region. Am. Birds 31: 987-988.

_____. 1978a. The changing seasons; the spring migration: March 1-May 31, 1978; Southern Atlantic Coast Region. Am. Birds 32: 992-993.

_____. 1978b. Briefs for the files. Chat 42: 36-38, 86-88.

Thompson, N.P., C.H. Courtney, D.J. Forrester and F.H. White. 1977a. Starvation pesticide interactions in juvenile Brown Pelicans. Bull. Environ. Contam. Toxicol. 17: 485-489.

Thompson, N.P., P.W. Rankin, P.E. Cowan, L.E. Williams, Jr. and S.A. Nesbitt. 1977b. Chlorinated hydrocarbon residues in the diet and eggs of the Florida Brown Pelican. Bull. Environ. Contam. Toxicol. 18: 331-339.

Thomson, A.L. 1965. The transequatorial migration of the Manx Shearwater (Puffin des Anglais). Oiseau Rev. Fr. Ornithol. 35 Suppl.: 130-140.

Tomkins, I.R. 1930. Some records from the Savannah River entrance during 1929. Auk 47: 577.

_____. 1931. Further notes from the Savannah River entrance. Auk 48: 279-282.

_____. 1934. Notes from Chatham County, Georgia. Auk 49: 252-253.

_____. 1941. Sight record of European Cormorant in Georgia. Oriole 6: 516.

_____. 1944. Gannets at sea off the Georgia coast. Oriole 9: 9-10.

_____. 1958. The birdlife of the Savannah River Delta. Gaviiformes through Charadriiformes. Georgia Ornithol. Soc. Occas. Pap. 4. 68 pp.

_____. 1959. A specimen of the Greater Shearwater from South Carolina. Chat 23: 19.

_____. 1963. The changing seasons; the fall migration: August 16-November 30, 1962; Southern Atlantic Coast Region. Aud. Field Notes 17: 22-24.

Toups, J.A. and M.F. Hodges. 1980. Olivaceous Cormorant--first Mississippi record. Mississippi Kite 10: 2-3.

Trautman, M.B. and T.W. Nye. 1968. An Ohio record of the Magnificent Frigatebird (Fregata magnificens). Wilson Bull. 80: 487-488.

Turcotte, W.H. 1972. Western Grebe sight record. Mississippi Ornithol. Soc. Newsl. 17: 25.

_____. 1973. Correction on first Western Grebe sight record. Mississippi Ornithol. Soc. Newsl. 18: 2.

Turner, R.E. and J.G. Gosselink. 1975. A note on standing crops of Spartina alterniflora in Texas and Florida in Contributions Marine Sci. Vo. 19: 113-118.

(USNFWL) U.S. National Fish and Wildlife Laboratory. 1980. Selected vertebrate endangered species of the seacoast of the United States: Brown Pelican. Eastern and California subspecies. U.S. Fish & Wildlife Serv., Biol. Serv. Program; FWS/OBS-80/01.40; March 1980. 16 pp.

van IJzendoorn, A.L.J. 1944. Some remarks on the life-history of the Black-necked Grebe (Podiceps n. nigricollis Brehm). Limosa 17: 8-13.

van Tets, G.F. 1959. A comparative study of the reproductive behaviour and natural history of three sympatric species of cormorants (Phalacrocorax auritus, P. penicillatus, and P. pelagicus) at Mandarte Island, B.C. M.S. thesis, Univ. British Columbia/Vancouver, Canada. vi and 86 pp.

Vaurie, C. 1965. The birds of the Palearctic fauna. Vol. I: Non-Passeriformes. H.F. and G. Witherby, Ltd., London, England. xx and 763 pp.

Vermeer, K. 1969a. Colonies of Double-crested Cormorants and White Pelicans in Alberta. Can. Field Nat. 83: 36-39.

_____. 1969b. Some aspects of the breeding chronology of Double-crested Cormorants at Lake Newell, Alberta, in 1968. Murrelet 50: 19-20.

_____. 1969c. The present status of Double-crested Cormorant colonies in Manitoba. Blue Jay 27: 217-220.

_____. 1970a. Arrival and clutch initiation of Double-crested Cormorants at Lake Newell, Alberta. Blue Jay 28: 124-125.

_____. 1970c. Some aspects of the nesting of Double-crested Cormorants at Cypress Lake, Saskatchewan, in 1969; a plea for protection. Blue Jay 28: 11-13.

