

# Marine Birds off the Coast of North Carolina

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## ABSTRACT

Records of 71 species of sea birds occurring along and off the North Carolina coast are summarized from published literature sources and from fifteen years (1975-1989) of offshore observations. At least 15 species of birds not previously established as occurring off North Carolina were documented with specimens or photographs during this study, and an additional 7 have been reported based on sightings.

The relatively rich foraging grounds off the Outer Banks of North Carolina account for such a diversity of species of marine birds that assigning the status of accidental or vagrant to even the rarer species might not be appropriate. The local marine micro-environments, are highly variable and account for the area's ability to provide a large species diversity. Seabirds are often simultaneously represented by temperate, boreal, and subtropical species all within a small geographical area. During the spring and fall, migrant species also contribute to the diversity. Although the Hatteras offshore area does not have the predictable large biomass of the Grand Banks during the summer months, it has the largest documented species diversity of pelagic seabirds (Lee 1986) and marine mammals (see Lee et al. 1982) in the western North Atlantic.

The distribution of seabirds in North Carolina's offshore waters is neither even nor random. Clear preferences for certain zones and seasons exist and are discussed in the individual species accounts.

## INTRODUCTION

For fifteen years, the North Carolina State Museum intensively studied marine birds off the northern North Carolina coast. These studies have revealed that the most diverse assemblage of seabirds anywhere in the North Atlantic occurs off this area. Although the diversity partly reflects local field work, the latitudinal position of North Carolina and its location in relation to the Gulf Stream, Labrador Current, and the edge of the continental shelf contribute to the variety of seabirds in the area. The local marine micro-environment is highly variable as a result of interaction of wind current, surface salinity, water temperature, water depth, and season. The currents and variable micro-environment combine to produce a rich foraging ground which accounts for the species diversity.

So many species rely on the productivity of North Carolina offshore waters that even the rarer species may not be truly "accidental." Many represent birds from extremely small populations, some only by a few thousand pairs in the North Atlantic. Although the relatively rich diversity of species is offset by comparatively low densities, many of the tropical and sub-tropical species normally live at low densities (1.5 to 12.2 birds/km<sup>2</sup>). The seemingly limited local abundance of these species does not diminish the significance of North Carolina's offshore waters for the birds. For several species, North Carolina waters represent the only area where they have been regularly encountered away from nesting areas.

The Hatteras area has long been regarded as a biological "Mason-Dixon Line" between boreal and tropical maritime elements. The state is at a latitude usually associated with temperate seas; however, boreal and tropical species may follow or follow prey items transported by oceanic currents to North Carolina's offshore waters. Thus, the seabirds are often simultaneously represented by temperate, boreal, and subtropical species all within a relatively small geographical area. During the spring and fall, migrant species also contribute to the diversity; but, the offshore area is, for the most part, unoccupied and unexploited by locally nesting seabirds. It is clear that most of the birds found off the state's coast are not geographically or seasonally distributed randomly; but, the identification of the specific factors responsible for local distributions is difficult. Hopefully, the ecological patterns suggested here will help others clarify the micro-distributional factors governing marine bird distribution.

The accessibility of the offshore Hatteras area makes it a practical study site, and the combination of marine factors discussed above makes it a fortunate one. Since the North Carolina State Museum's research began, various publications have reported the museum's findings. An overview of the study and a summary of the first 2-3 years of field work was provided by Lee and Booth (1979) in a paper on the seasonal distribution of offshore and pelagic birds. During the course of this study, over 20 species of birds were discovered that were unknown or thought to occur only rarely in North Carolina, the southeastern United States, or the western North Atlantic (Lee 1976; Lee 1979; Lee, et al. 1981; Lee and Platania 1979; Lee and Rowlett 1979; and Lee 1986a). Several detailed papers on the biology, natural history and phenology of seabirds have appeared and several studies on the life histories of specific species are in preparation. Such reports concern petrels and storm-petrels in North Carolina (Lee 1984) gannets and boobies in the Carolina's and Georgia (Lee and Haney 1984), the occurrence of Black-capped Petrels (Lee 1976), tropicbirds (Lee and Irvin 1983), Arctic Terns (Lee and Cardiff 1993) and Manx Shearwater (Lee 1995), and preliminary studies document mercury levels in organs and feathers of pelagic and inshore seabirds (Whaling et. al. 1980; Whaling and Olson 1981). A detailed analysis, currently in manuscript form, shows some interesting trends in mercury ingestion by local birds. In addition, a study on ingestion of plastics by North Carolina seabirds (Moser and Lee 1989) using information from this same series of birds has been completed. A study on the body temperatures of actively foraging seabirds was also published (Platania, Grant, and Lee 1981).

Two graduate students earned master degrees using materials collected during these offshore trips (Mobley 1980, 1981; Mobley and Miller 1982; and Brown 1980).

Starting in 1985, the Department of the Navy provided funds for the museum to study and monitor relatively shallow (10-20 fathoms) shelf waters in the Virginia Capes area, north and inshore of our principal study site. Information obtained from these studies has greatly complemented previous work on the general zonal distribution of marine birds as it relates to currents, upwellings and other factors governing surface productivity.

Early in this study, I determined that a minimum of 10 survey trips were needed to obtain a reasonable picture of the seasonal fauna (see methods). This goal was difficult to meet. One of the problems with offshore observations, in addition to the

unpredictable nature of seabirds, is scheduling trips in advance. Hayden (1975) pointed out that mid-Atlantic coastal wave climates have increased in duration and frequency in the last three decades. His data indicate that the greatest monthly frequencies of storms (waves greater than 5 feet at Cape Hatteras, North Carolina) now occur during months when bird diversity is high (the migration months of October and April) and at the time of year for which our knowledge is the least complete (December through April). In contrast, storm frequency is lowest from June through September, when the summer resident offshore avifauna is most stable and when biomass is small.

## METHODS AND OBJECTIVES

The primary objective of the research has been seasonal inventories; however, the zonal distribution of all species as it relates to season, water depth, and water temperature has also been recorded. Because our studies were collection-oriented, much information on common species such as taxonomic variations, food, molt, age weight, sex ratios, parasites, body temperature, and mercury loads is available. Specimen data are currently being prepared for publication. In the past, most detailed studies of marine birds have been conducted on the breeding grounds, and little information is available concerning their biology while at sea. The studies were focused on the outer Continental Shelf and slope, and in the Gulf Stream and inshore marine birds such as grebes and sea ducks are not even discussed in this report. For groups such as gulls and terns where some species are pelagic and others are confined to coastal zones, the pelagic birds are discussed in detail and the inshore species are mentioned in annotated lists. Lee and Booth (1979) discussed in more detail the rationale for species inclusion.

One day transects through as many marine zones as possible were run from the Outer Banks of North Carolina. Lee and Soggi (1989) showed locations of LORAN readings from these trips by month. These transects were conducted from chartered fishing boats that departed from Oregon Inlet or Hatteras Inlet. Shallow inshore waters, the edge of the continental shelf, and deep waters were surveyed, including the Gulf Stream and its inner edge. Areas of bird concentrations were identified and recorded and species composition was noted. Often, small samples of birds were collected with shotguns. Birds were frozen and processed later at the museum. Water temperature, LORAN readings and sea conditions were recorded regularly, as well as when any unusual observations were made. Although day length varies considerably the number of hours spent surveying was similar for all seasons. The number of observers per trip varied, but an increase in number of trip participants did not result in an increase in the number of birds tallied.

Although there have been many suggestions for methods of estimating, counting, and quantifying the numbers of birds encountered at sea (e.g. Powers 1982), off North Carolina, densities of birds are such that it is usually possible to count every individual, or at least to make fairly accurate estimates of flock size. Often, densities are so low that counting birds only during pre-established time blocks and only above pre-determined areas in relation to the position of the boat, would provide extremely limited sampling, miss many species altogether, and because of the concentrations of birds over current edges, feeding fish schools, etc., would provide a biased sample. Therefore, every bird that was seen and identified was counted. Such sampling provides

relatively consistent seasonal comparative information, but I recognize that larger high-flying birds can be seen at greater distances than smaller low-flying species. I have made no attempt here to correct for this or other sampling factors. Comparative information on numbers within a given species (or species groups such as storm-petrels) is more consistent than it is for comparing total numbers between species. Likewise, tallies from survey trips with rough seas, rain or other unfavorable factors are not as reliable as those from calm clear days (see discussion by Rowlett 1980). I do not believe that comparisons between our surveys and those done off other states are possible based on the information presented here. Variations in boat speeds, hours surveyed in each zone, and other factors would need to be considered prior to detailed comparisons. Within the parameters of this study, however, I believe results of different aspects and seasons of this study are comparable.

Numbers presented in this report are of actual counts or, for large aggregations of birds, are minimal estimates. Identifications were normally to species and information such as flocks of "white *Sterna*" are not included here except as total number of birds observed. We were much more critical in our identification of rarer species, and occasionally collected individuals to confirm such identifications. Seven species discussed in this report that apparently occur off North Carolina, have not had their identification confirmed by photographs or specimen. This makes it inadvisable to place them on the official list of state birds but most if not all occur in the states offshore waters. Three, at least, have been confirmed in adjacent states (Yellow-nosed Albatross [Va], Little Shearwater [SC], and Ivory Gull [Potomac River] and two others have been sighted elsewhere in the southeast (Black-browed Albatross [Fla], Soft-plumaged Petrel [Ga]). Sightings of two species, the Bermuda Petrel and the Cape Petrel, are less certain (see remarks in individual species accounts). Except for the Black-browed Albatross, most North Carolina records of these birds prior to 1990 are ones first obtained during these studies.

We have now completed 231 offshore trips mostly in the spring, summer and fall (see Table 1). Variability in seasonal sampling resulted from availability of boats, weather patterns, and because our funding largely stipulated offshore summer data collections. We found extreme variability in day-to-day and perhaps year to year bird concentrations and demonstrated that concentrations are related to variations in food resources. Thus, many trips are needed during each calendar period and over an extended period of time to illustrate normal variation in patterns of distribution and zones of occurrence. Based on results of this study I believed that at least 10 trips per month is the minimum sample size necessary to evaluate the normal range of variation. This sample size was obtained for all months except January, February, and March. However, analysis of monthly diversity compared to survey effort show all but the rare species to be documented in the first few offshore trips.

Values in figures illustrating seasonal distribution of specific birds were calculated using the average number of individuals seen per trip by two week intervals. This helps averaging variations in the number of individuals of a species seen on a given date. The information obtained in shallow shelf waters is not included in the figures presented with species accounts. Inclusion of surveys conducted on dates when only shelf waters were surveyed greatly biased the patterns illustrated. This is because of the

large number of days spent on these surveys (mostly during June, July, and August) and the extremely low total number of birds encountered. On the other hand, for monthly summaries and information on zonal distribution all records are included.

Table 1. Number of one-day offshore surveys off North Carolina (1975-1989) by month and half month periods, with average number of individual birds and total number of species recorded.

Month	# of Offshore Trips (day 1-15/day 16-end)	Average # Birds Recorded Per Trip	Total # Species Recorded
January	8 (1/7)	1538	16
February	7 (2/5)	2299	18
March	6 (3/3)	6721	18
April	22 (6/16)	411	34
May	16 (5/11)	267	29
June	29 (9/20)	240	34
July	33 (14/19)	426	26
August	47 (25/22)	471	30
September	27 (13/14)	286	26
October	14 (9/5)	241	22
November	10 (6/4)	325	27
December	12 (4/8)	1122	22
Total # Trips	231	Average # Birds Per Trip	Average # of Species
		1201	25.16

Thirteen summer (June-August) trips were analyzed for zonal distribution of marine birds as they relate to water depth. The summer period was chosen because offshore sea bird populations are most stable at this time. All trips chosen for this analysis departed from Oregon Inlet, NC. All records of seabirds (N = 5,316) dates, times of observations, LORAN reading, number of individuals observed, water depths and water temperature for these were entered into a dBase III program. For analysis of seasonal faunal composition total numbers of all species of birds encountered per month were entered on Macintosh Plus computer using a Microsoft Excel program. This aspect of the study appeared in Lee (1986) and Lee and Socci (1989).

Other major sources of information and abbreviations used in the text are: A.B. = American Birds; Atl. Nat. = Atlantic Naturalist; B.N.C. = Birds of North Carolina; Chat = The Chat; N.C.S.M. = North Carolina State Museum; and U.S.N.M. = United States National Museum. An asterisk (\*) indicates a N.C.S.M. specimen record. Observations, record dates, and statements that lack literature citations are from my personal records. No reports published after 31 December 1994 are included, but articles on specific species are included through September 1995.

All species of seabirds known or for which there are unconfirmed reports from the state's offshore waters are discussed. Appendix A summarizes the criteria for each

species included in this study. Information summarizing local status, and season and zone of occurrence is provided for the more common species. Most species accounts include remarks relating to local biology. Accounts for marine birds only rarely encountered offshore are presented in less detail.

The primary purpose of this publication is to provide in a single document an overview of a 15 year survey of the marine birds off the outer continental shelf area near Cape Hatteras North Carolina. While the information presented here is more than preliminary it is not inclusive. Although the field work is essentially complete most aspects of this study presently remain undeveloped.

I should point out that this manuscript was essentially completed by mid 1989. I have attempted to bring it up to date by adding references to studies published since that time and including the recent observations of birds that expand our local knowledge on various species. Nonetheless, this current version of the manuscript is a patchwork and certainly some relevant information was overlooked.

## SPECIES ACCOUNTS

### Common Loon (*Gavia immer*)

Status: Common migrant and winter resident.

Typical Season of Occurrence: November through April. Some migration is still underway in early May, and a few fall migrants are present by mid-October. Although records exist for every month for North Carolina, no birds have been observed at sea between June and late October (Fig. 1).

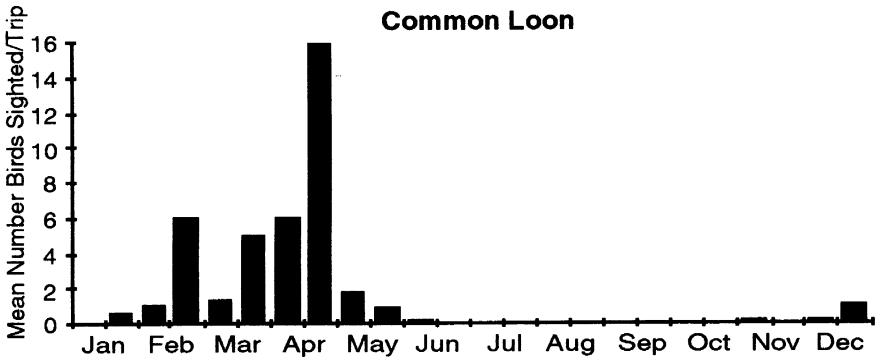


Fig. 1. Seasonal abundance of Common Loon in half month increments.

Maximum Counts: Over 73 were seen offshore on 17 April 1989.

Zone of Occurrence: Most Common Loons frequent waters inshore of the 20 fathom contour, but small numbers winter far out to sea. Haney (1990) estimated up to 20,000 individuals wintering in shelf waters between 29° and 35°N latitude. Most were in waters 0-19 meters in depth. Many inland records of migrants are also available for North Carolina.

Remarks: Lee (1987a) noted that Common Loons which were found offshore of

N.C. were normally not associated with current edges, schools of surface-feeding fish, or other seabirds. However, on 22 January 1986, three solitary Common Loons were found along a tide line in which large mats of *Sargassum* had accumulated. This tide line was more than 9 miles (15 km) in length and followed a contour of approximately 600 to 700 fathoms. Two loons were also found feeding in water 200 to 300 fathoms deep on 14 February 1987. These two birds were associated with other seabirds that were foraging among schools of False Albacore (*Euthynnus alleleratus*) along a small current edge. The association with current edges may indicate that loons, like other marine birds, are attracted by the potential of prey at marine fronts. (Haney and McGillivray [1985b] provided evidence for the distribution of marine birds along these fronts and explained their potential for increased productivity near the ocean's surface.)

The Common Loons encountered in areas of overlapping currents probably were foraging in the rich upper levels of the mixing waters rather than on the floor of the ocean. Dives by Common Loons to depths of 180 to 200 feet have been reported (Schorger 1947), but it is certain that Common Loons do not feed near or on the bottom of water 500 fathoms (3000 feet) deep (Lee 1987).

#### Other Loons

As far as is known in the southeast only the Common Loon winters at sea and is an epipelagic migrant. There is only one other species of loon that occurs regularly in the state and one other which has been seen on two occasions. Each is discussed briefly.

Red-throated Loon, (*Gavia stellata*.) This loon is a common migrant and regular winter resident along coastal North Carolina. Red-throated Loons rarely occur inland and we have no records of birds at sea. They are most common around inlets and in sounds. The species is usually found from late October through mid-May, but occasional birds may linger through the summer (late May, June, July, August).

Pacific Loon, (*Gavia pacifica*). There are several reports of this Pacific species from North Carolina (15 May 1987, Tove 1989 and 17 February 1974, Am. Birds 28:626-628, 24 March 1993 and 30 April 1993, Chat 58:59). Additional records are available for the southeastern United States including a specimen from just above the North Carolina-Virginia state line (University of Michigan, R. Storer per. comm.).

#### Albatrosses (*Diomedea* sp.)

Status: Rare vagrants. Both the Yellow-nosed Albatross, *D. chlororhynchos*, and the Black-browed Albatross, *D. melanophris*, have been reported but the latter has not been confirmed in the North Atlantic (McDaniel 1973).

Typical Season of Occurrence: The vagrant status and problems of identification prevent establishment of a typical season of occurrence. Two of the birds seen in North Carolina waters, an adult on April 17, 1978 (Lee and Booth 1979) and an immature reported on December 22, 1985 (Lee 1987) were probably Yellow-nosed Albatrosses. There is an August record of Black-browed Albatrosses off Morehead City (Dumont 1973).

Zone of Occurrence: All North Carolina records have been far at sea (200 fathoms,

[Lee 1987b]), but there are records from sounds and beach fronts in other parts of the southeast.

Remarks: The North Carolina sightings are not adequate for specific identification, and records for neither species have been accepted by the state's bird record committee. Observations of the Yellow-nosed Albatross are available in neighboring states and the southeast (Virginia, *Am. Birds* 34:260, 36:162; Florida, *Aud. Field Notes* 12:405; Louisiana, *Am. Birds* 24:615; and Texas, *Am. Birds* 26:875, 31:197). An injured Yellow-nosed Albatross was found on Key Largo, Monroe County, Florida in late May 1992 (*Am. Birds* 46:413). This is the first specimen record from North America. In addition to the single North Carolina report of the Black-browed Albatross (DuMont 1973), there is a Florida sighting (*Am. Birds* 29:44).

#### Northern Fulmar (*Fulmarus glacialis*)

Status: Common though irregular visitor off Cape Hatteras and northward. Uncommon south of Cape Hatteras.

Typical Season of Occurrence: Maximum numbers are found in March and the species is often common in April and late October (Fig. 2). They are seen sporadically in most other months although none has been sighted in August or September (Lee 1986a).

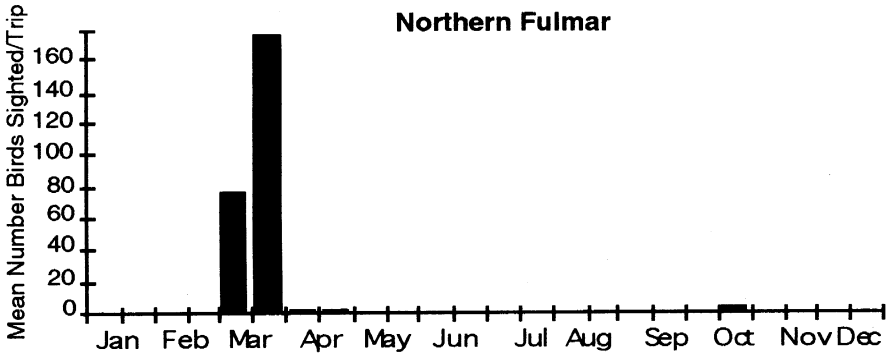


Fig. 2. Seasonal abundance of Northern Fulmar in half month increments.

Maximum Counts: 227 individuals were seen on 26 March 1981.

Zone of Occurrence: Fulmars are usually found on or near the edge of the Gulf Stream or other major marine fronts where upwellings and current edges concentrate food.

Remarks: Fulmars were unknown as far south as North Carolina prior to 1979 (Lee and Rowlett 1979). Since then, they have increased both in numbers and regularity of occurrence (Lee 1986a). Fisher (1952) suggested that the expansion of the range of Northern Fulmars at sea into the northeast Atlantic during the last two centuries could be attributed to the growth of commercial fishing and whaling industries. Wynne-Edwards (1962) disagreed with Fisher and suggested that the expansion resulted from the appearance of a new genotype that was capable of nesting



in lower latitudes in small, scattered colonies. Salomonsen (1965) proposed that recent oceanic temperature changes may relate to current fulmar distribution in the eastern and western North Atlantic. Similarly, Brown (1970) stated that feeding distribution was closely linked with cool water, but not fishing activity. Although no explanation is completely satisfactory, there is no doubt that the Atlantic population of Northern Fulmars has expanded south. Counts of fulmars on the Georges Bank off Massachusetts have reached up to 3,000 birds in a single day (Am. Birds 31:304), yet only two decades ago, the species was scarce south of Canada.

#### Cape Petrel [also known as Cape Pigeon] (*Daption capense*)

Status: A possible rare vagrant. The single North Carolina sight record (Lee 1986b) is only the second reported occurrence for the western North Atlantic. Lacking specimens, this species is not recognized on the official list of North Carolina birds. The A.O.U. (1983) does not recognize any records from the Northern Hemisphere as valid.

Typical Season of Occurrence: The date of the only record is 26 July 1985.

Zone of Occurrence: The record is from 200 fathoms.

Remarks: The only other record of the Cape Petrel in eastern North America is of a single bird collected in June of 1873 at Harpswell, Cumberland County, Maine (Norton 1922). Although there has been some controversy regarding this record, it appears to be valid (see Forbush 1929). Several other Northern Hemisphere sightings have been made off the Pacific coasts of Mexico and California (A.O.U. 1983). Cape Petrels have been reported off the European coast, at least five of these records are fairly well substantiated (Cramp and Simmons 1977). Nevertheless, most records from the northern hemisphere have been treated as suspect by some authors because of the possibility of intentional transport and release by sailors (Cramp and Simmons 1977). Lee (1993), for example, demonstrated that the pre-1853 specimen record of a Cape Petrel reported to be from off Monterey, California was not valid. In that study the validity of the Maine specimen is also discussed.

#### Black-capped Petrel (*Pterodroma hasitata*)

Status: Regular and common off North Carolina, but undocumented in the state prior to 1976 (Lee 1976).

Typical Season of Occurrence: Found during all seasons but most common during May, August, and late December through early January (Fig. 3).

Maximum Counts: Over 160 birds were seen on 22 May 1980, over 115 were seen on 28 December 1982, over 104 were seen on 8 May 1980, 82 were seen on 24 August 1985, and 154 were seen by Rowlett (pers comm.) on 8 September 1979. For additional high counts in the summer of 1992 see Chat 57:77.

Zone of Occurrence: Generally restricted to relatively deep water (100-1000 fathoms), Black-capped Petrels are most common in waters deeper than 500 fathoms (see Fig. 17 in Lee & Soggi 1989).

Remarks: Black-capped Petrels were long thought to be extinct (Haney 1987). A breeding population was discovered in southeast Haiti in 1961 (Wingate 1964) and a

small population was reported in eastern Cuba in 1977 (Bond 1978). The actual population size of this species is unknown but it is believed to be small. Populations are hard to locate and monitor because of their secretive, nocturnal nesting on inaccessible cliffs. The species has been extirpated from a large portion of its former breeding range.

In view of their mobility, high flight speeds, and the regular occurrence of adults off North Carolina's coast in the breeding season, it is likely that birds nesting in Haiti actually commute to North Carolina waters to feed (Lee and Haney ms).

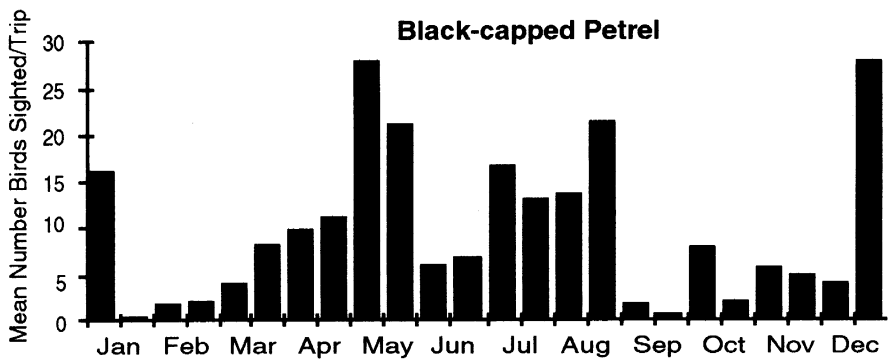


Fig. 3. Seasonal abundance of Black-capped Petrel in half month increments.

Because of their secretive inland nesting behavior, presence of unidentified breeding populations in the Bahamas, Greater Antilles or Lesser Antilles is possible. In January of 1992 Nicasico Viña (Univ. of Oriente) and I visited the area in the Sierra Maestra in eastern Cuba where Black-capped Petrels were reported. In 1977 Viña had collected six birds in this region. This was the only record for Cuba. This discovery was later interpreted by others (i.e., Bond 1985) as evidence that the species nested in the Sierra Maestra. Our 1992 field work in eastern Cuba indicated that, although this petrel was coming in at night to feed in a small restricted upwelling area adjacent to Cuba's southeastern coast, there was no indication that the species was flying inland to nests in the mountains (Lee and Viña 1993).

Without evidence of nesting in Cuba known breeding areas are restricted to the mountain ranges in southern Hispaniola where this petrel faces a number of conservation problems. The global population of Black-capped Petrels must be regarded as small and highly vulnerable. The recently discovered Dominican population (Ottenwalder and Vargas 1979) is quite small and apparently declining (>5 pairs January 1990; Lee and J. C. Haney, pers obser.). Because the species occurs regularly, and is sometimes common off the North Carolina coast, and because of the relatively small numbers known to nest in Hispaniola, it seems reasonable to assume that a significant portion of the total population is foraging off the coast of the southeastern United States, especially North Carolina.

Brinkley (1994b) discussed the evasive behavior of a Black-capped Petrel attacked

by a skua.

#### Bermuda Petrel (*Pterodroma cahow*)

Status: Possible rare visitor. Because of the lack of specimens, Bermuda Petrels are not officially recognized as occurring in North Carolina or North American waters.

Typical Season of Occurrence: At least six possible sightings of Bermuda Petrels have been made off North Carolina; however, only two birds were seen well enough to be identified with reasonable certainty. They were seen in April and December (Lee 1984; 1987b).

Maximum Counts: All reports are of single birds.

Zone of Occurrence: All reports are from deep water (1000+ fathoms) in the Gulf Stream.

Remarks: Watson (1966) noted that both *P. hasitata* and *cahow* have "occurred along the U.S. coast." There is apparently no basis for this statement (cf AOU 1983) and I am not aware of any pre-1966 reports away from Bermuda. Furthermore, the Bermuda Petrel closely resembles the Black-capped Petrel making identifications at sea difficult. The Black-capped Petrel is also represented off North Carolina by a smaller darker form of unknown origin that is similar in appearance and size to the Bermuda Petrel (Lee 1984). Therefore, the North Carolina records are tentative identifications only.

#### Soft-plumaged Petrel (*Pterodroma 'mollis'*)

Status: Possibly a very rare vagrant. Not on the official list of North Carolina or North American birds because of the absence of specimens (see Remarks).

Typical Season of Occurrence: All North Carolina reports are from May and June, but there is a November report from off Georgia.

Zone of Occurrence: The records are from deep (1000+ fathoms) Gulf Stream water.

Remarks: The three forms of *P. mollis*, all previously regarded as subspecies, are now recognized as separate species - *P. mollis*, *P. feae* and *P. madeira* (Bourne 1983). Distinguishing these birds by sight alone is difficult, perhaps impossible. Since the description of the bird off North Carolina (Lee 1984), there has been a second published report for North America. Haney et al. (1993) discussed a sight record of the Fea's Petrel, *Pterodroma feae*, made 145 km due east of St. Catherine's Island, Georgia on 9 November 1984. The status of the *P. mollis* complex in the North Atlantic was reviewed in this same publication. Based on the description they determined that the individual I saw off of North Carolina (Lee 1984) was the Soft-Plumage Petrel, *P. mollis*. They noted that my spring record was in the austral winter, a period when the southeast trade-winds extend north across the equator. They suggest that the additional spring reports from North Carolina, including a photographic record of *P. mollis* (Anon 1992), were from the southern hemisphere population. While *P. mollis* has now been reported from North Carolina's offshore waters, it is likely, based on the Haney et al. (1993) report, that either Atlantic taxa (*P. madeira* and *P. feae*), could also occur here as well. To date this has not been documented, but a recent photographic record (NCSM photo files no. 305; a video tape) appears not to be *P. mollis*. Thus,

while *P. feae* is now reported from North American waters (Haney et al. 1993) specific identity of birds found off North Carolina is still not clear. For example a male specimen of *P. feae* (USNM 536445) from the Cape Verde Islands has a distinct breast band that is nearly complete. While the area where the two bars extend into the breast do not come in contact, this could have been overlooked on the bird I saw. In the photograph (Anon 1992, Am Birds 46:1130) from 24 May 1992, however, the bird does appear to have a complete breast band.

There are numerous published studies that illustrate the difficulty of attempting to identify a specific individual bird of this group to a named taxon. These problems become magnified when dealing with sight reports and photographs made at sea. *Pterodroma mollis* (and probably other species in this complex) exhibit considerable dichromatic plumage variation (Schramm 1982) leaving major differences in their breeding distribution and phenology and slight differences in size (around 7 to 9% for wing measurements) as the reasons for their proposed specific status. (Note that this size difference is less than that between male and female Black-capped Petrels—a difference impossible to document on birds observed at sea.) Furthermore, birds with breast-bands have been seen among local birds that lack breast bands during a southward movement of seabirds off Madeira (W. R. P. Bourne pers. Comm.) and in the original study that elevated North Atlantic populations to full species, Bourne (1983a) states "...there is such a wide range of variation and overlap in their appearance, so that plumage is not a very satisfactory basis for their classification." Bourne (1983b) also reports on a *Pterodroma* specimen from Israel that had measurements in the "region of overlap of the southern form *P. mollis* and its larger representative in the North Atlantic *P. feae*." He notes that it lacked a pectoral band suggesting that it was *P. feae*.

Bibby and Del Nevo (1991) reported on a single record of *P. feae* from the Azores. However, they went on to say that in appearance and most measurements it was "close to *feae* but with a longer tail more like that of *cahow*." They further stated the unexpectedly early date for *P. feae* to be ashore in the Azores with a brood patch may indicate that this population is a link between *feae* and *cahow*, two North Atlantic taxa that should perhaps be classified as a single species (see Imber 1985). Monteiro and Furness (1995) captured, photographed and measured another individual in the Azores and concluded their bird was larger than those of the Cape Verde population of *P. feae* and most like those of the small (few dozen pairs) population of *P. feae* of Bugio in the Desertas Islands. Persons reading these accounts will appreciate the levels of difficulty in the identification of these birds even when they are in the hand.

Despite the persistent frustration of not knowing which species of the 'mollis' complex occur in North Carolina (and it is quite likely there is more than one), in this case collecting of a specimen is not justified. First, it is quite possible that a single bird could not be conclusively identified to species even if it was collected. Furthermore, this would still not resolve the issue as to how many species actually occur off North Carolina or any trends in differential seasonal distributions. Second, and more importantly, *P. feae* and *P. madeira* are the rarest of European birds. *Pterodroma feae* has a total population estimated to be a few hundred pairs and *P. madeira* has a population of less than 50 pairs nesting in a single colony. The very

suggestion in 1993 by one of our local seabird enthusiasts that a North Carolina bird should be collected (under our museum's collecting permit, and despite our refusal to allow this) stirred a minor international incident (W. R. P. Bourne pers. comm.). While it is fun and interesting to speculate on the origins of the North Carolina soft plumaged petrels, we all must recognize that the questions concerning specific identity of these birds may not be resolved for some time. While there is little doubt that these are valid species, the criteria under which they are evaluated do not lend themselves to identification through the general methodologies of birdwatchers. Minimally, we must have the patience to await for their global variations to be better documented.

North Carolina reports of petrels from this species complex are available for 3 June 1981 (believed to be *mollis* by Haney et al. 1993, Lee 1984), 25 May 1991 (stated as "almost certainly the *faeae* race" with no supporting evidence, American Birds 45:433), 24 May 1992 (photo stated to be *mollis*, Anon. 1992 and based on the development of the breast band in photograph in Am Birds [46:1130] appears to be *mollis*), and 27 June 1992 (Chat 57:77).

#### Herald Petrel (*Pterodroma arminjoniana*)

Status: Uncommon summer visitor with marked increase in the number of reports since being recorded in 1978 (Lee 1979). Total of 10 records and reports to date.

Typical Season of Occurrence: mid to late summer.

Earliest Spring Record: 21 May 1991 (Am. Birds 45:433).

Latest Fall Record: 26 September 1993 (Chat 58:126).

Maximum Counts: All sightings have been of single birds.

Zone of Occurrence: Most North Carolina records are from deep water (1000+ fathoms) off the Outer Banks. The 8 August 92 report is from over a mere 17 fathoms of water (Chat 57:100).

Remarks: Palmer (1962) and Murphy (1936) discuss and describe the variation in coloration of Trinidad Petrels. Individuals from the only known South Atlantic nesting site exhibit extreme variability including a light phase with white and black feet and legs, an intermediate phase with pink and black feet and legs, and a dark phase with all black feet and legs (Lowe and Kinnear 1930). Most North Carolina records and reports have been of dark phase birds.

#### Bulwer's Petrel, (*Bulweria bulweria*).

Hass (in press.) conducted offshore surveys, as an outgrowth of the study summarized herein. He identified a Bulwer's Petrel 50 miles ENE of Cape Hatteras (35°29'N 74°47'W) on 1 July 1992. This is only the fourth report for North America and the details of this record will be published elsewhere. Haney and Wainright (1985) described a Bulwer's Petrel seen on 1 May 1984 off northeastern Florida. Taylor (1972) observed this species on 14 May 1969 between Key West and Dry Tortugas, Florida and Lee (in Haney and Wainright 1985) briefly saw a bird fitting the description of this species off North Carolina on 6 June 1979. Additional sight records exist for the southeastern Caribbean and Netherlands Antilles (Haney and Wainright 1985), but the only conclusive documentation for this hemisphere is of a bird found on Soldado Rock

off Trinidad (French 1963).

### Cory's Shearwater (*Calonectris diomedea*)

Status: Common, often abundant migrant. Common offshore summer visitor.

Typical Season of Occurrence: Common from mid-May through mid-November (Fig. 4).

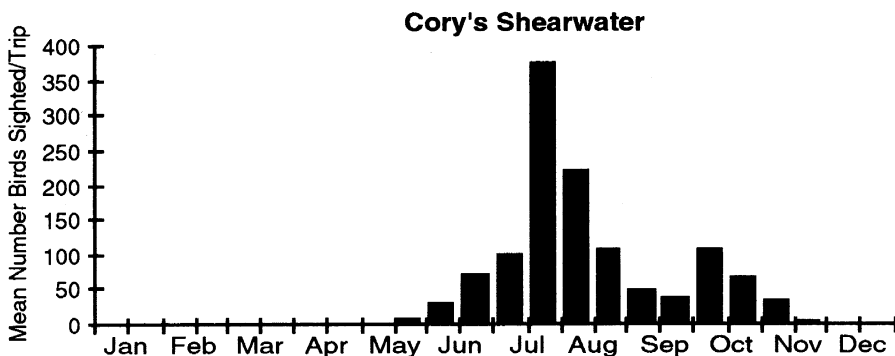


Fig. 4. Seasonal abundance of Cory's Shearwater in half month increments.

Earliest Spring Record: 8 March 1979 (Chat 43:96).

Latest Fall Record: 29 November 1979 (Chat 44:45).

Maximum Counts: The highest offshore count made during my studies was of over 3,174 birds on 19 July 1989. Rowlett (1978) and Buckley (1973) reported on large assemblages, up to 5,000 individuals, of these birds off Cape Hatteras.

Zone of Occurrence: Most common near the edge of the continental shelf and the edge of Gulf Stream, but large numbers may follow schools of fishes into other zones. Occasionally, large numbers are seen from land (Buckley 1973, Rowlett 1978).

Remarks: The type locality of *Calonectris diomedea borealis* is Chatham Island, Cape Cod, Massachusetts, and a series of Cory's Shearwaters I examined from off Woods Hole in the US National Museum are all of this race. Casual examination of material in other museums suggests that *borealis* is the most common race off the northeastern United States, while *C. d. diomedea* is well represented among the few specimens available from the southeast, including North Carolina. Both races are found off North Carolina with the nominate more common among 77 specimens examined (75.3%). Marine segregation of the two races is undetermined; *C. d. diomedea* is occasionally found off New York (AOU 1957) and all specimens from South America are *C. d. borealis* (Blake 1977).

### Greater Shearwater (*Puffinus gravis*)

Status: Common to abundant migrant. Often common offshore summer visitor.

Typical Season of Occurrence: Mid-May through mid-November (Fig. 5).

Earliest Spring Record: One possible Greater Shearwater was seen on 2 April 1981, the earliest confirmed record is 17 April 1978.

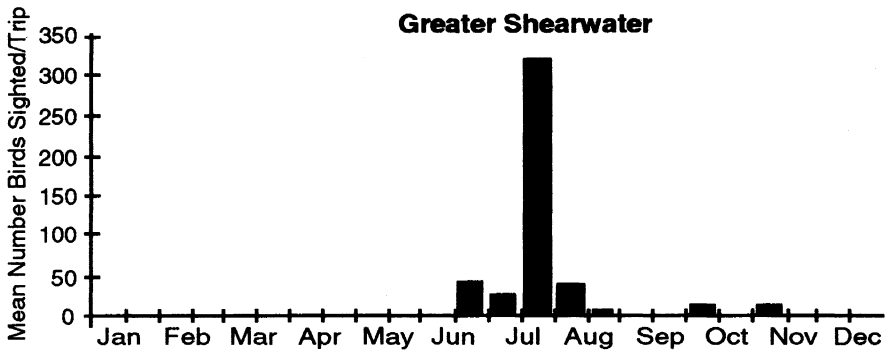


Fig. 5. Seasonal abundance of Greater Shearwater in half month increments.

Latest Record: 22 December 1985.

Maximum Counts: Over 2,950 were counted on 19 July 1989.

Zone of Occurrence: Greater Shearwaters typically occur along the inner edge of the Gulf Stream from 50 to 100 fathoms. However, this species often follows schools of feeding tuna into other zones.

Remarks: Wind conditions may arrest the northward migration of the young birds, and shearwaters arriving off North Carolina in late spring may die if insufficient food is available. Watson (1970) reported on a massive die-off of young Greater Shearwaters along the Carolina coast in early June 1969. Local newspapers reported 1000-2000 birds washed ashore along the eastern coast from the lower Delmarva Peninsula to Georgetown, South Carolina. Although extensive pathological testing failed to provide conclusive evidence for the cause of the deaths, the emaciated condition of the birds strongly suggested massive starvation. Similar but smaller die-offs occurred in late June and early July in the 1980s and 1990s (NCSM records and specimens).

#### Sooty Shearwater (*Puffinus griseus*)

Status: Fairly common spring migrant. Rare summer visitor and fall transient.

Typical Season of Occurrence: Most North Carolina records are from the last week of May and the first week of June with spring migration extending from mid-May through mid-June (Fig. 6). However, other individuals have been sighted in July, August, September and October (Lee 1986a).

Earliest Spring Record: 11 March 1973 (Chat 37:52).

Latest Spring Record: 29 June 1969 (NCSM 4068).

Maximum Counts: 233 north-bound migrants were counted on 23 May 1992 in 3.5 hours. 20 were counted in a hour off Core Banks on 20 May 1992 (Chat 57:54). Fifty birds were seen on 20 May 1977, the next highest count is of 8 Sooty Shearwaters on 20 May 1978.