_____. 1970d. Distribution and size of colonies of White Pelicans (Pelecanus erythrorhynchos) in Canada. Can. J. Zool. 48: 1029-1032.

_____. 1973. Great Blue Heron and Double-crested Cormorant colonies in the Prairie Provinces. Can. Field Nat. 87: 427-432.

Vermeer, K. 1977. Comparison of White Pelican recoveries from colonies east and west of the Canadian Rocky Mountains. Murrelet 58: 79-82.

Vermeer, K. and R. Vermeer. 1975. Oil threat to birds on the Canadian west coast. Can. Field Nat. 89: 278-298.

Vermeer, R. and K. Vermeer. 1974. Oil pollution of birds: an abstracted bibliography. Can. Wildl. Serv., Pesticide Section. Manuscript Reports No. 29. 68 pp.

Vinson, J.-M. 1976. Notes sur les Procellariens de l'ile Ronde. [Notes on the Procellariiformes of Round Island.] Oiseau Rev. Fr. Ornithol. 46: 1-24. [In French with English summary.]

von Dingle, E.S. and E.B. Chamberlain. 1941. Cory's Shearwater in South Carolina. Auk 58: 251.

Voous, K.H. 1957. The birds of Aruba, Curacao, and Bonaire. Studies on the fauna of Curacao and other Caribbean islands: No. 29. Martinus Nijhoff, The Hague, Netherlands. 260 pp.

_____. 1963. Food of White-tailed Tropic Bird (Phaethon lepturus). Ardea 51: 252.

Voous, K.H. and J. Wattel. 1963. Distribution and migration of the Greater Shearwater. Ardea 51: 143-157.

Wallace, H.E. 1970. Operation Dirty Bird. Fla. Wildl., April 1970: 4-7.

Warham, J. 1959. The Trinidad Petrel, Pterodroma arminjoniana, a new bird for Australia. Emu 59: 153-158.

_____. 1964. Marked Sooty Shearwaters Puffinus griseus in the Northern Hemisphere. Ibis 106: 390-391.

Warham, J., W.R.P. Bourn and H.F.I. Wlliott. 1974. Albatross identification in the North Atlantic. Am. Birds 28: 585-598.

Warinner, J.E., M. Nolan, C.G. Becker, R.W. Middleton and W.M. Rizzo. 1976. Coastal and nearshore environments. Pp. 1-49 in Virginia Institute of Marine Science. An assessment of estuarine and nearshore marine environments. Special report in applied science and ocean engineering (revised). Virginia Institute of Marine Science, Gloucester Point, VA. xvi and 132 pp.

Warner, L. 1976. The status of the barrier islands of the southeastern coast. A summary of the barrier island inventory. Open Space Institute, New York, NY. i and 43 pp.

Watson, G.E. 1966. Seabirds of the tropical Atlantic Ocean. Smithsonian Press, Washington, DC. xxix and 120 pp.

_____. 1971. Molting Greater Shearwaters (Puffinus gravis) off Tierra del Fuego. Auk 88: 440-442.

Watson, G.E. 1975. Birds of the Antarctic and sub-Antarctic. William Byrd Press, Richmond, VA. xvii and 350 pp.

Wayne, A.T. 1910. Birds of South Carolina. Contrib. Charleston Mus. No. 1. 254 pp.

Weber, W.C. 1977. Birds around the state - spring migration and breeding season, 1977. Mississippi Kite 7: 42-53.

Weber, W.C. and J.A. Jackson (comps.). 1978. Birds around the state - fall migration, 1977. Mississippi Kite 8: 19-27.

Webster, F.S., Jr. 1957a. The changing seasons; the fall migration: August 16-November 30, 1956; South Texas Region. Aud. Field Notes 11: 38-43.

_____. 1959. The changing seasons; the winter season: December 1,1958-March 31, 1959; South Texas Region. Aud. Field Notes 13: 306-309.

_____. 1960. The changing seasons; the nesting season: June 1-August 15, 1960; South Texas Region. Aud. Field Notes 14: 461-465.

_____. 1961a. The changing seasons; the winter season: December 1, 1960-March 31, 1961; South Texas Region. Aud. Field Notes 15: 343-345.

_____. 1961b. The changing seasons; the nesting season: June 1-August 15, 1961; South Texas Region. Aud. Field Notes 15: 479-481.

_____. 1962a. The changing seasons; the fall migration: August 16-November 30, 1961; South Texas Region. Aud. Field Notes 16: 52-58.

_____. 1962b. The changing seasons; the nesting season: June 1-August 15, 1962; South Texas Region. Aud. Field Notes 16: 489-493.

_____. 1963a. The changing seasons; the fall migration: August 16-November 30, 1962; South Texas Region. Aud. Field Notes 17: 46-50.

_____. 1963b. The changing seasons; the winter season: December 1, 1962-March 31, 1963; South Texas Region. Aud. Field Notes 17: 341-343.

_____. 1963c. The changing seasons; the spring migration: April 1-May 31, 1963; South Texas Region. Aud. Field Notes 17: 415-419.

_____. 1964a. The changing seasons; the fall migration: August 16-November 30, 1963; South Texas Region. Aud. Field Notes 18: 52-57.

_____. 1964b. The changing seasons; the winter season: December 1, 1963-March 31, 1964; South Texas Region. Aud. Field Notes 18: 369-372.

_____. 1964c. The changing seasons; the spring migration: April 1-May 31, 1964; South Texas Region. Aud. Field Notes 18: 466-472.

_____. 1965. The changing seasons; the nesting season: June 1-August 15, 1965; South Texas Region. Aud. Field Notes 19: 559-564.

Webster, F.S., Jr. 1966a. The changing seasons; the fall migration: August 16-November 30, 1965; South Texas Region. Aud. Field Notes 20: 66-72.

_____. 1966b. The changing seasons; the nesting season: June 1-August 15, 1966; South Texas Region. Aud. Field Notes 20: 582-585.

_____. 1967a. The changing seasons; the fall migration: August 16-November 30, 1966; South Texas Region. Aud. Field Notes 21: 54-59.

_____. 1967b. The changing seasons; the winter season: December 1, 1966-March 31, 1967; South Texas Region. Aud. Field Notes 21: 433-440.

_____. 1967c. The changing seasons; the spring migration: April 1-May 31, 1967; South Texas Region. Aud. Field Notes 21: 520-524.

_____. 1967d. The changing seasons; the nesting season: June 1-August 15, 1967; South Texas Region. Aud. Field Notes 21: 585-587.

_____. 1968a. The changing seasons; the spring migration: April 1-May 31, 1968; South Texas Region. Aud. Field Notes 22: 550-557.

_____. 1968b. The changing seasons; the nesting season: June 1-August 15, 1968; South Texas Region. Aud. Field Notes 22: 623-628.

_____. 1969. The changing seasons; the fall migration: August 16-November 30, 1968; South Texas Region. Aud. Field Notes 23: 77-81.

_____. 1970a. The changing seasons; the fall migration: August 16-November 30, 1969; South Texas Region. Aud. Field Notes 24: 66-69.

_____. 1970b. The changing seasons; the winter season: December 1, 1969-March 31, 1970; South Texas Region. Aud. Field Notes 24: 518-521.

_____. 1970c. The changing seasons; the spring migration: April 1-May 31, 1970; South Texas Region. Aud. Field Notes 24: 622-624.

_____. 1970d. The changing seasons; the nesting season: June 1-August 15, 1970; South Texas Region. Aud. Field Notes 24: 696-699.

_____. 1971a. The changing seasons; the winter season: December 1, 1970-March 31, 1971; South Texas Region. Am. Birds 25: 600-603.

_____. 1971b. The changing seasons; the spring migration: April 1-May 31, 1971; South Texas Region. Am. Birds 25: 768-771.

_____. 1971c. The changing seasons; the nesting season: June 1-August 15, 1971; South Texas Region. Am. Birds 25: 875-878.

_____. 1972a. The changing seasons; the fall migration: August 16-November 30, 1971; South Texas Region. Am. Birds 26: 84-88.

_____. 1972b. The changing seasons; the winter season: December 1, 1971-March 31, 1972; South Texas Region. Am. Birds 26: 627-629.

Webster, F.S., Jr. 1972c. The changing seasons; the spring migration: April 1-May 31, 1972; South Texas Region. Am. Birds 26: 780-783.

_____. 1972d. The changing seasons; the nesting season: June 1-August 15, 1972; South Texas Region. Am. Birds 26: 875-878.