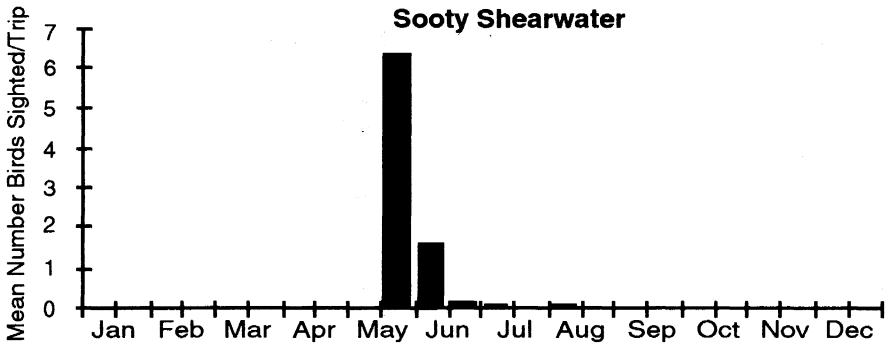


Fig. 6. Seasonal abundance of Sooty Shearwater in half month increments.

**Zone of Occurrence:** Many individuals migrate northward within a few miles of land (at least between Cape Hatteras and the Virginia line). Others are seen along the inner edge of the Gulf Stream, but large numbers are never seen which suggests that the majority of individuals migrate far offshore.

**Remarks:** No races are recognized although I am not aware of any comparisons of the morphometrics of Atlantic and Pacific populations. The Pacific population of Sooty Shearwaters numbers in the millions, but the Atlantic population is small. Atlantic birds are believed to be from nesting colonies in the Falkland Islands (Cramp and Simmons 1977), where the total population is estimated to be between one and ten thousand pairs (Croxall et al. 1984). Cooper et al. (1991) studied primary molt and migration patterns in Sooty Shearwaters based on South Atlantic beach-wrecked birds they found in South Africa. They suggested that breeding Sooty Shearwaters migrate preferentially into the North Pacific during the austral winter and that young birds, after molting in the South Atlantic, migrate into the North Atlantic. Based on the presence or absence of a bursa, both adult and young birds were collected while migrating along the North Carolina coast.

A Sooty Shearwater was reported from Bogue Sound near Emerald Isle on 14 July 1989 (Am Birds 44:74) and another was seen over Currituck Sound at US 64 (26 May 1990, Chat 55:35). These are the only North Carolina records not associated with a storm known to me of a bird not directly over the Atlantic.

**Manx Shearwater (*Puffinus puffinus*)**

**Status:** Uncommon offshore migrant. Uncommon winter visitor. Rare summer visitor. No confirmed records from North Carolina prior to 1979 (Lee and Rowlett 1979). Manx Shearwaters may be locally increasing in abundance.

**Typical Season of Occurrence:** Fall migration is underway as early as mid-October and peaks in late December, however, small numbers of birds are seen off North Carolina throughout the winter (Fig. 7). Spring migration is evident by mid-March and continues until mid-June.

**Maximum Counts:** Forty-two birds were counted on 16 March 1984.

**Zone of Occurrence:** With the exception of a few records of birds migrating near



the coast (i.e., Buckley 1973), all specimens and most positive visual records are from far offshore. Most of these birds were seen or collected along the inner edge of the Gulf Stream.

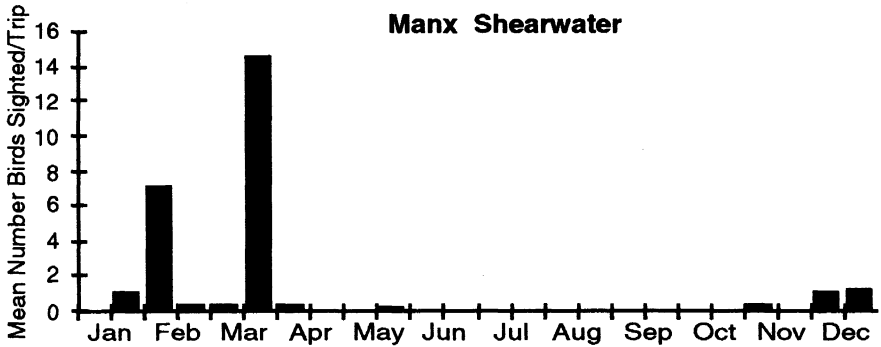


Fig. 7. Seasonal abundance of Manx Shearwater in half month increments.

Remarks: The general increase in the number of records in the southeastern United States parallels the recent expansion of the Manx Shearwater population. Some individuals occurring off the southeast area are probably from the newly formed North American colonies. Three Manx Shearwaters, banded in nesting colonies in Great Britain, were recovered in the southeast; a bird whose skeletal remains were found in 1975 in Texas had been banded at Hallival, Inverness, Scotland on 8 August 1973 (Clapp et al 1982) and two birds collected on 16 March 1984 off Oregon Inlet, North Carolina (NCSM 10108-9) had been banded as adults nearly 20 years previously (7 August 1967 and 30 June 1965) in colonies on Bardsey Island on the north coast of Wales (Chris Mead, BTO, per comm.). Banded birds from Bardsey Island have been recovered wintering off Brazil, and some have been recovered as far south as Argentina and Uruguay.

Lee (1992 and in press) surveyed the southeastern (Maryland to Texas) records of Manx Shearwater. While not common, this shearwaters occurred regularly in pelagic zones off the southeastern United States. The number of birds being reported each year seems to be increasing. Most occurrences, as expected, are during migration periods and 37.8% of all records are from the spring. The timing of migration is difficult to determine because birds are present throughout the winter and there are a small number of summer records. The local occurrence of molting adults and immatures indicates that at least some segment of the population does not undergo transequatorial migration. Based on band records it appears that summer records are, largely and perhaps exclusively, immature birds that are not obligated to return to their nesting areas in northern latitudes. The information presented by Lee (1992 and in press) on age and sex ratios, weights, molt sequence and food habits was the first recorded away from the species breeding grounds.

### Little Shearwater (*Puffinus assimilis*)

Status: Very rare possible visitor. In the absence of specimens or photographs, this species has not been confirmed as occurring in North Carolina.

Typical Season of Occurrence: Unclear, there are three winter reports and two summer reports. Most other western Atlantic records are of winter birds.

Earliest Record: 14 November 1978 (Lee and Platania 1979).

Latest Record: 21 February 1985 (Lee 1988b), plus two summer sight reports.

Maximum Counts: 15 individuals were seen 37 miles east of Diamond Shoals Light on 16 August 1987 (Lee 1988b).

Zone of Occurrence: Sightings of the Little Shearwater in North Carolina have been made in the 200 to 1200 fathom zone.

Remarks: For years, two specimens were the only indication that the Little Shearwater (*Puffinus assimilis*) strayed into the western North Atlantic. The first published record is of a bird that struck a lighthouse on Sable Island, off Nova Scotia, September 1, 1896 (Dwight 1897; Am. Mus. Nat. Hist. 407683). The second is actually an earlier record of a storm-exhausted bird picked up alive on Sullivan's Island, South Carolina, in August 1883 (Mus. Comp. Zool. 220051). This bird, mistakenly identified as an Audubon's Shearwater (*Puffinus lherminieri*), changed hands several times, and it was 40 years before it was correctly identified (Peters 1924). Another 60 years elapsed before a substantial number of western Atlantic reports emerged, although there are still fewer than 20 records available. At present, there are scattered reports for the northern Atlantic south to New York, the Carolinas, and Puerto Rico (Lee 1988b).

### Audubon's Shearwater (*Puffinus lherminieri*)

Status: Common, often abundant, summer visitor. Several early winter records suggest that a few Audubon's Shearwaters winter as far north as North Carolina.

Typical Season of Occurrence: Common from late April through November and large numbers (thousands) occur in late August and September (Fig. 8). There are a few winter records from December through March (Lee 1986a NCSM records).

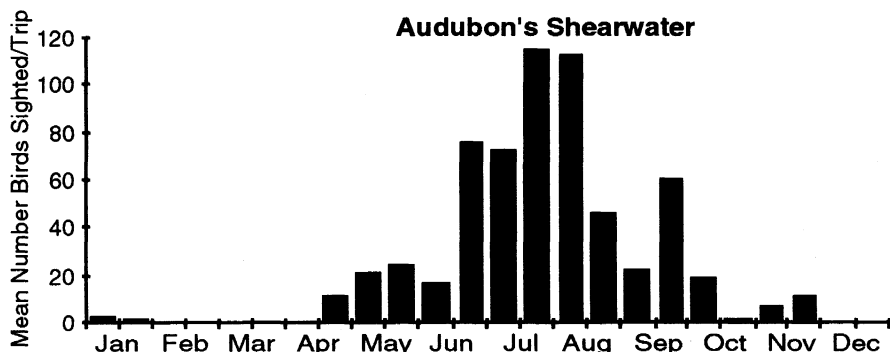


Fig. 8. Seasonal abundance of Audubon's Shearwater in half month increments.

Earliest Spring Record: The earliest definite record is 7 April 1987.

Latest Winter Record: 22 January 1989.

Maximum Counts: 2,285 were counted on 29 September 1979 (R. Rowlett pers comm) and 1,500 were reported from a single trip on 18 September 1988 (Amer. Birds 42:299). The highest count I personally tallied was over 1,000 birds on 19 July 1982.

Zone of Occurrence: Usually found along the inner edge of the Gulf Stream or over water 50 to 500 fathoms deep.

Remarks: Audubon's Shearwaters appear in large numbers soon after their nesting season. The relatively small population known from the Caribbean and the large numbers regularly seen off the North Carolina coast in late summer indicate that perhaps up to 75% of the total population summers here, although local concentrations are quite variable (Lee and Socci 1989).

Lee and Clark (1995) studied the breeding biology of Audubon's Shearwaters in the Bahamas. They note that the species' March-to-early July nesting season explains the low numbers of birds encountered in North Carolina in the spring to mid-June period. The subsequent period of maximum abundance corresponds with adults and fledglings moving north into North Carolina waters once the nesting season is completed. Weight and measurements, and comparisons of variation in coloration of under tail coverts of Bahamas birds, are within the typical range of variation of specimens collected off North Carolina (Lee 1988).

#### Wilson's Storm-Petrel (*Oceanites oceanicus*)

Status: Common to abundant offshore migrant and summer visitor.

Typical Season of Occurrence: Wilson's Storm-Petrels arrive in early April and most depart by early October (Fig. 9). From mid-April through early September, they are present in considerable numbers, when hundreds to thousands can be seen on a single day.

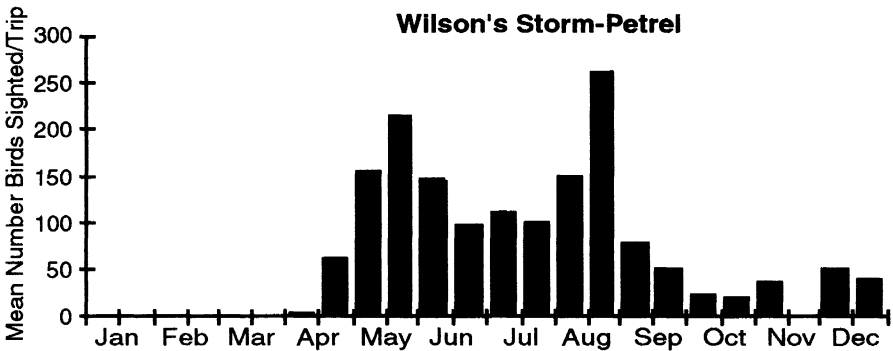


Fig. 9. Seasonal abundance of Wilson's Storm-Petrel in half month increments.

Earliest Spring Record: 8 March 1974 (Chat 38:78).

Latest Fall Record: 20 December 1986.

Maximum Counts: 1,912 were tallied on 29 August 1985.

Zone of Occurrence: Wilson's Storm-Petrels are seen in shallow water but are

most common in the 40-800 fathom area. They decrease in frequency in waters over 800 fathoms. Occasionally seen from shore.

Remarks: Prior to 1985, there were no reliable records of Wilson's Storm-Petrels north of the equator after October. With the exception of three records from the Cape Verdes and one from St. Paul's Rocks, none had been seen north of 30° S in December (Palmer 1962). My early studies had shown that this storm-petrel becomes scarce and occurs sporadically off the southeastern United States after mid-September, with the previous latest North Carolina record being 23 October 1979 and the earliest date of return 2 April 1981.

Since the winter of 1985, however, I have had three very late records all involving fairly large number of birds. On 5 December 1985, I encountered at least 153 individuals 30-40 miles off Oregon Inlet (Lee 1988a). On 9 November 1986, an offshore trip yielded a minimum count of 246 Wilson's Storm-Petrels and on 20 December 1986, we found 351 Wilson's Storm-Petrels in the same area. The 1986 record is the latest recorded date for the Northern Hemisphere. No unusual weather patterns (local or global) can account for their presence on any of these dates. It is not clear if these records are the result of changing behavioral patterns, aberrant behavior, or simply the poor coverage of pelagic regions off the southeastern United States during the winter season. However, not even a single Wilson's was encountered on other late fall surveys off North Carolina which suggests that sampling bias is not entirely responsible for the lack of other records. Additionally, birds present in the numbers found in 1985 and 1986 should have been reported from other trips, at least from somewhere in the Northern Hemisphere, if this pattern of late movement is typical.

#### White-faced Storm-Petrel (*Pelagodroma marina*)

Status: Uncommon but regular visitor. Not known from the state prior to 1979 (Lee and Rowlett 1979).

Typical Season of Occurrence: Most records are from late summer.

Earliest Summer Record: 24 July 1993 (Chat 58:102).

Latest Fall Record: 9 October 1982, 2 individuals (Am. Birds 38:189).

Maximum Counts: Four individuals were seen on 29 August 1985.

Zone of Occurrence: All non-storm-related sightings have been from deep water (300-500 fathoms).

Remarks: The regularity of records of White-faced Storm Petrel in the western North Atlantic indicates that they are not merely storm victims. Some adults and first-year birds from the Cape Verde Islands migrate northwest in late summer to feed. Older immature birds may travel as far as the continental shelf and slope waters off the eastern United States, where they molt before returning to the eastern North Atlantic late in the fall. All collected specimens are of the Cape Verde race *P. m. eadesi* (Watson, Lee & Backus 1986).

#### Leach's Storm-Petrel (*Oceanodroma leucorhoa*)

Status: Regular migrant, sporadic summer visitor and possibly rare winter visitor.

First reported from the state in 1968 (Williams and Williams 1968).

Typical Season of Occurrence: Spring migration is from mid-May to early June. Fall migration is from mid-September to early November. There are many summer records (Fig. 10).

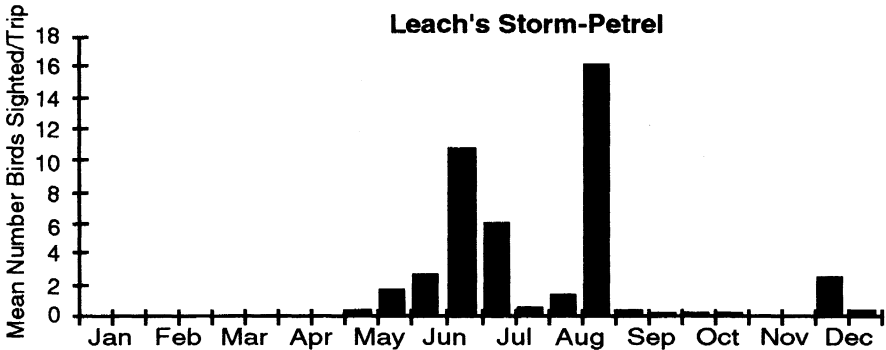


Fig. 10. Seasonal abundance of Leach's Storm-Petrel in half month increments.

Earliest Spring Record: 1 May 1992 (Chat 57:54), two birds seen on 2 May 1981.

Latest Fall Record: 20 December 1986.

Maximum Counts: A total of 88 birds were seen in five different flocks on 29 August 1985, and 133 were seen on 24 August 1985.

Zone of Occurrence: During migration, birds are seen inshore as well as in the warmer waters of the Gulf Stream. During other seasons, they are confined to deep water.

Remarks: Migration of *O. leucorhora* must be well to the east of our study area, possibly in the mid-Atlantic. The numbers of Leach's Storm-Petrels recorded in North Carolina, and the southeast in general, are too small to account for the large western Atlantic population of this species. For example Sklepkovych and Montevecchi (1989) reported over 3,360,000 breeding pairs of Leach's Storm-Petrels on a single 6.3 x 1 km island off eastern Canada. This represents only one of the North Atlantic colonies.

#### Band-rumped Storm-Petrel (*Oceanodroma castro*)

Status: Common summer resident, although unknown prior to 1974 (Fussell 1974) and its abundance was not discovered until 1984 (Lee 1984). Many records confirmed with specimens.

Typical Season of Occurrence: Late May through mid-August with peak abundance in mid-July (Fig. 11). Offshore specimen records are available from 5 July through 21 August. Specimen records from the southeastern US are available from as early as 14 May 1989 (Texas Cooperative Wildlife Coll. # 12440).

Earliest Record: 20 May 1993 (Chat 58:59).

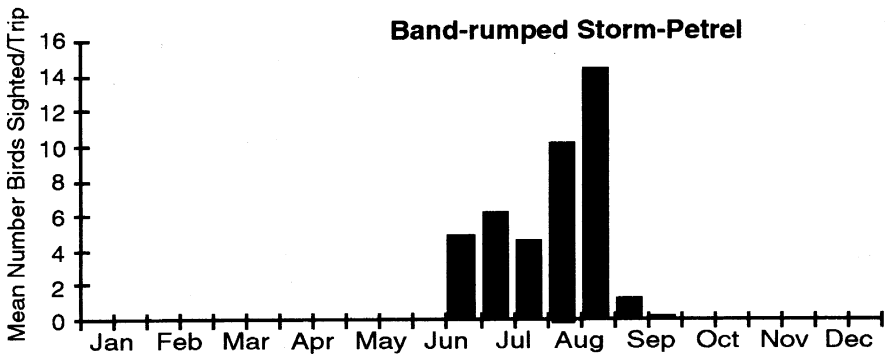


Fig. 11. Seasonal abundance of Band-rumped Storm-Petrel in half month increments.

Latest Record: 13 September 1987.

Maximum Counts: 76 were seen on 15 August 1986 and 64 were seen in scattered flocks on 24 August 1985.

Zone of Occurrence: Usually found in the 500 to 1000 fathom zone, only occasionally are individuals seen over inshore waters (i.e., Chat 57:55).

Remarks: The principal obstacle to understanding the marine distribution of Band-rumped Storm-Petrels has been an inability to distinguish this species from other white-rumped storm-petrels. This knowledge deficit has only recently been alleviated (Naveen 1981-82, and Harrison 1983a, 1983b, Lee 1984). Nevertheless, many bird-watchers fail to recognize that field marks are often inadequate for species recognition even under ideal sea conditions.

#### White-tailed Tropicbird (*Phaethon lepturus*)

Status: Regular but uncommon summer visitor.

Typical Season of Occurrence: Confirmed sightings of White-tailed Tropicbirds are from mid-May through mid-September.

Earliest Record: 16 May 1992 (Chat 57:55).

Latest Record: 27 September 1979 (R. Rowlett pers. comm.).

Maximum Counts: Three birds on 6 August 1985\*.

Zone of Occurrence: Usually seen in the vicinity of the Gulf Stream, but there are records from shallow water in the Hatteras Bight.

Remarks: Although large storms certainly affect the movements and distribution of most seabirds and are responsible for most, if not all, coastal and inland sightings of *Phaethon*, few of the records available from offshore North Carolina seem to be of storm-driven individuals. However, the inland records of White-tailed Tropicbirds in North Carolina (two from Lake Jordan and one from a lake near Shelby) resulted from hurricanes.

#### Red-billed Tropicbird (*Phaethon aethereus*)

Status: Uncommon visitor. Unknown from North Carolina prior to 1981 (Lee et al. 1981).

**Typical Season of Occurrence:** Confirmed records of Red-billed Tropicbirds are from early May to September.

**Earliest Spring Record:** 16 May 1979\*.

**Latest Fall Record:** 1 September 1981.

**Maximum Counts:** Two birds were collected on 16 May 1979\*.

**Zone of Occurrence:** All records are from far offshore, usually in the Gulf Stream.

**Remarks:** Evidence of Red-billed Tropicbirds in this region suggests that some of the early sight records for White-tailed Tropicbirds, *Phaethon lepturus*, may be suspect. Although numerous reports of tropicbirds, chiefly of White-tailed, are available from the western North Atlantic and Gulf of Mexico, few are supported by specimens or photographs. Until recently (see Peterson 1980), the White-tailed Tropicbird was the only tropicbird recognized in popular field guides as occurring in this area. This led observers to believe that there was no reason to question tropicbird sight identifications. It also made only limited information necessary for specific identifications in the field. Misidentifications probably resulted from the lack of information available. In addition, because most of the distinguishing field characters of tropicbirds are on the dorsal surface, and flying tropicbirds are normally seen only from below, there is an even greater likelihood that some previous records were incorrect. Lee and Irvin (1983) and Lee et al. (1981) briefly reviewed the nature of tropicbird records from eastern North America, including the upper Gulf of Mexico, and discussed the more obvious field identification problems.