_____. 1973a. The changing seasons; the fall migration: August 16-November 30, 1972; South Texas Region. Am. Birds 27: 82-85.

_____. 1973b. The changing seasons; the winter season: December 1, 1972-March 31, 1973; South Texas Region. Am. Birds 27: 637-639.

_____. 1974a. The changing seasons; the fall migration: August 1-November 30, 1973; South Texas Region. Am. Birds 28: 76-78.

_____. 1974b. The changing seasons; the winter season: December 1, 1973-March 31, 1974; South Texas Region. Am. Birds 28: 661-663.

_____. 1974c. The changing seasons; the nesting season: June 1-July 31, 1974; South Texas Region. Am. Birds 28: 922-925.

_____. 1975a. The changing seasons; the fall migration: August 1-November 30, 1974; South Texas Region. Am. Birds 29: 82-85.

_____. 1975b. The changing seasons; the winter season: December 1, 1974-March 31, 1975; South Texas Region. Am. Birds 29: 711-714.

_____. 1975c. The changing seasons; the nesting season: June 1-July 31, 1975; South Texas Region. Am. Birds 29: 1003-1006.

_____. 1976a. The changing seasons; the fall migration: August 1-November 30, 1975; South Texas Region. Am. Birds 30: 95-97.

_____. 1976b. The changing seasons; the winter season: December 1, 1975-March 31, 1976; South Texas Region. Am. Birds 30: 739-741.

_____. 1976c. The changing seasons; the spring migration: April 1-May 30, 1976; South Texas Region. Am. Birds 30: 863-865.

_____. 1976d. The changing seasons; the nesting season: June 1-July 31, 1976; South Texas Region. Am. Birds 30: 975-978.

_____. 1977a. The changing seasons; the autumn migration: August 1-November 30, 1976; South Texas Region. Am. Birds 31: 197-199.

_____. 1977b. The changing seasons; the winter season: December 1, 1976-February 28, 1977; South Texas Region. Am. Birds 31: 349-351.

_____. 1977c. The changing seasons; the spring migration: March 1-May 31, 1977; South Texas Region. Am. Birds 31: 1020-1022.

_____. 1977d. The changing seasons; the nesting season: June 1-July 31, 1977; South Texas Region. Am. Birds 31: 1158-1160.

Webster, F.S., Jr. 1978a. The changing seasons; the fall migration: August 1-November 30, 1977; South Texas Region. Am. Birds 32: 227-230.

_____. 1978b. The changing seasons; the spring migration: March 1-May 31, 1978; South Texas Region. Am. Birds 32: 1028-1031.

_____. 1978c. The changing seasons; the nesting season: June 1-July 31, 1978; South Texas Region. Am. Birds 32: 1182-1185.

_____. 1979a. The changing seasons; the autumn migration: August 1-November 30, 1978; South Texas Region. Am. Birds 33: 193-195.

_____. 1979b. The changing seasons; the winter season: December 1, 1978-Febuary 28, 1979; South Texas Region. Am. Birds 33: 295-296.

Wehle, D.H.S. 1978. Studies of marine birds on Ugaiushak Island. Environmental assessment of the Alaskan Continental Shelf, annual reports of principal investigators. NOAA Environmental Research Lab., Boulder, CO. Appendix III. 98 pp.

West, R.C. 1977. Tidal salt-marsh and mangal formations of Middle and South America. Pp. 193-213 in V.J. Chapman (ed.). Ecosystems of the world 1: wet coastal ecosystems. Elsevier Sci. Publ. Co., Amsterdam, The Netherlands. xi and 428 pp.

Weston, F.M. 1947. The changing seasons; the spring migration: April 1-June 1, 1947; Pensacola (Florida) Region. Aud. Field Notes 1: 152-153.

Wetmore, A. 1924. Food and economic relations of North American grebes. U.S. Dept. Agric. Bull. No. 1196. 23 pp.

_____. 1935. The Common Loon in the Florida Keys. Auk 52: 300.

_____. 1965. The birds of the Republic of Panama. Part I: Tinamidae (tinnanamous) to Rhynchopidae (skimmers). Smithsonian Misc. Coll. No. 150. iv and 483 pp.

Wetmore, A. and B.H. Swales. 1931. The birds of Haiti and the Dominican Republic. Bull. U.S. Natl. Mus. No. 155. iv and 483 pp.