#### Masked Booby (*Sula dactylatra*)

**Status:** Uncommon visitor. First verified record was not reported until 1983 (Davis and Needham 1983).

**Typical Season of Occurrence:** late June through early October. Isolated records from early June and January also exist.

**Earliest Record:** 7 June 1966 (Holmes 1966).

**Latest Record:** 3 October 1981 (Davis and Needham 1983).

**Maximum Counts:** Two were collected on 14 August 1984\*.

**Zone of Occurrence:** Usually found in deep Gulf Stream waters although three beach records exist (including a Masked Booby that resided in a tern colony in 1981).

**Remarks:** Nearly half of the northern records (Carolinas and Georgia) of Masked Boobies are of juvenile or subadult birds. Seven of 15 records in North Carolina, where age was recorded, were of subadults. Because of the nature of the plumage development, several of the birds reported as adults could easily have had undetected traces of subadult plumage. The presence of these young birds may indicate that they disperse farther, or remain away from the nesting colonies longer than do adults. This would, as with gannets, limit feeding competition between young and adults and would perhaps be even more important to birds living in nutrient-poor tropical systems.

#### Brown Booby (*Sula leucogaster*)

**Status:** Rare vagrant.

Typical Season of Occurrence: Too few North Carolina records exist to establish a typical season of occurrence. Other southeastern records indicate that most sightings are in winter and spring, but most North Carolina reports are from the summer.

Earliest Record: 25 April 1983 (Amer. Birds 37:858).

Latest Record: 30 December 1987.

Maximum Counts: All North Carolina records are of single birds.

Zone of Occurrence: Most southeastern records are sightings from land. The Brown Boobies seen may have been exhausted, storm-blown individuals. Sightings off North Carolina have been over shelf and Gulf Stream waters.

Remarks: Considering the number of trips taken off the southeastern coast in pursuit of seabirds, it is interesting that so few records are available. Reports and records are summarized by Hass and Patterson (in press).

Nearly all US records are of young birds.

### Northern Gannet (*Morus bassanus*)

Status: Common migrant and winter visitor.

Typical Season of Occurrence: Northern gannets are abundant between late November and early March; however, they are commonly seen from late October to mid-April (Fig. 12) and many records exist outside this period. The season of occurrence was summarized by Lee and Haney (1984).

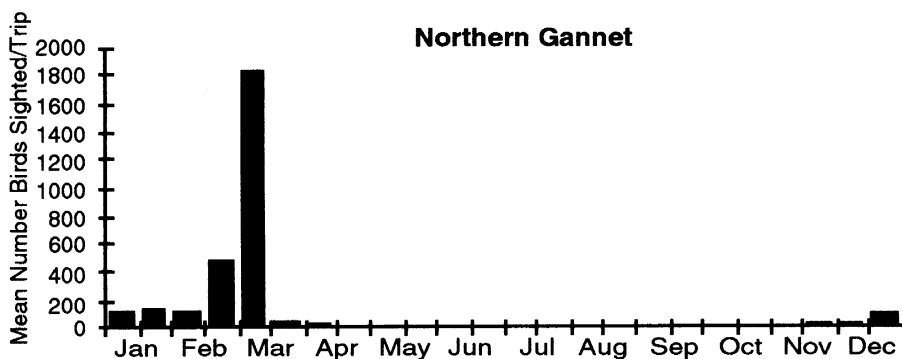


Fig. 12. Seasonal abundance of Northern Gannet in half month increments.

Maximum Counts: 10,000+ reported at Cape Point on 13 February 1982 (Chat 46:82) and 10,650 from Bodie-Pea Island on 28 December 1991 (Chat 57:14). In three hours, 7,000 were counted in migration at Atlantic Beach on 12 April 1992 (Chat 57:56).

Zone of Occurrence: Birds are regularly seen within a few miles of the beach (often in sight of land) and over shallow water. During midwinter, gannets are most abundant in the inner to mid-shelf area (up to 40 fathoms).

Remarks: In one specimen (NCSM 9101) the radius of the left wing had obviously been broken. The bird was an adult male (2990 g) in good health when collected. Apparently the wing broke and healed while the bird was still in the nest,



since a post-fledging bird would probably not survive a broken wing.

There are few inland records of this species. In their review of the status of the genus *Sula* for the Carolinas Lee and Haney (1984) found only one inland occurrence record of Northern Gannets but it was from within a few miles of the coast. Therefore, two sightings from the Piedmont at Falls Lake, in Wake County, NC, on 30 November and 1 December 1991 (Am Birds 46:408) are interesting inland reports. Other reports from Pamlico Sound (28 December 1990, Chat 56:8) Bogue and Pamlico Sounds (6 January 1993 and 31 December 1992, Chat 58:21) and Manns Harbor (9 January 1989, Chat 54:21) are unusual but not as unexpected.

### Magnificent Frigatebird (*Fregata magnificens*)

Status: Uncommon and irregular visitor.

Typical Season of Occurrence: There is one winter record which was apparently not storm-related (30 January 1939, Pearson et al. 1959). Most other reports are associated with weather disturbances and are from May to September (Lee and Booth 1979).

Earliest Record: 1 May 1953 (Chat 17:70).

Latest Record: 2 September 1949 (Chat 14:31).

Maximum Counts: Four were seen on 2 August 1944 (Chat 8:60).

Zone of Occurrence: Most reports are from the coastal area south of Cape Hatteras although there are some reports by charter boat captains of frigatebirds in deep waters off Oregon Inlet.

Remarks: Frigatebirds exhibit much plumage variation, particularly among immatures and females. Differences between species are slight and diagnostic characters are primarily based on size. Generally, the species replace each other geographically. All records from the southeast are considered *Fregata magnificens*, but north of Florida, identifications are seldom verified or reported with details that would eliminate the other species. In fact most published reports do not indicate the sex or the age of the birds. Ascension (*F. aquila*), Lesser (*F. ariel*), and Great (*F. minor*) Frigatebirds all occur in the tropical Atlantic and a Lesser Frigatebird has been identified from photographs taken on 3 July 1960 in Maine (Snyder 1961). Thus, although most records of *Fregata* in the southeast are certainly *F. magnificens* the local occurrence of other species is expected.

### Other Pelecaniformes

The other species of Pelecaniformes known to occur in North Carolina are discussed briefly below. The Anhinga, *Anhinga anhinga*, is excluded because it is not found in marine habitats. All others occur in coastal areas but are not primarily oceanic in distribution. An overview of the status, distribution and season of occurrence is presented for each species.

American White Pelican, (*Pelecanus erythrorhynchos*). This pelican occurs mostly along the coast where it is an irregular and rare fall and winter visitor from 17 October to early March. Occasionally, it is seen during other seasons, and there are several summer records of birds associated with nesting Brown Pelican colonies. Inland

sightings are rare (Clinton, Chat 14:26-27; Lake Junaluska, Chat 17:69-70; Statesville, 17 November to 16 December 1979, Chat 44:83; Jordan Lake, three records). There are no offshore records.

Brown Pelican, (*Pelecanus occidentalis*). This pelican is a year-round coastal resident that is most common during the warmer months. For years, North Carolina represented the northern nesting limit of this species on the Atlantic coast, but recently the species has expanded its breeding range north to Maryland. The first known nesting in North Carolina occurred at Royal Shoal in 1929 (Pearson et al. 1942). In the last decade, the breeding population has expanded considerably. Parnell (pers comm.) has monitored an increase from 82 nests in North Carolina in 1977 to 2426 nests in North Carolina in 1988. There are now seven colonies in the state. Locally, these birds nest from late March through August.

There are a few inland sightings (Charlotte, Chat 46:43; Waynesville, Chat 44:45; Cumberland County, Chat 46:43, 47:76; Greenville, Chat 57:14; Grimesland, Chat 57:56); and the species is occasionally seen far offshore. Lee and Horner (1989) reported flocks of Brown Pelicans in the summer of 1976 foraging 50 miles SE of Beaufort. In the spring of 1989, I saw many scattered individuals as far as 8 miles off of Oregon Inlet.

Parnell (1977) reviewed the history of the nesting colony at Ocracoke Inlet and commented on the status of the North Carolina population and Parnell and Soots (1979) reported on the local distribution, habitat and behavior of the species. Young birds banded in North Carolina have been recovered commonly in Florida and as far south as the coast of Cuba (Parnell pers comm.).

Great Cormorant, (*Phalacrocorax carbo*). This northern cormorant is an uncommon, but now regular winter coastal visitor. The species was first reported in the state's coastal waters in 1970 (Chat 35:22). Sightings are increasing annually, and as many as 60 birds have been seen at one locality (Parnell pers comm.). Records are from early September to early June, and there are several summer records. There are inland records (Goldsboro, Am. Birds 43:300; Lake Phelps, Chat 58:60; Lake Townsend, Chat 59:72) and no offshore records. Grant (1991) reported on the first specimen records of Great Cormorants from the state.

Double-crested Cormorant, (*Phalacrocorax auritus*). This cormorant is a common, and often abundant, winter resident of coastal North Carolina, particularly around inlets. A few birds remain in coastal areas throughout the year. Individuals and small groups frequent inland lakes and impoundments, especially bay lakes, in the southeastern counties, during all seasons of the year (Lee 1987c). A breeding colony, discovered in 1898 at Great Lake in Craven County, was abandoned about 1950 (Grant 1970). In 1953, a few cormorants were found nesting at Lake Ellis in Craven County (Grant 1970), which was regarded by many authors as the northernmost permanent breeding site of the southeastern subspecies. Examination of specimens, however, indicates that they are intermediate between the *P. a. auritus* and *floridanus* although Post (pers comm.) does not consider *floridanus* a valid form. Nesting was reported from the piedmont of North Carolina for the first time in 1985 (Jordan Lake, Chatham County, Chat 49:102). The status of other nonmigrating birds during the summer months is unclear.

Lee and Horner (1989) reported birds at the 100 fathom contour on 3 November 1979, and other migrants were seen 10 miles off the beach in early June 1988 in the Virginia Capes region (NCSM records).

**Red-necked Phalarope (*Phalaropus lobatus*)**

Status: Common, often abundant offshore migrant.

Typical Season of Occurrence: Spring migration is evident from early May to early June although it may begin as early as late April. There are some summer records and fall migration extends through October (Fig. 13). There is a single winter sighting from 5 February 1940 (B.N.C.).

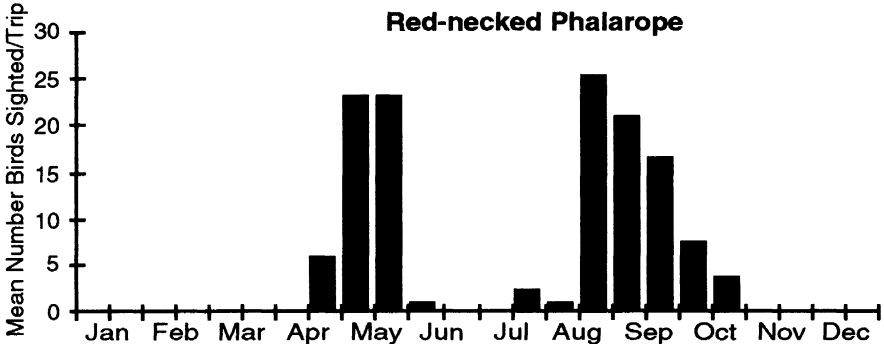


Fig. 13. Seasonal abundance of Red-necked Phalarope in half month increments.

Earliest Spring Record: 18 April 1980.

Latest Spring Record: 5 June 1992 (Chat 57:81).

Earliest Fall Record: 3 July 1987.

Latest Fall Record: 23 October 1979.

Maximum Counts: 121 seen on 21 September 1988, 100+ on 21 August 1988.

Zone of Occurrence: Red-necked Phalaropes are usually found along or near the inner edge of the Gulf Stream or other oceanic fronts. They are seldom found in water less than 20 fathoms in depth.

Remarks: Information on the winter distribution of both pelagic species of phalaropes is still poorly understood. (The Wilson's Phalarope *P. tricolor* does not occur at sea.) The winter ranges of both *P. fulicaria* and *P. lobatus* are usually described as being in the southern hemisphere yet both winter off Southern California, and the Red-necked Phalarope is known to winter north to the Azores in the eastern Atlantic. Recently, Haney (1985) noted both species off the Georgia continental shelf in February 1984, with the Red Phalarope three times more common than the Red-necked Phalarope. However, because there are essentially no other records of this species north of Florida after October, and some sightings of single birds may be misidentifications, it appears that Red-necked Phalaropes winter only rarely in the southeast. Furthermore, there is no indication that this species winters as far north as North Carolina. The only winter report for the Carolinas is a single 5 February 1940

sighting by Pearson et al. (1942).

Lee and Hass (in ms) studied the biology of both *Phalaropus lobatus* and *P. fulicaria* off the North Carolina coast. They report on season of occurrence, ecological distribution, plumage and molt, age and sex ratios, differential seasonal movements of each sex, and food habits. The stomach contents for 92 *P. fulicaria* and 37 *P. lobatus* were examined. Food items were similar in size for both species and ranged from <1 to 3 mm in length. The frequent presence of parts of *Sargassum*, including floats and the presence of *Sargassum* snails (*Litiopa melanostoma*), found in the stomachs examined, confirms that phalaropes forage in *Sargassum* regularly.

Based primarily on material obtained through the North Carolina State Museum's offshore studies, Ditmann et al. (1989) and Ditmann and Zink (1991) studied the mitochondrial DNA variation among phalaropes. They concluded that Red and Red-necked Phalaropes are sister taxa, but no DNA fragments united phalaropes as a monophyletic group.

#### Red Phalarope (*Phalaropus fulicaria*)

Status: Common, often abundant migrant. Sometimes present in large numbers in the winter.

Typical Season of Occurrence: Spring migration begins in early March and extends through late May although the species is rare after mid-to- late April. Fall migration is not as well defined but it appears to be underway by early October. From mid-October to the start of spring migration, Red Phalaropes can be abundant off the coast of North Carolina (Fig. 14).

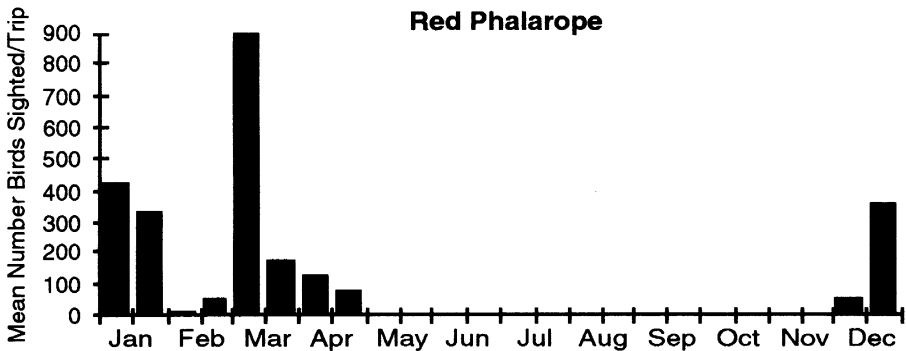


Fig. 14. Seasonal abundance of Red Phalarope in half month increments.

Earliest Record: 15 August 1992 (Chat 57:104).

Latest Record: 22 May 1992 (Chat 58:99).

Maximum Counts: Thousands were seen on 29 December 1977, 2,057+ were counted on 7 March 1987, and an estimate of over 10,000 was made of flocks seen at Beaufort on 3-5 February 1989 (Am. Birds 43:465).

Zone of Occurrence: Red Phalaropes are usually found along the inner edge of the Gulf Stream or other oceanic fronts. They are seldom seen in water less than 20

fathoms deep, along the coast, or inland.

Remarks: (See Red-necked Phalaropes.) This species is relatively common, sometimes in large numbers, along the edge of the continental shelf of North Carolina. Prior to studies by the NC State Museum and those of Haney, there was little evidence that this species commonly wintered off the southeastern United States.

#### Pomarine Jaeger (*Stercorarius pomarinus*)

Status: Common migrant. Small numbers of immature birds summer off North Carolina.

Typical Season of Occurrence: Most spring migration occurs between late March and early June. Some immature and subadult birds may be found off the coast throughout the summer. The start of fall migration is unclear because of the presence of summering birds, however migration peaks in late October and early November. By late December, they have moved out of the area (Fig. 15).

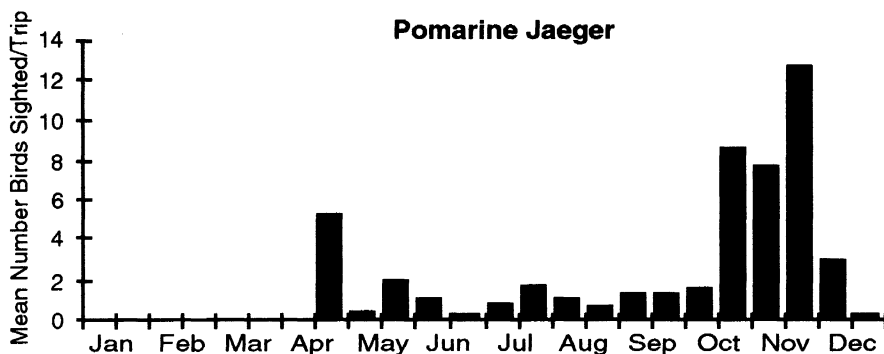


Fig. 15. Seasonal abundance of Pomarine Jaeger in half month increments.

Earliest Spring Record: 17 April 1978, 17 April 1982, 17 April 1989. (Only records supported by specimens are cited for this and other jaegers.)

Latest Winter Record: 20 December 1984.

Maximum Counts: 37+ birds were recorded on 25 November 1977 and 37 were counted on 25 October 1985.

Zone of Occurrence: Typically found between 50 and 100 fathoms. There is a single inland record for the state (Hendrickson and Allen 1985).

Remarks: Although these are the largest and easiest to identify of the three species of *Stercorarius*, there are a number of small specimens obtained in our series, which I believe would be misidentified by most bird watchers. For example, we have documented a 500 gram difference between largest and smallest females.

Between late 1989 and early 1993 there were a number of interesting regional jaeger reports published in *American Bird* and *The Chat*. These included reports that were interesting because of the season of occurrence and ones that were of birds seen at inland localities. The validity of some of identifications may be questionable because none had supporting details and this species group is hard to identify.

Parasitic Jaeger (*Stercorarius parasiticus*)

Status: Occasionally common migrant. Winter status unclear, rare summer visitor.

Typical Season of Occurrence: Fall migration occurs in September and October. Spring migration occurs from mid-May through early June (Fig. 16). Records exist outside both periods.

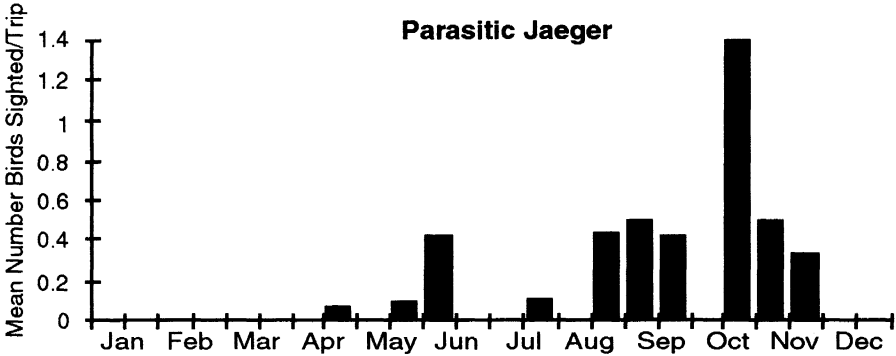


Fig. 16. Seasonal abundance of Parasitic Jaeger in half month increments.

Earliest Spring Record: 29 April 1980.

Latest Fall Record: 25 November 1979, but there are many sight reports from later dates which are assumed to be of this species.

Maximum Counts: At least 7 were seen on 25 October 1985.

Zone of Occurrence: Usually found within a few miles of the beach although a few offshore records do exist.

Remarks: See account of *S. longicaudus*. Extrapolating the local season of occurrence and relative abundance of the Parasitic Jaeger in the southeast, and North Carolina in particular, is difficult since most reports are unsubstantiated sightings and vague photographs. For the other two species, Pomarine Jaeger and Long-tailed Jaeger, a modest number of confirmed records allows a reasonable assessment of their period of occurrence, abundance, plumage and other biological information. This is not true for *S. parasiticus*.

Long-tailed Jaeger (*Stercorarius longicaudus*)

Status: Regular and common migrant. Immatures are fairly common summer visitors. First confirmed record was in 1977 (Lee and Rowlett 1977), first reported in 1973 (Buckley 1973).

Typical Season of Occurrence: Most common from mid-September through mid-October during fall migration. Spring migration peaks in May. There are records from outside both these periods, and individual birds are encountered throughout the summer (Fig. 17).

Earliest Spring Record: 22 April 1989.

Latest Fall Record: 20 December 1984.

Maximum Counts: Four were seen on 28 September 1988.

Zone of Occurrence: Sightings are usually made offshore along the outer edge of the continental shelf and beyond, although there are beach front and inland reports and records.

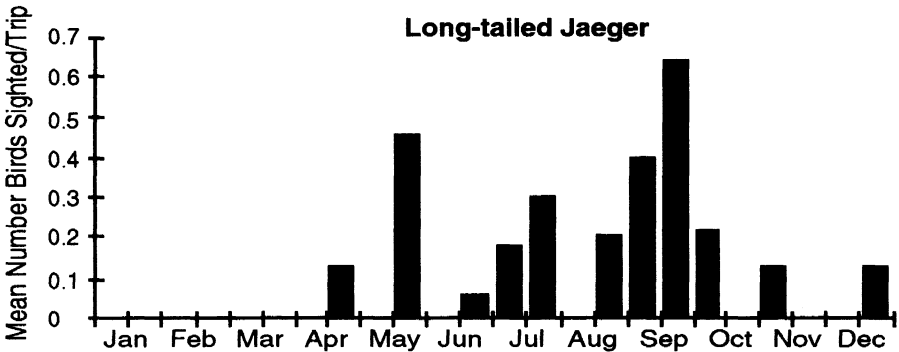


Fig. 17. Seasonal abundance of Long-tailed Jaeger in half month increments.

Remarks: Offshore studies have shown this jaeger to be not only a regular and rather common migrant off North Carolina, but also a species present in small numbers in summer and perhaps into early winter (Lee 1986a, 1987b, N.C.S.M. records). Offshore, the Long-tailed Jaeger is more common and more regular than the Parasitic Jaeger (*Stercorarius parasiticus*), which is similar in appearance. Before the mid-1970s, Parasitic Jaegers were thought to be the more common because they were often sighted from shore. Long-tailed Jaegers, which prefer deep water, were only rarely seen inshore and were therefore considered rare. In addition, misidentifications were encouraged by the lack of previous local records of Long-taileds. Although birds in adult plumage should present little problem in identification, approximately 90% of the records off North Carolina for these two species are of immatures or adults which do not yet have characteristic plumages.

#### Great Skua (*Catharacta skua*)

Status: Uncommon winter visitor. First specimen record for the state was reported in 1977 (Lee and Rowlett 1977).

Typical Season of Occurrence: Positive Great Skua records are available from December until mid-February, but reports outside this period which cannot be assigned to species may represent Great Skuas.

Earliest Record: 2 December 1981\*.

Latest Record: 3 April 1993, photo in Am. Birds 47:404.

Maximum Counts: Most local records of skuas are of single birds. Two were seen on 19 January 1988.

Zone of Occurrence: All records are from shelf waters.

Remarks: Information presented here is based on the assumption that only two taxa occur regularly in the North Atlantic (the limited photographs and specimens

available suggest this). Plumages of many of the *antarctica* forms would be difficult to distinguish from the nominate *skua*, and there is some suggestion that *lonnbergi* occasionally visits the northern hemisphere.

Brinkley (1994a) discussed a skua he saw on 22 May 1992, a date when he reported five *C. maccormicki* off North Carolina. He concluded that it was either an "old or aberrantly plumaged" *C. skua* or *C. antarctica*. He then built a case for it being one of the southern hemisphere forms mentioning all the species (except *C. chilensis*) and known hybrids. While there is no doubt that this report represents an interesting sighting, the discussion while informative is inconclusive.

#### South Polar Skua (*Catharacta maccormicki*)

Status: Regular but uncommon migrant. First definite record for the state was reported in 1977 (Lee and Rowlett 1977).

Typical Season of Occurrence: Spring migration is evident in May, and some birds remain off the coast throughout the summer and are present until at least September. Other records of skuas outside this period may be South Polar Skuas.

Earliest Record: 18 May 1993 (Chat 58:64).

Latest Record: 19 September 1992 (Chat 57:105).

Maximum Counts: Most reports are of single birds, five on 22 May 1992 (Chat 57:58).

Zone of Occurrence: Verified records are from deep Gulf Stream waters.

Remarks: The first reported specimen of a South Polar Skua in eastern North America was from Cape Hatteras, North Carolina in May 1976 (U.S.N.M. 593001, Lee and Rowlett 1979). Subsequently, additional specimens were collected off the Grand Banks and North Carolina (U.S.N.M. and N.C.S.M.). These specimen records cast doubt on the specific identification of all North Atlantic sightings of skuas made prior to the 1970s when only the Great Skua was known from the North Atlantic.

#### Black-legged Kittiwake (*Rissa tridactyla*)

Status: Common and regular offshore migrant and winter visitor.

Typical Season of Occurrence: Early November through March but there are many records outside this period (Fig. 18).

Earliest Fall Record: 1 September 1979 but this is an unseasonal record; the next earliest record is 6 October 1982.

Latest Spring Record: 22 May 1992 (Chat 57:55).

Maximum Counts: Over 164 were counted on 19 January 1988, and a single flock had at least 27 birds on 29 January 1988.

Zone of Occurrence: Most records are from near the edge of the continental shelf, but Black-legged Kittiwakes are also seen in shallow water and from shore. They do not seem to be as restricted to particular zones as most other seabirds.

Remarks: Collections of birds obtained off North Carolina show that in addition to immature and adult birds, there are a large number of immature and subadult plumages representing at least the three age classes proposed by Dwight (1925) and perhaps several others as well. Variation in bill color, the amount of dark feathering around the



eye, color reduction, black in the tail and other feathers in birds in our series indicates that the middle plumage/age class is actually composed of stocks from several different years. Dates of collection of these birds rules out an orderly progression from one plumage to another in a single year. The fact that this has been overlooked is not surprising since large winter series of Black-legged Kittiwakes and birds away from breeding areas were not previously available for study.

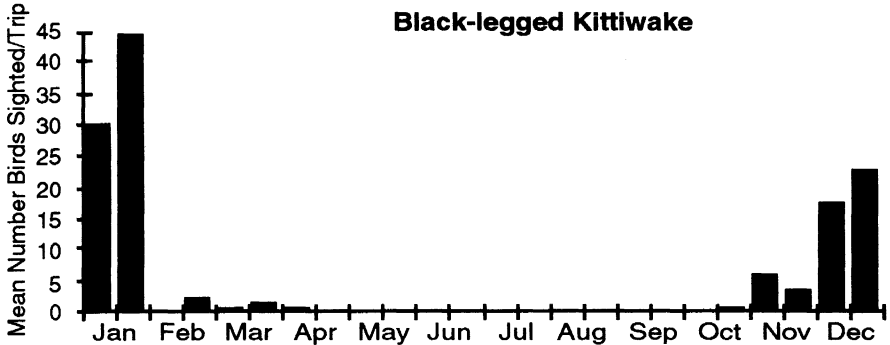


Fig. 18. Seasonal abundance of Black-legged Kittiwake in half month increments.

#### Sabine's Gull (*Xema sabini*)

Status: Rare migrant. First reported from North Carolina in 1977 (Culbertson 1977).

Typical Season of Occurrence: Spring migration is from March to May and fall migration occurs in September and October.

Earliest Fall Record: 15 July 1992 (Chat 57:81).

Latest Fall Record: 21 October 1976 (Culbertson 1977).

Earliest Spring Record: 10 March 1983 (Chat 47:80).

Latest Spring Record: 30 May 1982 (Chat 46:120).

Maximum Counts: Three were seen on 18 September 1988 (Tove 1989).

Zone of Occurrence: Although there are both coastal and offshore records as well as one inland record, it appears that these gulls are largely offshore migrants (see Remarks).

Remarks: The rarity of this species along the coastal area of southeastern North America is probably because of the west to east fall open ocean route migration which moves these gulls away from land. The various inland records are probably also a result of eastward movement of birds from western North America.

#### Other Species of Gulls

Fifteen species of gulls are known to occur in North Carolina or its offshore waters. Six of these are quite common and widespread and the remaining nine are, or were, considered rare or of irregular occurrence. Many of the rarer species, however, are increasing in both numbers and regularity of appearance in the southeast.

The two pelagic species of gull, the Black-legged Kittiwake, *Rissa tridactyla* and Sabine's Gull, *Xema sabini* have already been discussed. The other gull species are primarily coastal, or are at least frequently seen from the shore. The following is a brief discussion of these gulls and Figure 19 presents the documented season of occurrence of each.

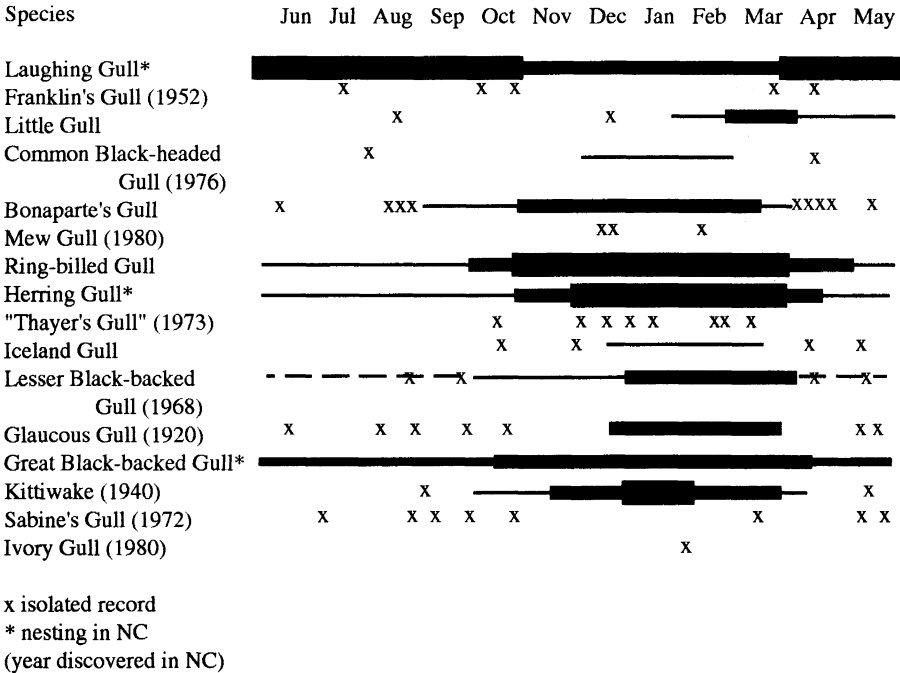


Fig. 19 Seasonal abundance abundance of coastal gull species.

Laughing Gull, (*Larus atricilla*). This is the common breeding gull of the southeastern United States. It occurs in North Carolina throughout the year. Parnell (pers. comm.) documented an increase from 9,369 pairs in 1977 to 18,979 pairs in 1988 in North Carolina. The species is mostly coastal in distribution but individuals are seen over water up to 20 fathoms deep in the summer. During winter and the migratory seasons, this gull is common offshore, and modest numbers winter along the inner edge of the Gulf Stream and on other oceanic fronts. Laughing Gulls also can be found inland, particularly during spring migration.

Franklin's Gull, (*Larus pipixcan*). This species is a very rare migrant in the southeast. There are seven reports and records from North Carolina, and the seasonal distribution is the following: Spring: 31 March 1984 (adult Chat 49:17-18), 13 April 1987 (Am. Birds 41:417); Summer: 7 July 1991 (Chat 55:62; Am Birds 45:89); Fall: 8 October 1983 (imm Chat 49:17-18), 29 October 1988 (Am. Birds 43:301). North Carolina records are from both inland and coastal localities. There are no offshore

reports. There is a single North Carolina specimen (NCSM 228).

Little Gull, (*Larus minutus*). Although this species was unknown in North Carolina or its waters until 1971 (Carter and Parnell 1974), Little Gulls now occur here regularly. Dates of occurrence range from 20 August 1978 (Chat 43:99) to 21 May 1983 (Chat 47:109), although most records are from late February through early April. A single inland record, 29 August 1971 (Chat 36:30), is now regarded as a misidentification. Nearly all reports are of birds seen from the coast. Most sightings are of birds associated with Bonaparte's Gulls. On 29 January 1988, I saw two Little Gulls ca 20 miles ENE of Oregon Inlet among a flock of Bonaparte's Gulls. This is the only offshore record for North Carolina. The increasing number of reports of Little Gulls in coastal North Carolina correlates with the recent expansion of North American populations of this European species. Coastal North Carolina is currently the southern limit of normal occurrence. There are no North Carolina specimens, but photographic records (NCSM files) confirm the presence of Little Gulls in coastal waters.

Common Black-headed Gull, (*Larus ridibundus*). This European gull was first reported in North Carolina by Cox (1968). Since then, approximately twenty sightings have been made. Most reports are from December through early March, but dates of occurrence range from 10 August 1967 (Cox 1968) to 23 April 1973 (Wright 1973). The Common Black-headed Gull is occasionally associated with Bonaparte's Gulls. All records are from coastal North Carolina, and there are no offshore records of this species. There is a single North Carolina specimen (NCSM 10373).

Bonaparte's Gull, (*Larus philadelphia*). These gulls are extremely abundant offshore during winter months. Bonaparte's Gulls are present from the beginning of September through the end of March and occur in maximum numbers from November through mid-March. A few immature birds have been seen during August, April, May, and June. Flocks of wintering Bonaparte's Gulls occur in inshore and offshore zones, but the species is most numerous along current edges of the Gulf Stream. Offshore birds in adult plumage outnumber immatures at least 20 to 1 in winter, and often the proportion of adults is even higher. There are many specimens from North Carolina.

Mew Gull, (*Larus canus*). Two reports and one photographic record of this gull are available from Hatteras, North Carolina. Lewis et al. (1981) noted an adult Mew Gull on 31 December 1980 and Lewis (1984) sighted a first-winter Mew Gull on 27 December 1983. The photographic record is from 19 February 1993 (Dinsmore et al 1995, NCSM files). These authors suggested that the sightings represent two different races of Mew Gull. While these identifications may be correct and there are a number of records of Mew Gulls in eastern North America, the absence of North Carolina specimens precludes subspecific identifications of local birds.

Ring-billed Gull, (*Larus delawarensis*). This is a common inland and coastal species, which is most abundant in the winter months. Lewis et al. (1981) sighted an estimated 24,000 at Cape Hatteras on 31 December 1980. This species is rarely seen more than a few miles from the beach, and the few offshore records may be individual vagrants. There are numerous specimens from North Carolina.

Herring Gull, (*Larus argentatus*). This species reaches the southern limit of its breeding distribution in coastal North Carolina (Parnell and Soots 1975). The number

of nesting pairs has doubled in the last decade (433 pairs in 1977, 965 pairs in 1988, Parnell, pers. comm.). Herring Gulls occur throughout the year but are most abundant in winter. Offshore, they are present from mid-September to mid-April and common from mid-October to early April. Adults are seen only occasionally over 20 miles from shore.

Glaucous Gull, (*Larus hyperboreus*). The Glaucous Gull is an uncommon winter visitor to coastal North Carolina. They are most common from December through early March with individuals occasionally encountered throughout the remainder of the year. The few inland records are largely from tidewater areas. There are no pelagic records but it has been seen up to 10 miles offshore. Individuals occurring in North Carolina vary considerably in size. Several North Carolina specimens are available. Numerous studies (e.g. Patten and Weisbrod 1974) have shown that this species hybridizes readily with *L. argentatus*, a species to which it is closely related.

Iceland Gull, (*Larus glaucoides*). North Carolina represents the southernmost area of regular occurrence of Iceland Gulls. The Iceland Gull is an uncommon and sporadic mid-to-late winter coastal visitor with extreme periods of occurrence being 15 October 1986 (Chat 51:112) and 21 April 1983 (Chat 47:109). Fussell et al. (1982) summarized sightings of this gull in North Carolina. Many reports have accumulated since their study. There are several inland (tidewater) reports, but the species primarily occurs along the coast. Helmuth (1920) first reported the Iceland Gull in the state, a bird seen 90 miles off the coast and the only oceanic report for North Carolina.

There are several visual reports of 'Thayer's Gull', [*Larus thayeri*,] available for North Carolina. Carlson (1973) reported a single bird in Kill Devil Hills on 26 October 1971, Tove (1985) sighted a 'Thayer's Gull' at Hatteras on 27 December 1983, and 2 others were seen on 18 January 1987 and on 1 March 1987 (Am Birds 41:270) at the same location. Others were seen off the Inlet at Beaufort on 3 February 1988 (Tove 1989) and Cape Hatteras point from 30 December 1992 through 19 February 1993 (Chat 58:26). There are photographs of Thayer's Gull from 5 Dec 1989 (Am Birds 44:413) and 27 December 1991 at Cape Hatteras (Chat 57:18). All Thayer's Gulls seen in North Carolina have been in first-winter plumage or adults. These and other reports were summarized by Tove (1989). Thayer's Gulls were previously considered a race of *L. argentatus*, but they are now regarded as a race of *L. glaucoides* (Snell 1989, Godfrey 1986).

Lesser Black-backed Gull, (*Larus fuscus*). The Lesser Black-backed Gull was formerly an uncommon winter coastal visitor, but during the last decade has been seen in increasing numbers. Although most common in the winter months, individuals have been reported from coastal North Carolina during all seasons. Lewis (1980) summarized the status of this gull in North Carolina, but the majority of reports accumulated subsequent to his work. The species is presently irregular south of Hatteras. All specimens from the southeast have been of a single race (*graellsii*) although various bird watchers claim to have identified other subspecies. There is a single specimen (NCSM 8195) and several photographic records from North Carolina.

Great Black-backed Gull, (*Larus marinus*). This species now breeds as far south as North Carolina (Parnell and Soots 1975). At present, only about a dozen pairs are believed to nest on coastal dredged-spoil islands in the state (Parnell pers. comm.).

Great Black-backed Gulls occur throughout the year with maximum numbers appearing in winter. This gull commonly occurs offshore and there are a number of inland records (i.e., Chat 57:18). Most of my offshore records prior to 1980 are of immature birds; however, birds of all ages occur over shelf waters, and occasionally farther out. Great Black-backed Gulls and Herring Gulls are frequently associated with winter trawlers in 10 to 20 fathoms of water. There are numerous specimens from North Carolina.

Ivory Gull, (*Pagophila eburnea*). A single unconfirmed report of this gull was provided by Lee (1980) from Carteret County on 29 January 1980. This represents the southernmost published report for the western Atlantic. An additional record in the 1800's from the Potomac River, MD/VA line (Proc. Nat. Inst. 1842) partly bridges the geographical gap between the North Carolina report and the southernmost documented occurrence in New Jersey (AOU 1953). This Potomac record has been overlooked by recent authors. No specimens or photographic records from North Carolina exist.

#### Arctic Tern (*Sterna paradisaea*)

Status: Rare migrant, a few summer reports and records of migrants distort any pattern of bimodal occurrence. First reported in North Carolina in 1979 (Lee and Rowlett 1979).

Typical Season of Occurrence: Most birds seen are spring migrants which pass the area from mid-April through mid-May. A few fall migrants have been seen in early September. There are two summer visual records and one summer specimen.

Earliest Spring Record: 13 April 1993 (Chat 58:64).

Latest Fall Record: 15 October 1979.

Maximum Counts: 30 were seen on 10 September 1979 in association with Hurricane David (R. Rowlett pers comm). Most reports are typically of single birds.

Zone of Occurrence: Because migration occurs far offshore there are few records of this species (see Remarks).

Remarks: The small number of records indicates that major spring migratory routes are far offshore in the western North Atlantic. Arctic Terns probably fly directly from the coast of South America to North America, and bypass the recessed coasts of the southeastern United States and the Gulf of Mexico. Fall migrants move eastward across the North Atlantic to the coast of Europe and Africa and then south to the Antarctic (Wynne-Edwards 1935, Salomonsen 1967).

Lee and Cardiff (1993) reviewed all the reports of Arctic Terns from the Southeastern United States (Maryland to Texas) and provided information on all 11 specimen records. The vast majority (84%) of the records were from the spring. Fall migration through the region was limited. The extreme scarcity of Arctic Terns in the fall is attributed to their clockwise North Atlantic migration route. The fact that their migration routes are far offshore accounts for the species' relative local rarity at other seasons. A large percentage of the specimen records are of sub-adults and birds in *portlandica* plumage.