White, F.H., D.J. Forrester and S.A. Nesbitt. 1976. Salmonella and aspergillus infections in Common Loons overwintering in Florida. J. Anim. Vet. Med. Assoc. 169: 936-937.

Whitfield, A.K. and S.J.M. Blaber. 1979. Feeding ecology of piscivorous birds at Lake St. Lucia, Part 3: swimming birds. Ostrich 50: 10-20.

Wilbur, H.M. 1969. Breeding biology of Leach's Petrel (Oceanodroma leucorhoa). Auk 86: 433-442.

Williams, J. [=C.J. Pennock]. 1919. Notes from St. Marks, Florida. Auk 36: 586-587.

Williams, L.E., Jr. 1973. Spring migration of Common Loons from the Gulf of Mexico. Wilson Bull. 85: 230.

Williams, L.E. and S.G. Clawson. 1963. First specimens of ten species of birds for Mississippi. Auk 80: 199-201.

Williams, L.E., Jr. and T. Joanen. 1974. Age of first nesting in the Brown Pelican. Wilson Bull. 86: 279-280.

Williams, L.E., Jr. and L. Martin. 1968. Nesting status of the Brown Pelican in Florida in 1968. Q.J. Fla. Acad. Sci. 31: 130-140.

_____. 1971. Nesting populations of Brown Pelicans in Florida. Proc. 24th Annu. Cont. Southeastern Assoc. Game and Fish Commissioners: 154-169.

Williams, R.B. and D.C. Williams. 1968. Leach's Petrel along the North Carolina coast. Chat 32: 45.

Williams, S.O., III. 1978. Colonial Waterbirds on the Mexican Plateau. Pp. 44-47 in W.E. Southern (comp.). Proc. Conf. Colonial Waterbird Group, Dekalb, IL, 20-23 October 1977. viii and 205 pp.

Wilson, F.N. 1929. The loon at close range. Bird-Lore 31: 95-108.

Wingate, D.B. 1964. Discovery of breeding Black-capped Petrels on Hispaniola. Auk 81: 147-159.

_____. 1972. First successful hand-rearing of an abandoned Bermuda Petrel chick. Ibis 114: 97-101.

_____. 1978. Excluding competitors from Bermuda Petrel nesting burrows. Pp. 93-102 in S.A. Temple (ed.) Endangered birds. Management techniques for preserving endangered species. Internatl. symp. on management techniques for preserving birds. Univ. Wisc. Press/Madison, WI. 466 pp.

Wolf, K. 1955. Some effects of fluctuating and falling water levels on waterfowl production. J. Wildl. Manage. 19: 13-23.

Woodard, D. 1966. The changing seasons; the winter season: December 1, 1965-March 31, 1966; Central Southern Region. Aud. Field Notes 20: 431-433.

Woodward, P.W. 1972. The natural history of Kure Atoll, northwestern Hawaiian Islands. Atoll Res. Bull. 164. 318 pp.

Woolfenden, G.E. 1956. Preening and other behavior of a captive Horned Grebe. Wilson Bull. 68: 154-156.

_____. 1965. A specimen of the Red-footed Booby from Florida. Auk 82: 102-103.

_____. 1973. The changing seasons; the winter season: December 1, 1972-March 31, 1973; Florida Region. Am. Birds 27: 603-607.

Woolfenden, G.E. and F.E. Lohrer. 1968. Great Cormorant seen on Old Tampa Bay, Florida. Fla. Nat. 41: 169.

Woolfenden, G.E. and R.W. Schreiber. 1973. The common birds of the saline habitats of the eastern Gulf of Mexico: their distribution, seasonal status, and feeding ecology. Pp. IIIJ-1 - IIIJ-21 in J.I. Jones et al. (eds.). A summary of knowledge of the eastern Gulf of Mexico, 1973. Martin-Marietta Aerospace, Orlando, FL.

Wray, D.L. and H.T. Davis. 1959. Revised edition of birds of North Carolina (1942) by T.G. Pearson et al. Bynum Printing Co., Raleigh, NC. xxvii and 434 pp.

Wynne-Edwards, V.C. 1953. Leach's Petrels stranded in Scotland in October-November, 1952. Scott. Nat. 65: 167-189.

Yocum, L.F., S.W. Harris and H.A. Hanson. 1958. Status of grebes in eastern Washington. Auk 75: 36-47.