#### Bridled Tern (*Sterna anaethetus*)

Status: Common summer resident. First reported from North Carolina in 1963 (Grant 1963).

Typical Season of Occurrence: Mid-May through mid-October with peak abundance between mid-August and mid-September (Fig. 20).

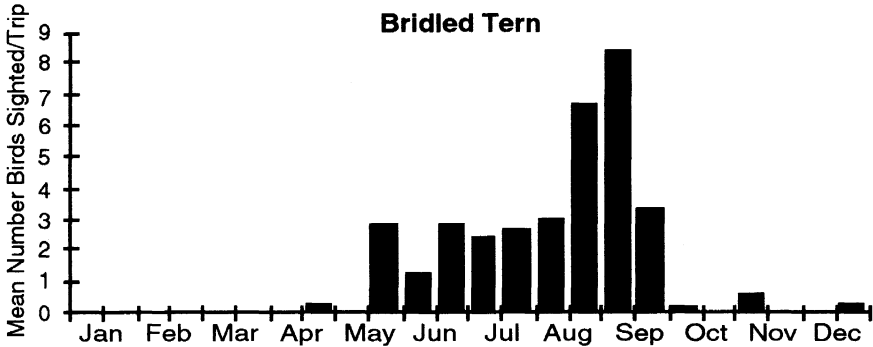


Fig. 20. Seasonal abundance of Bridled Tern in half month increments.

Earliest Spring Record: 17 April 1978.

Latest Fall Record: 20 December 1982.

Maximum Counts: The highest local counts are 45 seen on 8 September 1979 (R. Rowlett, pers comm) and 34 seen on 18 August 1989.

Zone of Occurrence: Inner edge of the Gulf Stream and its associated eddies. Less regularly found beyond the continental shelf.

Remarks: These terns are almost always associated with floating mats of *Sargassum*. Examination of stomachs and crops of 62 birds showed that they prey heavily on small fishes and invertebrates associated with *Sargassum*.

As common and as regular as this bird is off North Carolina, it is hard to explain why it remained unverified as a regular summer resident through the mid 1970's.

#### Sooty Tern (*Sterna fuscata*)

Status: Irregular visitor.

Typical Season of Occurrence: Early June through September (Fig. 21). One winter storm record (B.N.C.).

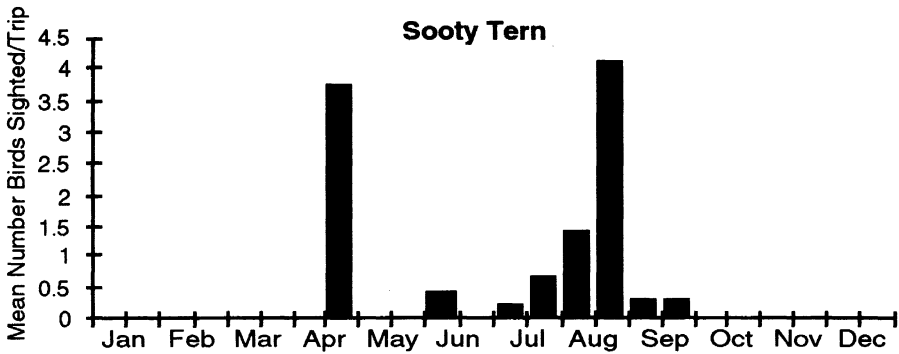


Fig. 21. Seasonal abundance of Sooty Tern in half month increments.

Earliest Record: 17 April 1989.

Latest Record: 30 September 1979 (R. Rowlett pers. comm.).

Maximum Counts: R. Rowlett counted 668 birds on 4 September 1979 and high numbers on other days associated with Hurricane David. Forty-four were seen on 17 April 1989. Off North Carolina, counts of 10 to 15 birds are unusually high.

Zone of Occurrence: Typically found in deep waters within the Gulf Stream. Beach and inland records are usually associated with tropical storms but a few individuals have been seen recently in tern colonies on the Outer Banks.

Remarks: Since the 1930s, a few Sooty Terns have nested on the Gulf Coast in Louisiana and Texas (Lowery 1974). In recent years, they have continued to appear during the nesting season in other tern colonies in the Carolinas. While current authors have considered this report to represent a recent expansion of the breeding distribution, Pearson et al (1959) reported a pair of Sooty Terns that appeared to be nesting at Cape Lookout in 1959. Fussell et al. (1981) found Sooty Terns at Cape Lookout in a mixed tern colony in 1978. Although Sooty Terns associated with nests at Cape Hatteras were watched closely and eggs were found, there was no evidence of successful reproduction in North Carolina. Nevertheless, Sooty Terns have been reported in this colony during most subsequent years, and they typically have exhibited a protracted period of residence. In a tern colony in South Carolina at least one pair successfully reproduced (Wilkinson 1988b) and there have been several additional attempts at nesting there (Wilkinson 1988a).

#### Brown Noddy (*Anous stolidus*)

Status: Accidental. First reported in North Carolina in 1945 (Appleberry 1951) but not confirmed until 1979\* (NCSM).

Typical Season of Occurrence: Early June to early September.

Earliest Record: 25 May 1991.

Latest Record: 8 September 1977\*.

Maximum Counts: Excluding storm-related records, the highest count of this species in North Carolina is 2 on 9 June 1977 (Lee and Booth 1979).

Zone of Occurrence: Most records are associated with tropical storms but three

offshore records may not be related to aberrant weather.

Remarks: Excluding the twenty or more individuals associated with Hurricane David in early September 1979 (Fussell and Allen-Grimes 1980), and 3 with Hurricane Hugo in September 1989 (Am Birds 44:253) there are only six reports of *A. stolidus* in North Carolina. Although the Brown Noddy is the second most common breeding seabird in the Caribbean (Van Halewyn and Norton 1982), the paucity of records north of Florida suggests that the species occurs off North Carolina only as an a vagrant.

### Other Species of Terns

While Bridled and Sooty Terns and Brown Noddys are truly pelagic, and the Arctic Tern is pelagic during its non-breeding period, most of the other North Carolina terns at least occasionally occur in the state's offshore waters. Each is discussed briefly with emphasis on season of occurrence and relative abundance offshore. All species are supported by North Carolina specimens.

Gull-billed Tern, (*Sterna nilotica*). These terns return to North Carolina breeding colonies by mid-April and remain throughout the summer. A few individuals are usually present throughout the fall. Only a small number of pairs now nest in the state. Parnell (pers. comm.) notes a decline from 1,690 in 1973 to 153 in 1988. This species occurs primarily along the coast, although it is occasionally seen inland. My only offshore record is for a bird seen on 22 June 1977.

Caspian Tern, (*Sterna caspia*). Caspian Terns occur in North Carolina throughout the year. Most records are of coastal migrants, but occasionally migrants are reported inland. There are a few records of sporadic nesting by Caspian Terns in coastal North Carolina (Parnell and Soots 1976). I have not seen this species more than a few miles offshore.

Royal Tern, (*Sterna maxima*). These terns occur throughout the year in coastal North Carolina, but they are only common from mid-March through late October. Parnell (pers. comm.) reports an increase between 1977 and 1988 from 9,755 to 11,794 nesting pairs in the state. Unlike the other locally nesting terns, Royal Terns often forage far at sea. I have regularly seen adult birds feeding 30 to 35 miles from the closest nesting colony and commuting to the colony carrying fishes. Modest numbers are also seen offshore during migration.

Sandwich Tern, (*Sterna sandvicensis*). Approximately 1450 pairs of Sandwich Terns nested in coastal North Carolina in 1988 (Parnell pers. comm.). These birds are present from 21 March to 20 October. Occasionally migrants are seen in November and as late as 31 December 1990 (Am Birds 45:431) in southeastern coastal areas. The species regularly forages up to 12 miles off the coast, but it has not been recorded in deep oceanic zones even during migration. Small numbers can often be seen resting on the Whimbrel Shoals Buoy seven miles off the beach, although no birds have been seen at any of the towers 20 miles off the coast. The subspecies in our area is *S. s. acuflavida*, but there are two visual reports for *S. s. eurygnatha*, the Cayenne Tern (Buckley and Buckley 1984, Am Birds 44:255).

Roseate Tern, (*Sterna dougallii*). Migratory individuals are found primarily along the coast but in the spring a few individuals are also seen far at sea. Roseate Terns migrate northward in May and return south past North Carolina from August through



October (latest date of occurrence 28 October 1974). Peak fall migration is in early September. There is also one record of a bird picked up after a storm on 20 January 1937 at Cape Hatteras (Pearson et. al. 1959).

Although there are only one or two confirmed nesting records for the state (Lee and Parnell 1980, Soots and Parnell 1975b), there are numerous visual records of birds in breeding plumage in North Carolina during June, July and August (birds in spring migration are also in full breeding plumage), and two young birds in the NCSM collection from 16 and 17 August 1939 (Oregon Inlet) suggest previous nesting in the state. Roseate Terns are typically associated with mixed tern colonies and the number seems to be increasing. No additional nest records are available for the state, but with increasing interest in the protection of tern colonies and the vigilance of bird watchers, it is likely that additional nesting will be documented in the near future. Many Atlantic Coast terns are currently expanding their range and populations, and it is likely that Roseate Tern colonies could develop in North Carolina in the next several decades (Lee and Parnell 1989).

The U.S. Fish and Wildlife Service has determined that the northeastern population of Roseate Terns is Endangered and that the Florida and Caribbean population is Threatened (Federal Register: 42064).

Common Tern, (*Sterna hirundo*). This species is present from April through September. A report from 16 November 1991 (Cape Hatteras, Am Birds 46:253) is the latest reported date of this species for North Carolina. This report is at least a month and a half later than the latest confirmed date. Additional fall records with supporting documentation would be useful. All previously published winter reports are believed to be *S. forsteri* in that there are no confirmed *S. hirundo* winter records from the area. Although the species is primarily coastal, large numbers occur far offshore during both spring and fall migration. About 2,600 pairs currently nest in North Carolina (Parnell, pers. comm.).

Forster's Tern, (*Sterna forsteri*). These terns are found throughout the year in coastal North Carolina and are often abundant during the migration period. Successful breeding in the state was not confirmed until the summer of 1971 (Am Birds 25:844). Forster's Terns now breed in many areas in northern North Carolina (Soots and Parnell 1975a) and Parnell (pers. comm.) reported about a thousand pairs nested there in 1988. Offshore records are available for 6, 10, and 24 September 1976.

Least Tern, (*Sterna antillarum*). Least Terns are common coastal nesting species which are present from 28 March through 10 October. There is a single winter record from 2 January 1965 (Chat 29:22). Parnell (pers. comm.) estimated the breeding population of the state to be 1,500 pairs in 1988, but at least two sizeable colonies were not included in this estimate. Least Terns forage primarily in sounds and inlets along beach fronts, but there are several records from far offshore (29, 30, June 1977; 10 May 1979; 4 August 1989 [juv]).

Black Tern, (*Chlidonias niger*). This species is a rather common spring and fall offshore migrant. Smaller numbers are seen in coastal and inland localities throughout the state. There are numerous summer records of nonbreeding vagrants, but the typical period of occurrence is late April through early May and mid-July through mid-September. The earliest reported occurrence of Black Terns in North Carolina is

28 April 1973 (Chat 37:68); the latest is 28 October 1967 (Chat 32:31).

#### Dovekie (*Alle alle*)

Status: Uncommon sporadic winter visitor.

Typical Season of Occurrence: Early November through February.

Earliest Record: 3 November 1969 (Chat 34:27).

Latest Record: 9 March 1992 (Chat 57:106). One out of seasonal report from 8 June 1947 (J. B. Funderburg pers comm).

Maximum Counts: Over one thousand were seen in the winter of 1936-37 in the Oregon Inlet area (Pearson et al. 1942).

Zone of Occurrence: All records, with one exception (7 November 1977), are of birds seen along beach fronts, in sounds or blown inland by storms. The 7 November bird was seen 34 miles east of Oregon Inlet.

Remarks: Brimley (1909), Murphy and Vogt (1933), and Pearson et al. (1942) reported several Dovekie invasions into North Carolina: January 1909, 7 November 1932, December 1936 to January 1937, 8 November 1938 to 24 February 1939, and 7 and 8 December 1950.

#### Thick-billed Murre (*Uria lomvia*)

Status: Rare winter visitor.

Typical Season of Occurrence: Early December through February.

Earliest Record: 9 December 1966 (Chat 31:75).

Latest Record: 28 February 1960 (Chat 24:25).

Maximum Counts: Excluding 2 birds seen on 24 January 1972 at Wrightsville Beach (Amer. Birds 26:590), all records are of individual birds.

Zone of Occurrence: All local records are of birds sighted from land. Birds occur off the beach and in sounds.

Remarks: None.

#### Razorbill (*Alca torda*)

Status: Uncommon winter visitor.

Typical Season of Occurrence: Mid-November through mid-February with maximum numbers from mid-December through early February.

Earliest Record: 16 November 1975 (Chat 40:50).

Latest Record: 27 March 1985.

Maximum Counts: All North Carolina records are of single birds.

Zone of Occurrence: With the exception of one sighting 12 miles off Pea Island, all reports of Razorbills in North Carolina have been of birds seen from shore.

Remarks: There are relatively few records of this bird south of Cape Hatteras.

#### Atlantic Puffin (*Fratercula arctica*)

Status: Rare visitor.

Typical Season of Occurrence: The beginning of January through early March in

Virginia waters (Kain 1987, LeGrand and Dias 1995). The North Carolina reports are from mid-August and mid-February.

**Zone of Occurrence:** Based on other records, puffins are expected to be confined to zones over deep offshore waters. However, the August 1993 individual was apparently over the inner continental shelf.

**Remarks:** LeGrand and Dias (1995) discussed two sight reports of Atlantic Puffins off North Carolina. One in alternate plumage was sighted on 14 August 1993 and one in basic plumage was seen on 18 February. Although unknown from North Carolina until 1993, the species was certainly expected to occur locally based on other reports from the southeast. There are numerous reports from Maryland and Virginia, a possible record from Georgia described by Audubon (Ga. Ornith. Soc. 1977) and a specimen of a young bird collected in Martin County, Florida on 6 December 1986 (UF 21310; Brooks 1988). Four records from Bermuda (Amos 1991) indicate that puffins winter occasionally southward to our latitudes and that they will indeed winter far at sea.

## DISCUSSION

This study complements the general survey of marine birds of the southeastern United States provided by Clapp et al. (1982, 1983) and the work of others in the western North Atlantic (Powers 1983), and of specific areas (Rowlett 1980, Naveen unpublished [Maryland], Forsythe [South Carolina] Haney (eg. 1985) [Georgia], Sykes, Johnson [Florida], and Duncan and Harvard 1980 [Northern Gulf of Mexico]).

During the course of this study, 231 survey trips were conducted during which 277,431 individual birds were tallied and identified. The faunal composition and relative abundance of species in North Carolina's offshore waters varies considerably from season to season. A simple overview shows the presence of winter residents, summer residents, and spring and fall migrants. However, many of the summer/tropical species linger at our latitudes well into early winter, and at least one tropical species, the Black-capped Petrel, is present throughout the winter. Likewise, individuals of wintering species may be present to mid-May or longer, and various immature northern birds or adults that presumably had nesting failures appear off the North Carolina coast in the summer. Although the composition of fauna offshore at any particular time is a mosaic of species, the species which dominate particular seasons, are very predictable.

**Faunal Composition:** The North Atlantic boreal element is represented mostly by winter visitors such as Northern Fulmars, Northern Gannets, Black-legged Kittiwakes, Great Skuas, Razorbills, Thick-billed Murres and Dovekies. Also from the north come many spring and fall migrants such as Manx Shearwaters, Leach's Storm-Petrels, and Arctic Terns. Some of these migrants are tundra nesting species such as phalaropes (2 species), jaegers (3 species), and Bonaparte's Gulls.

Summer visitors and residents come from a wide array of geographic locations. Several of the birds are transatlantic migrants such as Cory's and Little Shearwaters, White-faced and Band-rumped Storm-Petrels and 'Soft-Plumaged' Petrels. These birds nest on various small islands off the European and African coast and in the Mediterranean Sea. Another group of birds come from nesting grounds in the tropical

and subtropical Atlantic. Most of these are from the nearby Caribbean, but at least one species is from a tropical island in the southern hemisphere. The tropical and subtropical birds include Audubon's Shearwater, Black-capped, Bermuda and Herald Petrel, tropicbirds (2 species), boobies (2 species) and Sooty, Bridled, and Noddy Terns. Additional summer birds are from the South Atlantic and are temperate to sub-polar in origin. These birds include Greater Shearwaters, Wilson's Storm-Petrels and South Polar Skuas. The Sooty Shearwater is also a transequatorial migrant but it seldom summers off North Carolina's coast.

To this faunal assemblage are added various local (eastern North American) species. Some, such as the Royal Tern are most common offshore in summer and others such as the Black, Common and Roseate Tern are most common during migration. The locally nesting Laughing Gull is present through the year but it is common offshore mainly in late fall through mid-spring. This is also true of other gulls which winter along and off our coast. Of the locally nesting birds, however, only the Royal Tern regularly forages far at sea (up to 50 miles from land). Sandwich Terns occasionally feed up to 12 miles off the beach, while other species seldom venture out of sight of land during their nesting period.

The composite fauna described above produces one of the richest assemblages of seabirds to be found anywhere in the North Atlantic. On a single day in June it is possible to see birds from the Mediterranean Sea, Greenland, the South Polar islands, islands off the African coast, the Alaskan tundra, the Caribbean and the southeastern United States, all feeding in the same area.

**Seasonal Variation:** The winter fauna is composed largely of gulls, and Herring Gulls make up 10% of the total number of birds encountered in December, 3% in January, 78% in February, and 57% in March. Other gulls, Greater Black-backed, Bonaparte's, Laughing, and Black Legged Kittiwakes, comprise a large percentage of the remaining fauna during this period. Other important winter birds include Red Phalaropes, and Northern Gannets. Double-crested Cormorants are abundant around inlets. Northern Fulmars not present throughout the winter are abundant by March. In general, the highest biomass occurs in winter, but the species diversity is lowest (Table 1). Nearly all winter birds are of northern origin.

Spring is a transition period with wintering species, (mostly immatures) still present, some of the summer fauna arriving, and many transient species appearing. Wilson's Storm-Petrels make up over 10% of the fauna in April and over 61% by May. Migrant Red Phalaropes (22.5%) in April are replaced by Red-necked Phalaropes (8.5%) by May. While migration extends well into June, some summer birds become quite common by May (Audubon's Shearwater [8.5%], Cory's Shearwater [2%]). In spring, there is a marked decline in total biomass and a considerable increase in diversity. Brinkley (1994a) discussed spring migration off central North Carolina.

The summer fauna is composed mostly of tropical and subtropical species, transequatorial migrants, and birds from the eastern North Atlantic. Wilson's Storm-Petrels (36% June, 16% July, 33% August), Cory's Shearwaters (18% June, 35% July, 35% August), and Audubon's Shearwaters (18% June, 14% July, 13% August) dominate the fauna, but several tropical species that exist in low numbers and are distributed in low densities forage off the Carolina coast in quantities which

suggest that North Carolina waters are important for these species during the non-breeding season (Bridled Tern, Band-rumped Storm-Petrel, Black-capped Petrel). This is probably also true for tropicbirds and Masked Boobies. Despite the small numbers of these species reported in local waters the Caribbean populations are quite small (1,600-10,000 pairs; see discussion in Lee and Socci 1989). Summer is also a period of low biomass and high diversity.

The composition of the fall fauna is similar to that of spring except that most summer birds remain through early to mid-November (Wilson's Storm-Petrels are unusual after mid-October) and are a major component of the total number of birds. Bridled Terns become common off the coast in September (2%), apparently dispersing northward after their breeding season. Jaegers, phalaropes, and Common Terns are abundant migrants, and by November Double-crested Cormorants, Northern Gannets, Herring Gulls and Laughing Gulls comprise a large percentage of the total fauna. Species diversity and biomass do not change significantly during the fall. An abrupt change to winter fauna occurs in December.

Lee and Socci (1989) graphically presented the major faunal elements for each month of the year and their Figure 32 indicated the general seasonal distribution and abundance of the more regularly encountered and generally more pelagic species of seabirds found off the North Carolina coast. More accurate depictions of the relative abundance of common species are illustrated in figures with the species accounts.

Seasonal variation in abundance indicated in Table 1 is in part a reflection of the large number of inshore gulls tallied on trips from late December through early March. Except for the spring migratory period, the number of species in the area is fairly constant, although species composition is not.

**Zonal Distribution and Foraging:** Most seabirds, Procellariidae in particular, forage over pelagic regions where prey is distributed in discontinuous and sporadically available patches. Nevertheless, marine birds are locally very predictable in their choice of general foraging areas. For convenience and measurable reference I have chosen to demonstrate the species distributional patterns as they relate to water depth not distance from shore. It should be understood, however, that water depth is not a prime causal factor for distribution. However, at certain seasons and localities, food availability is predictable at certain water depths.

Within a given area, birds may find food by using visual clues or olfactory means. Often, hundreds of seabirds, of a dozen or more species, will converge on an area, feed and disperse in a span of 15 to 30 minutes.

Primary foraging sites for large flocks of birds are over feeding fish schools, along current edges (oceanic fronts), and around and in thick patches of *Sargassum*. Most species are opportunistic and resort to a variety of foraging techniques. Within a broad assemblage of feeding repertoires, most species have one or two primary methods of hunting and feeding.

Current edges are one of the most important factors in attracting foraging seabirds. These edges are not static and are normally short-lived. Haney and McGillivray (1985a) demonstrated the importance of Gulf Stream fronts on the local distribution of Cory's Shearwaters off Georgia and Florida. They illustrated how a convergence of fronts formed at the continental shelf break and circulated water from 25-100 m into

thermoclines producing upwellings important for surface marine organisms. Hill and Johnson (1974) presented the theory of upwelling over the shelf break. Various authors have demonstrated the importance of oceanic fronts on the distribution of marine birds (e.g. Kinder et al. 1983 and Schneider et al. 1987).

Specific information on upwelling in the Hatteras/Oregon Inlet area of North Carolina is fragmentary but follows the same patterns detailed by Haney and McGillivray (1985a,b). Wells and Gray (1960) show, for example, how southwesterly winds in July and August blow on-shore below Hatteras and parallel to shore north of Hatteras. This causes local upwellings and cooling of offshore surface water north of Hatteras. These upwellings account for the relatively rich productivity and diversity of the offshore waters off Oregon Inlet. Inshore, because of solar radiation and surf action, productivity is not as pronounced, and biota (including birds) is less abundant.

Secondary fronts that occur within the Gulf Stream also produce, or concentrate, local upwellings (pers. observation). Gulf Stream filament eddies that break off from the Gulf Stream may also transport nutrient-rich waters and cause local upwellings which may concentrate prey and birds. These may concentrate marine birds offshore and move them into shallow water zones. The effect of seasonal changes in water temperatures (Fig. 2 in Haney and Lee 1994) and surface salinity (31-36‰ range of local annual variation) as they relate to upwellings in the distribution of seabirds or their prey is not clear at this time.

One of the major hunting strategies used by marine birds is aerial searching combined with plunge-diving or "dipping" for prey. Different species fly at different heights above the surface of the sea. The largest and most powerful flyers typically cover large areas (normally of low productivity zones) and fly at the greatest heights. Birds that usually hunt in this fashion are terns, jaegers, tropicbirds and boobies. Haney, Frisrup and Lee (1992) showed how flocks of various sizes are recruited from distances of 0.7 to 6.2 km. with theoretical upper limits of 20–30 km.

Most of the lower flying species hunt using both visual and olfactory stimuli. Species such as shearwaters and petrels rarely fly more than a few meters above the sea surface.

Patches of *Sargassum* attract specialists such as Bridled Terns, Audubon's Shearwaters and Masked Boobys. All three of these species feed largely on invertebrates and small fishes associated with *Sargassum*. Haney (1986) reported on the use of *Sargassum* "reefs" and its influence on the distribution of foraging seabirds.

Because of differences in types of food, in feeding behavior and in the size of prey, the various species concentrate their daily activities where specific foraging conditions are optimum, but many will converge on high productivity areas when they are available. The net result is that each species lives over or near a zone where its dietary needs are most easily met.

A basic, but probably over simplified, species breakdown of local foraging zones is as follows (with the most characteristic species identified by bold type):

Deep water (500-1200 fathoms)—beyond edge of Continental Shelf - **Black-capped Petrel**, Bermuda Petrel, Soft-Plumaged Petrel, Herald Petrel, **Band-rumped Storm-Petrel**.

Deep water (300-500 fathoms) - White-faced Storm-Petrel, Leach's Storm-Petrel,

## Sooty Tern.

Shelf-edge (50-100 fathoms) and/or edge of Gulf Stream - Manx Shearwater, **Audubon's Shearwater**, Greater Shearwater, **Cory's Shearwater**, **Bridled Tern**, Wilson's Storm-Petrel, **Red and Red-necked Phalaropes**, **Pomarine Jaegers**, **Long-tailed Jaegers**, Northern Fulmar.

Inshore Waters (15-100 fathoms). No birds typically inhabit this zone. Cory's Shearwaters, Wilson's Storm-Petrels and Royal Terns are sometimes present in small numbers.

Inshore waters (2-20 fathoms) - within seven miles of beach front. **Northern Gannets**, **Sandwich Terns**, most other terns, Double-crested Cormorants, alcids, **Parasitic Jaegers**.

Water temperatures vary with season and with distance from shore (Haney and Lee 1993). While water temperature preferences are apparent for most species, the positive correlations between water depth, distance from shore, salinity, and temperature makes it difficult to determine to which factors the birds or their food sources are responding.

Table 2 illustrates the zonal distribution of seabirds tallied during offshore survey trips conducted in June, July and August. The data represent 5316 individual entries and indicate the number of birds seen per hour over different depths of water. It is clear that the shallow water zones, where we conducted our studies for the Navy have the smallest number of birds and species (Table 2 in Lee and Socci 1989).

Table 2. Summer zonal distribution (individuals/hour) of six species selected to show deep-water, shelf-edge, and inshore distributions and zones of overlap. (From Lee 1986a see also Fig. 15a and 15b)

Survey Depth (fathoms)	Total hrs. in zone	Wilson's Storm-Petrel	Cory's Shearwater	Audubon's Shearwater	Black-capped Petrel	Band-rumped Storm-Petrel	Royal Tern	All species*
≤10	10.42	0.38	0	0	0	0	4.41	11.13
11-19	7.25	1.38	3.17	0	0	0	2.48	12.41
20-30	35.42	2.32	4.71	0.62	0	0	0.28	10.42
31-50	12.42	14.75	6.04	0.72	0	0	1.13	43.32
51-99	4.17	20.86	5.52	16.07	0.24	0	0.96	50.05
100-400	18.50	25.08	6.97	4.49	1.14	0.16	0.54	78.38
401-799	18.17	24.49	7.15	4.62	2.92	1.32	0.17	71.44
≥800	19.75	14.23	17.92	15.34	3.39	1.11	0.10	61.62

\* Includes birds not listed in this table.

There is a general lack of birds in less than 50 fathoms of water. This is not only true for actual numbers of birds encountered but, when tallies are corrected for total amount of time surveying inshore waters the minimal nature of the diversity and biomass is obvious (see Table 2). The Wilson's Storm-Petrel and Cory's Shearwater were included because they are the only pelagics that regularly occur inside the 50 fathoms zone. Nevertheless, they occur here only in low densities.

In North Carolina during the last few years there seems to have been an increase in the number of inland records of birds that have primarily marine and coastal distributions. Many of these records have been reported in either *American Birds* or *The Chat*. While many of the records were associated with Hurricane Hugo or other storms, others were not. The creation of large freshwater reservoirs during the 1970's in the Piedmont of North Carolina is one factor responsible for the increasing number of inland marine bird records. Also there has been an increase in local interest in bird watching and the network for reporting unusual records has grown. Representative records follow, but I have not attempted to make a comprehensive listing. Only species for which there were few previous non-coastal records are included.

Brown Pelican-26 February 1989, Tranters Creek, Washington, NC *Chat* 54:21; 10 March 1989 Greenville (*Chat* 54:42). Jaegers-17 and 27 November 1991, 3 December 1992, all from Jordan Lake (*Am Birds* 46:252, *Am Birds* 46:410). Laughing Gull-23 April 1989, Falls Lake; 15 May 1989, Greensboro (*Chat* 54:45), 21-25 November 1992, Raleigh 23 August 1992, Goldsboro (*Chat* 57:105). Bonaparte's Gull-15 December 1990, Transylvania County (*Chat* 56:12). Glaucous Gull-7-10 May 1989, Jordan Lake (*Am Birds* 43:1305). Greater Black-backed Gull-11 March 1989 (*Chat* 54:45); 20 January 1992, Jordan Lake (*Am Birds* 46:410). Common Terns-125 on 9 May 1989, Jordan Lake (*Am Birds* 43:1305). Other inland recent records are discussed in the species accounts.

#### RECENT STUDIES AND STUDIES IN PROGRESS

An overview of my first 16 years of seabird surveys off North Carolina was presented at a symposium on the Outer Continental Shelf sponsored by the Mineral Management Service (Lee 1991). In this review I discussed species diversity, the sampling program, seasonal variability, biased population sex ratios, seasonal characterizations, and zonal foraging distributions. Much of the information presented in that summary parallels what was presented in the proceeding pages.

Using specimens acquired during the studies reported herein, Moser and Lee (1992) evaluated the incidence of plastic ingestion by seabirds. Gut contents of over 1,000 birds were analyzed from specimens collected off the North Carolina coast between 1975 and 1989. Twenty-one of 38 seabird species (55%) examined had ingested some amount of plastic. The most plastic was found in Procellariiformes. The occurrence of plastic in their digestive tracks clearly correlated with feeding modes and diets. Plastic ingestion by Procellariiformes increased over a 14-year period, apparently as a result of increased rates of plastic pollution in the North Atlantic. Some species showed a tendency to select specific plastic shapes and colors, indicating that they may be mistaking plastics for specific potential prey items. No evidence was found that the seabirds' health was affected by the presence of plastic. Even in Northern Fulmars, Greater Shearwaters and Red Phalaropes, the species that ingested the largest quantities and highest frequencies, there was no indication that the plastic had been detrimental to the birds.

Based on information obtained during the North Carolina offshore surveys reported in this study, Haney et al. (1992) used geometric relationships to calculate the upper



and lower limits from which seabirds can be visually recruited to form flocks in the open sea. By analyzing arrival times and flight speeds they found that the potential recruitment distances were closer to the lower theoretical limits with a mean distance of 4.5 km. This study will prove useful in projecting seabird density levels because flock size can now be calibrated against units of surface area.

Using information obtained off North Carolina and in South Atlantic Bight Haney and Lee (1994) studied the effects of meteorological conditions on the offshore dispersal of gulls. They found gull's presence in offshore habitats to be weakly associated with seasonal variability in mean wind speeds and strongly associated with monthly and accumulated air-sea heat flux and wind speed variance. Individual meteorological variables explained as much as 59-93% of seasonal changes in gull abundance. Summer meteorological conditions in much of the western North Atlantic facilitate coastal foraging by gulls but preclude efficient foraging in offshore habitats. Because of meteorological conditions gulls delay dispersal to oceanic waters in the western North Atlantic several months after the cessation of breeding.

LeGrand (1990) compiled and summarized sightings of birds displaced by Hurricane Hugo (September 1989). This work and ones discussing Hurricane David in 1979 (Fussell and Allen Grimes 1980) and Hurricane Diana in 1984 (LeGrand 1985) are the only detailed reports on the local effects of hurricanes on seabirds. LeGrand (1990) discusses the following displaced seabirds, most of which were believed to have been transported inland in the storms eye: Cory's Shearwater, Audubon's Shearwater, Leach's Storm-Petrel, White-tailed Tropicbird, Pomarine Jaeger, Parasitic Jaeger, South Polar Skua, Laughing Gull, Herring Gull, Caspian Tern, Royal Tern, Sandwich Tern, Common Tern, Arctic Tern, Forster's Tern, Least Tern, Bridled Tern, Sooty Tern, Black Tern, and Brown Noddy. Many of the records LeGrand discussed are from South Carolina.

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#### LITERATURE CITED

- American Ornithologists' Union. 1957. The A.O.U. Checklist of North American Birds. 5 ed The American Ornithologists' Union, Baltimore. 691 pp.
- American Ornithologists' Union. 1983. The A.O.U. Checklist of North American Birds, 6th ed. The American Ornithologists' Union, Allen Press, Lawrence, Kansas. pp.
- Amos, E. J. R. 1991. A Guide to the Birds of Bermuda. E.J. R. Amos, Warwick, Bermuda. 206 pp.
- Anonymous. 1992. A soft-plumaged petrel in the U.S.A. *Birding World* 5.
- Appleberry, E. L. 1951. Noddy Tern seen in Brunswick County, NC. *Chat* 15:33.

- Bibby, C. J. And A. J. Del Nevo. 1991. A first record of *Pterodroma feae* from the Azores. Bull. British Ornithologist's Club 111:183-186.
- Blake, E. R. 1977. Manual of neotropical birds. Vol. 1. Univ. Chicago Press, Chicago, IL xix and 674 pp.
- Bond, J. 1978. Twenty-second supplement to the check-list of birds of the West Indies (1956). The Academy Nat. Sci. Phil. 20 pp.
- Bond, J. 1985. Birds of the West Indies. 5th edition. Houghton Mifflin Co., Boston.
- Bourne, W. R. P. 1983a. The Soft-plumaged Petrel, the Gon-gon and the Freira, *Pterodroma mollis*, *P. feae*, and *P. madeira*. Bull. Br. Ornithol. Club 103:52-58.
- Bourne, W. R. P. 1983B A Gon-gon *Pterodroma (mollis) feae* in Israel. Bull. British Ornithologist's Club 103:110.
- Brimley, H. H. 1909. North Carolina Notes. Auk 26:436-437.
- Brinkley, E. S. 1994a. Spring migration of seabirds off central North Carolina: 22 May 1992, with notes on two skua (*Catharacta*) taxa. Chat 58:94-101.
- Brinkley, E. S. 1994b. Evasive maneuvers of Black-capped Petrel (*Pterodroma hasitata*). Chat 58:18-21.
- Brooks, J. M. 1988. First record of the Atlantic Puffin for Florida. Fla. Field Naturalist 16:10-12.
- Brown, M. 1980. External parasites (Mallophaga and Acarina) of Wilson's Storm Petrel, *Oceanites oceanicus* Kuhl, off the North Carolina coast. Unpublished Masters thesis. N.C. State University.
- Brown, M., D. L. Hughes and G. H. Williamson. 1976. A Bridled Tern from North Carolina. Chat 40:95.
- Brown, M. M. and G. S. Grant. 1970. Sooty Tern and Audubon's Shearwater off North Carolina in September. Chat 34:102-103.
- Brown, R. G. B. 1970. Fulmar distribution: a Canadian perspective. Ibis 112:44-51.
- Buckley, P. 1970. Brown Booby, Magnificent Frigatebird and Sabine's Gull new to Virginia. Amer. Birds 24:650-652.
- Buckley, P. A. 1973. A massive spring movement, including three species new to North Carolina, at Cape Hatteras National Seashore. Amer. Birds 27:8-10.
- Buckley, P. A. and F. G. Buckley. 1984. Seabirds of the North and Middle Atlantic Coast of the United States. Pp. 101-117. In J. P. Croxall, P. G. H. Evans, and R. W. Schreiber, Eds. Status and conservation of the World's Seabirds International Council for Bird Preservation. Tech. Publ. No. 2. 778 pp.
- Carlson, C. W. 1973. Thayer's Gull at Kill Devil Hills, NC. Chat 37:50-51.
- Carter, J. H. III and J. F. Parnell. 1974. Little Gulls at Cape Hatteras, NC. Chat 38:40.
- Chamberlain, B. R. 1953. Franklin's Gull in North Carolina. Chat 17:23-24.
- Chamberlain, B. R. 1964. Sooty Terns driven to land by Hurricane Cleo. Chat 28:134.
- Clapp, R. B., R. C. Banks, D. Morgan-Jacobs, and W. A. Hoffman. 1982. Marine Birds of the Southeastern United States and Gulf of Mexico. Part I. Gaviiformes through Pelecaniformes. U.S. Fish and Wildlife Service, Office Biological Services, Washington, D.C. FWS/OBS-82101.
- Clapp, R. B., D. Morgan-Jacobs and R. C. Banks. 1983. Marine Birds of the Southeastern United States and Gulf of Mexico. Part III: Charadriiformes. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C.

FWS/OBS - 83/30. xvi and 853 pp.

- Cooper, J., L. G. Underhill, and G. Avery. 1991. Primary molt and transequatorial migration of the Sooty Shearwater. *The Condor* 93:924-930.
- Cox, G. 1968. Black-headed Gull at Ft. Macon, N.C. *Chat* 32:28.
- Croxall, J. P., P. G. H. Evans and R. W. Schreiber. 1984. Status and conservation of the World's Seabirds. ICBP Tech. Publ. No. 2.
- Crampt, S. and K. E. L. Simmons (eds). 1977. *Birds of the Western Palearctic Volume I*. Oxford University Press.
- Culbertson, P. M. 1977. Sabine's Gull in Forsyth County, NC. *Chat* 4:97.
- Davis, R. and A. Bryan. 1983. An additional Red-billed Tropicbird sighted in North Carolina offshore waters. *Chat* 47:100-101.
- Davis, R., and R. Needham. 1983. Blue-faced Booby in N.C. *Amer. Birds* 37:117-118.
- Dinsmore, S. J., J. O. Fussell, and J. Nance. 1995. Mew Gull at Cape Hatteras, North Carolina. *Chat* 59:24-25.
- Dittmann, D. L., R. M. Zink, and J. A. Gerwin. 1989. Evolutionary genetics of phalaropes. *Auk* 106:326-331.
- Dittmann, D. L. and R. M. Zink. 1991. Mitochondrial DNA variation among Phalaropes and Allies. *Auk* 108:771-779.
- DuMont, P. G. 1973. Black-browed Albatross sightings off the United States east coast. *Am. Birds* 27:739.
- Duchain, A. 1968. Sooty Tern at Chimney Rock, N.C. *Chat* 327:98-99.
- Duncan, C. D. and R. W. Harvard. 1980. Pelagic birds of the Northern Gulf of Mexico. A preliminary summary of distribution and abundance with comments on field identification. *Amer. Birds* 34:122-132.
- Dwight, J., Jr. 1897. A species of shearwater (*Puffinus assimilis* [Gould]) new to the North American fauna. *Proc. Biol. Soc. Wash.* 11:69-70.
- Dwight, J., Jr. 1925. The gulls (Laridae) of the world; their plumages, molts, variations, relationships and distribution. *Bull. Am. Mus. Nat. Hist.* 52:63-402.
- French, R. 1963. Bulwer's Petrel (*Bulweria bulwerii*) in Trinidad, West Indies. *Auk* 80:379.
- Fisher, J. 1952. *The Fulmar*. Collins, London, England. xv + 496 p.
- Forbush, E. H. 1929. *Birds of Massachusetts and other New England states. Part 1*. Massachusetts Department of Agriculture. 481 p.
- Fussell, J. 1974. Specimen of Harcourt's Storm-Petrel found in North Carolina. *Chat* 38:23.
- Fussell, J. and A. Allen-Grimes. 1980. Bird sightings associated with Hurricane David. *Chat* 44:89-100.
- Fussell, J. O. III, M. J. (sic) Tove, and H. E. LeGrand, Jr. 1982. Reports on six recent sightings of the Iceland Gull in North Carolina with comments on problems of field identification. *Chat* 46:57-71.
- Fussell, J. O. III, T. L. Quay, and R. J. Hader. 1981. Sooty Tern nest found near Cape Lookout, N.C. *Amer. Birds* 35:236.
- Georgia Ornithological Society. 1977. *Annotated Checklist of Georgia Birds*. Occ. Publication No. 6. Georgia Ornithological Society.
- Godfrey, W. E. 1986. *Birds of Canada*. Revised ed. National Mus. of Natural Sci.,

National Mus. of Canada, Ottawa, Ontario.