Young, T.R. and J.C. Dickinson. 1937. 1937 Tortugas expedition. Fla. Nat. 11: 1-6.

Ytreberg, N.J. 1957. Horndykkerens (Podiceps auritus L.) forekomst i Norge og noen trekk fra dens biologi. [The occurrence of the Slavonian Grebe (Podiceps auritus L.) in Norway and some data of its breeding biology.] Det Kgl. Norske vidsk. Selsk. Museet Arbok 1956-57: 49-74. [In Norwegian.]

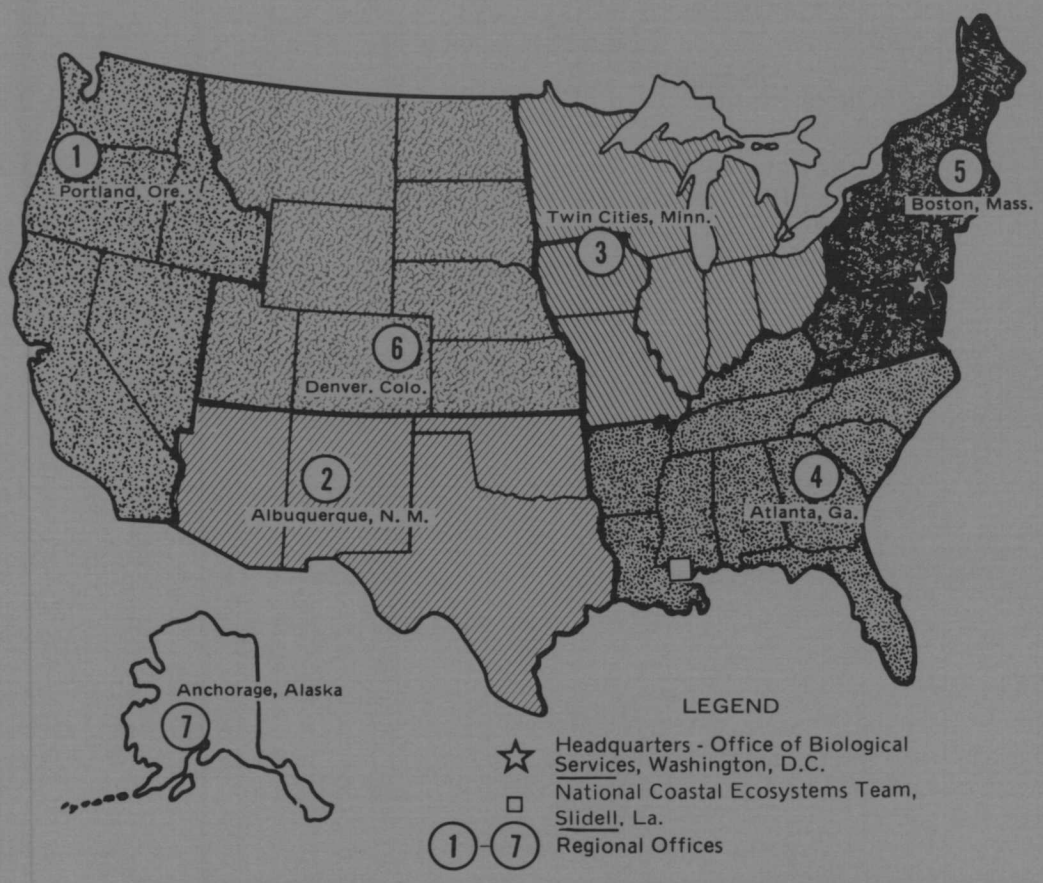
Zimmerman, D.A. 1968. Specimen of the Magnificent Frigatebird from New Mexico. Condor 70: 398.

Zimmerman, D.R. 1975b. To save a bird in peril. Coward, McCann, and Geoghagen, Inc., New York, NY. 286 pp.

Zinn, K.S. 1977. Olivaceous Cormorants nesting in north central Texas. Southwest. Nat. 21: 556-557.

_____. (comp.). 1978. Sabine National Wildlife Refuge, La. The 77th Audubon Christmas Count--December 17, 1977. Am. Birds 32: 739.

Zino, P.A. 1971. The breeding of Cory's Shearwater Calonectris diomedea on the Salvage Islands. Ibis 113: 212-217.



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