- Grant, G. S. 1970. Decline of the Double-crested Cormorant as a breeding bird in North Carolina. *Chat* 34:34-36.
- Grant, G. S. 1973. Second Bridled Tern specimen from North Carolina. *Chat* 37:23-24.
- Grant, G. S. 1991. Specimen records of the Great Cormorant from North Carolina. *Chat* 55:31-32.
- Grant, G. S., M. M. Browne and J. F. Parnell. 1976. The Black-legged Kittiwake in the Carolinas. *Chat* 40:12-13.
- Grant, R. H. 1963. Bridled Tern off the North Carolina coast. *Chat* 27:21-22.
- Hayden, B. P. 1975. Storm wave climates at Cape Hatteras, North Carolina: Recent secular variations. *Science* 190:981-983.
- Haney, Christopher J. 1985. Wintering phalaropes off the southeastern United States: application of remote sensing imagery to seabird habitat analysis at oceanic fronts. *Jour. Field Ornithology* 56:321-333.
- Haney, J. C. 1986. Seabird patchiness in tropical oceanic waters: the influence of sargassum "reefs". *Auk* 103:141-151.
- Haney, J. C. 1987. Aspects of the pelagic ecology and behavior of the Black-capped Petrel (*Pterodroma hasitata*). *Wilson Bull.* 99:153-312.
- Haney, J. C. 1990. Winter habitat of Common Loons on the Continental Shelf of the southeastern United States. *Wilson Bull.* 102:253-263.
- Haney, J. C., C. A. Faanes, and W. R. P. Bourne. 1993. An observation of Fea's Petrel, *Pterodroma fea* (Procellariiformes: Procellariidae), off the southeastern United States, with comments on the taxonomy and conservation of Soft-plumaged and related petrels in the Atlantic Ocean. *Brimleyana* 18:115-123.
- Haney, J. C., K. M. Fristrup, and D. S. Lee. 1992. Geometry of visual recruitment by seabirds to ephemeral foraging flocks. *Ornis Scandinavica* 23:49-62.
- Haney, J. C. and David Lee. 1994. Air-sea heat flux, ocean wind fields, and offshore dispersal of gulls. *Auk* 111(2):427-440.
- Haney, Christopher J. and Philip A. McGillivray. 1985a. Aggregations of Cory's Shearwaters (*Calonectris diomedea*) at Gulf Stream Fronts. *Wilson Bull.*, 97(2). pp. 191-200.
- Haney, Christopher J. and Philip A. McGillivray. 1985b. Midshelf fronts in the South Atlantic Bight and their influence on seabird distribution and seasonal abundance. *Biological Oceanography* 3(4). pp. 401-430.
- Haney, J. C. and S. C. Wainright. 1985. Bulwer's Petrel in the South Atlantic Bight. *Am. Birds* 39(5):868-870.
- Harrison, P. 1983a. Identification of White-rumped North Atlantic Petrels. *British Birds* 76:161-174.
- Harrison, P. 1983b. Sea birds an identification guide. Houghton Mifflin Company. Boston. 448 pp.
- Hass, T. (In press) An additional record of Bulwer's Petrel *Bulweria bulwerii* of the southeastern United States of America. *Marine Ornithology*.
- Hass, T. And B. Patterson. (In press) An unprecedented wave of Brown Boobies (*Sula leucogaster*) in North Carolina. *Chat*
- Helmuth, W. T. 1920. Extracts from notes made while in naval service. *Auk*

37(2):255-261.

- Hendrickson, H. T. and D. F. Allen. 1985. First inland record of Pomarine Jaeger from the Carolinas. *Chat* 49:41-42.
- Hill, R. B. and J. A. Johnston. 1974. A theory of upwelling over the shelf break. *J. Phys. Oceanogr.* 4:19-27.
- Holmes, R. P. 1966. Atlantic Blue-faced Booby off Bogue Banks, North Carolina. *Chat* 30:107.
- Imber, M. J. 1985. Origins, phylogeny and taxonomy of the gadfly petrels *Pterodroma* ssp. *Ibis* 127:197-229.
- Jones, H. L. 1967. Status of the Razorbill in the Carolinas. *Chat* 31:55-57.
- Kain, T. (Ed.). 1987. Virginia's Birdlife an Annotated Checklist. 2nd edition. Virginia Avifauna Number 3.
- Kale, H. W. 1963. Occurrence of the Greater Shearwater along the southern Atlantic and Gulf Coast of the U.S. *The Oriole* 28:1-4.
- Kinder, T. H., G. L. Hunt Jr., D. Schneider and J. D. Schumaker. 1983. Correlations between seabirds and oceanic fronts around the Pribilof Islands, Alaska. *Estuarine, Coastal and Shelf Science.* 16:309-319.
- Lee, D. S. 1976. Occurrence of the Black-capped Petrel in North Carolina waters. *Chat* 41:1-2.
- Lee, D. S. 1979. Second record of the South Trinidad Petrel (*Pterodroma arminjoniana*) for North America. *Am. Birds* 33:138-139.
- Lee, D. S. 1980. Probable sight record of an Ivory Gull in North Carolina. *Chat* 44:105-106.
- Lee, D. S. 1984. Petrels and storm-petrels in North Carolina's offshore waters: including species previously unrecorded for North America. *Am. Birds* 38:151-163.
- Lee, D. S. 1986a. Seasonal distribution of marine birds in North Carolina waters, 1975-1986. *Amer. Birds* 40:409-412.
- Lee, D. S. 1986b. Second record of the Cape Petrel in the Western North Atlantic. *Chat* 50:118-119.
- Lee, D. S. 1987a. Common Loons wintering in offshore waters. *Chat* 51(2):40-42.
- Lee, D. S. 1987b. December records of seabirds off North Carolina. *Wilson Bull.* 99(1):116-121.
- Lee, D. S. 1987c. Breeding birds of Carolina bays: succession-related density and diversification of ecological islands. *Chat* 51:85-102.
- Lee, D. S. 1988a. First record of Wilson's Storm-Petrels on a Christmas bird count. *Am Birds* 41:1331-1333.
- Lee, D. S. 1988b. The Little Shearwater (*Puffinus assimilis*) in the western North Atlantic. *Am. Birds* 42:213-220.
- Lee, D. S. 1989. Jaegers and skuas in the western North Atlantic: some historical misconceptions. *Am. Birds* 43(1):18-21.
- Lee, D. S. 1991. Pelagic seabirds off the North Carolina coast: An overview of 16 years of surveys. *Proceedings of Fourth Atlantic Outer Continental Shelf Region Information Transfer Meetings. MMS/OCS Study 92-0001.* pg. 77-86.
- Lee, D. S. 1992. Manx Shearwaters off the Southeastern US coast. (Abstract) *Wilson Ornithological Society Meeting 1992* pg 14.

- Lee, D. S. 1993. Comments on four pre-1853 seabirds reportedly obtained off Monterey, California. *Auk* 110:402-404.
- Lee, D. S. (In press). Pelagic ecology of Manx Shearwater *Puffinus puffinus* off the Southeastern United States of America. *Marine Ornithology*.
- Lee, D. S. and J. Booth Jr. 1979. Seasonal distribution of offshore and pelagic birds in North Carolina waters. *Amer. Birds* 35:715-721.
- Lee, D. S. and S. Cardiff. 1993. The status of the Arctic Tern in the coastal and offshore waters of the southeastern United States. *Jour. Field Ornith* 64:158-168.
- Lee, D. S. and M. K. Clark. 1995. Seabirds of the Exuma Land and Sea Park. *Bahamas Journal of Science* 2:2-9, 15-21.
- Lee, D. S., J. B. Funderburg, and M. K. Clark. 1982. A distributional survey of North Carolina mammals. *Occas. Papers of the North Carolina Biological Survey*. 72 p.
- Lee, D. S. and G. Grant. 1986. An albino Greater Shearwater: feather abrasion and flight energetics. *Wilson Bulletin* 98:488-490.
- Lee, D. S. and C. Haney. 1984. The genus *Sula* in the Carolinas: an overview of the phenology and distribution of gannets and boobies in the South Atlantic Bight. *Chat* 48(2):29-45.
- Lee, D. S. and K. O. Horner. 1989. Movements of land-based birds off the Carolina coast. *Brimleyana* 15:111-121.
- Lee, D. S. and E. W. Irvin. 1983. Tropicbirds in the Carolinas: Status and period of occurrence of two tropical pelagic species. *Chat* 47(1):1-13.
- Lee, D. S. and J. F. Parnell. (ed) 1990. Endangered, Threatened and Rare Fauna of North Carolina. Part III. A Re-evaluation of the Birds. *Occas. Papers. N.C. Biol. Survey*. 1990-1. 52 pp.
- Lee, D. S. and S. P. Platania. 1979. Unverified sight records of seabirds in North Carolina waters. *Chat* 43:79-81.
- Lee, D. S. and R. A. Rowlett. 1979. Additions to the seabird fauna of North Carolina. *Chat* 43:1-9.
- Lee, D. S. and M. C. Socci. 1989. Potential effects of oil spills on seabirds and selected other oceanic vertebrates off the North Carolina coast. *Occas. Pap. NC Biol. Surv.* 1989-1. 64 pp.
- Lee, D. S. and N. Viña. 1993. A re-evaluation of the status of *Pterodroma hasitata* in Cuba. *Ornitologia Neotropical* 4:99-101.
- Lee, D. S., D. B. Wingate, and H. W. Kale II. 1981. Records of Tropicbirds in the North Atlantic and upper Gulf of Mexico, with comments on field identification. *Am. Birds* 35:887-890.
- LeGrand, H. E., Jr. 1985. South Atlantic Coast Region. *Am Birds* 33:715-721.
- LeGrand, H. E., Jr. 1990. Bird sightings in the Carolinas associated with Hurricane Hugo. *Chat* 54:73-78.
- LeGrand, H. E. Jr. And N. W. Dias. 1995. Two records of Atlantic Puffin for North Carolina. *Chat* 59:93-94.
- LeGrand, H. E. Jr. and W. C. Hunter. 1985. Two records of the Franklin's Gull for North Carolina. *Chat* 49:17-18.
- LeGrand, H. E. Jr. and M. Tove. 1980. Immature Lesser Black-backed Gull in Carteret County, N.C. *Chat* 44:82-83.

- Lewis, R. H. 1980. Lesser Black-backed Gulls in the Carolinas. *Chat* 44:79-81.
- Lewis, R. H. 1984. Second record of Mew Gull for North Carolina. *Chat* 48:94-95.
- Lewis, R. H., M. Tove, and H. E. LeGrand, Jr. 1981. Rare gulls at Cape Hatteras, N.C., including first Carolina record of Mew Gull. *Chat* 45:75-77.
- Lowe, P. R. and N. B. Kinnear. 1930s. British Antarctic ('Terra Nova') expedition 1910. *Zoology*, 4, No 5, *Birds*:103-193.
- Lowery, G. 1974. Louisiana birds. 3rd ed. Baton Rouge, Louisiana: Louisiana State University Press. 651 pp.
- Marsh, C. and R. J. Hader. 1974. Red Phalarope in Wake County, N.C. *Chat* 38:71-72.
- McDaniel, J. W. 1973. Vagrant albatrosses in the western North Atlantic and Gulf of Mexico. *Am. Birds* 27:563-565.
- Mobley, R. W. 1980. The gastrointestinal helminths of some seabirds from North Carolina. Unpublished Masters Thesis NC State Univ.
- Mobley, R. W. 1981. Intestinal helminths of some NC seabirds (abstract). Southeastern coastal and Estuarine birds: a conference. Baruch Institute, Univ. S.C.
- Mobley, R. W. and G. C. Miller. 1982. Helminths of some seabirds from North Carolina. *Brimleyana* 7:61-68.
- Monteiro, L. R. And R. W. Furness. 1995. Fea's Petrel *Pterodroma feae* in the Azores. *Bull. British Ornithologist's Club* 115:9-14.
- Moser, M. L. and D. S. Lee. 1989. Ingestion of marine plastics by western Atlantic seabirds. Report to Nat. Marine Fisheries Service 57 p.
- Moser, M. and D. S. Lee. 1992. A fourteen year survey of plastic ingestion by western North Atlantic seabirds. *Colonial Waterbirds* 15(1):83-94.
- Murphy, R. C. 1936. Ocean birds of South America. Vols. I and II. *Am. Mus. Nat. Hist.*, New York, NY. xxiv and 1245 pp.
- Murphy, R. C. and W. Vogt. 1933. The Dovekie Influx of 1932. *Auk* 50:325-349.
- Naveen, R. 1981-1982. Storm-petrels of the World: an introductory guide to their identification. *Birding* 13:216-239; 14:10-15, 56-62, 140-147.
- Newton, J. G., O. H. Pilkey, and J. O. Blanton. 1971. An Oceanographic Atlas of the Carolina Continental Margin. Duke Marine Laboratory, Beaufort, NC. 57 pp.
- Norton, A. H. 1922. The Pintado Petrel (*Daption capense*) in Maine. *Auk* 9:101-102.
- Ottenwalder, J. A. and T. Vargas M. 1979. Nueva localidad para el Diablotin en la Republica Dominicana. *Naturalista Postal* 1976-1979. 36/79:85-186.
- Palmer, R. S. (ed.). 1962. Handbook of North American birds, Vol. I: Loons through Flamingos. Yale Univ. Press. New Haven, CT. 567 pp.
- Parnell, J. F. 1977. Birds. Pages 330-384 in *Endangered and Threatened Plants and Animals of North Carolina*. J. E. Cooper, S. S. Robinson, and J. B. Funderburg, editors. N.C. State Mus. Nat. Hist., Raleigh.
- Parnell, J. F. and R. Soots. 1975. Herring and Great Black-backed Gulls nesting in North Carolina. *Auk* 92:154-157.
- Parnell, J. F. and R. F. Soots. 1976. Caspian Tern nesting in North Carolina. *Chat* 40:14-15.
- Parnell, J. F. and R. F. Soots. 1979. Atlas of Colonial Waterbirds of North Carolina Estuaries. UNC Sea Grant Publication. UNC-SG-7810.

- Patten, S., Jr. and A. R. Weisbrod. 1974. Sympatry and interbreeding of Herring and Glaucous-winged gulls in southeastern Alaska. *Condor* 76:343-344.
- Pearson, T. G., C. S. Brimley, and H. H. Brimley. 1942. *Birds of North Carolina*. N.C. Dept. Agric., Raleigh. 416 pp. and (revised D. L. Wray and H. T. Davis). 1959. *Birds of North Carolina*. N.C. State Museum of Natural History, Raleigh, 434 pp.
- Peters, J. L. 1924. A second North American record for *Puffinus assimilis*. *Auk* 41:337-338.
- Peterson, R. T. 1980. *A Field Guide to the Birds East of the Rockies*. Houghton Mifflin Company. Boston. 384 p.
- Platania, S. P., G. S. Grant and D. S. Lee. 1986. Core temperatures of non-nesting western Atlantic seabirds. *Brimleyana* 12:13-18.
- Post, P. W. 1967. Manx, Audubon's and Little Shearwaters in the northwestern North Atlantic. *Bird Banding* 38:278-305.
- Potter, E. F., J. F. Parnell, and R. P. Teulings. 1980. *Birds of the Carolinas*. Univ. N.C. Press, Chapel Hill.
- Powers, K. D. 1982. A comparison of two methods of counting birds at sea. *J. Field Ornith.* 53:209-222.
- Powers, K. D. 1983. Pelagic Distribution of Marine Birds off the Northeastern United States. NOAA Technical Memorandum NMFS-F/NEC-27. 201 pp.
- Reynolds, A. and B. Reynolds. 1978. Black-headed Gull in Eastern North Carolina. *Chat* 42:32-33.
- Rowlett, R. A. 1978. A massive flight of Cory's Shearwaters at Cape Hatteras. *Chat* 42:45-46.
- Rowlett, R. A. 1980. Observations of marine birds and mammals in the northern Chesapeake Bight. U.S. Fish Wildl. Serv. Biol. Ser. Prog. FWS/OBS-80/04. 87 pp.
- 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.
- Salomonsen, F. 1967. Migratory movements of the Arctic Tern (*Sterna paradisaea* Pontoppidan) in the southern Ocean. *K. Dan. Vidensk. Selsk. Biol. Medd.* 24:1-42.
- Schneider, D. N. M. Harrison and G. L. Hunt, Jr. 1987. Variation in the occurrence of marine birds at fronts in the Bering Sea. *Estuarine, Coastal and Shelf Science*. 25:135-141.
- Schoryer, A. W. 1947. The deep diving of the loon and Oldsquaw and its mechanism. *Wilson Bull.* 59:151-159.
- Schramm, M. 1982. Recent records of the dark form of the soft plumaged petrel *Pterodroma mollis* from the subantarctic. *Cormorant* 10:3-6.
- Sklepkovych, B. O. and W. A. Montecchi. 1989. The world's largest known nesting colony of Leach's Storm-Petrels on Baccalieu Island, Newfoundland. *Amer. Birds* 43:38-42.
- Snell, R. R. 1989. Status of *Larus* gulls at Home Bay, Baffin Island. *Colonial Waterbirds* 12:12-23.
- Snyder, D. E. 1961. First record of the Least Frigatebird (*Fregata ariel*) in North America. *Auk* 78:265.



- Soots, R. F. and J. F. Parnell. 1975a. Ecological succession of breeding birds in relation to plant succession on dredge islands in North Carolina. N.C. Sea Grant Publ. UNC-SG. 75-27 viii and 91 pp.
- Soots, R. F. and J. F. Parnell. 1975b. First record of the Roseate Tern nesting in North Carolina. *Chat* 39:20-21.
- Taylor, J. W. 1972. Probable Bulwer's Petrel off Key West, Florida. *Wilson Bull.* 84:198.
- Tove, M. H. 1985. A record of Thayer's Gull from Hatteras Inlet, Dare County, NC. *Chat* 49:44-46.
- Tove, M. H. 1989. Reappraisal of the Status of gulls in the Carolinas. *Chat* 53:53-65.
- Van Halewyn, R. and R. L. Norton. 1984. The Status and conservation of seabirds in the Caribbean. ICBP Technical Publication. No. 2:169-222.
- Watson, G. E. 1966. Seabirds of the Tropical Atlantic Ocean. Smithsonian Press, Washington, DC. xxix and 120 pp.
- Watson, G. E. 1970. A shearwater mortality on the Atlantic coast. *Atl. Naturalist* 25:75-80.
- Watson, G. E., D. S. Lee, and E. S. Backus. 1986. The status and subspecific identity of White-faced Storm-Petrels in the western North Atlantic Ocean. *Am. Birds* 40:401-408.
- Wells, H. W. and I. E. Grey. 1960. Summer upwellings off the northeast coast of North Carolina. *Limn and Oceanogr.* 5:108-109.
- Whaling, P., D. S. Lee, J. Bonaventura, and M. Rentzepis. 1980. The body burden approach of looking at natural mercury accumulation in pelagic seabirds (abstract). 1980. Annual Meeting of American Ornithologist's Union.
- Whaling, P. and E. Olson. 1981. Substantial levels of natural mercury found in three species of pelagic seabirds (abstract). Southeastern Coastal and Estuarine Birds: A Conference. Baruch Institute, Univ. of S.C.
- Wilkinson, P. M. 1988a. Second nesting of the Sooty Tern in South Carolina. *Chat* 52:40.
- Wilkinson, P. M. 1988b. First instance of a Sooty Tern's hatching on the Atlantic coast of North America. *Chat* 52:81-82.
- Williams, R. B. and D. C. Williams. 1968. Leach's Petrel along the North Carolina coast. *Chat* 43:45.
- Wingate, D. B. 1964. Discovery of breeding Black-capped Petrels on Hispaniola. *Auk* 81:147-59.
- Wray, D. L., H. T. Davis, G. Hamphthon, and S. Messenger. 1953. Loon flight at Cape Lookout, N.C. *Chat* 17:91-29.
- Wright, J. S. 1973. A Black-headed Gull at Pea Island N.W.R. *Chat* 37:80-81.
- Wynne-Edwards, V. C. 1935. On the habits and distribution of birds on the North Atlantic. *Proc. Boston Soc. Natur. Hist.* 40:233-346.
- Wynne-Edwards, V. C. 1962. *Animal Dispersion in Relation to Social Behaviour.* Oliver and Boyd, Edinburgh.

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Appendix A: Basis for inclusion of the 71 bird species in this study as determined by currently available documentation (September 1995).

Species	Specimen NCSM	Archived Photograph NCSM	Detailed Published Report
<i>Gavia immer</i>	x		
<i>Gavia stellata</i>	x		
<i>Gavia pacifica</i>			Tove 1989
<i>Diomedea chlororhynchus</i>			Lee & Booth 1979
			Lee 1987
			Dumont 1973
<i>Diomedea melanophris</i>			
<i>Fulmarus glacialis</i>	x		
<i>Daption capense</i>			Lee 1986b
<i>Pterodroma hasitata</i>	x		
<i>Pterodroma cahow</i>			Lee 1984, 1987b
<i>Pterodroma 'mollis'</i>		x	Lee 1984
<i>Pterodroma arminjoniana</i>	x		
<i>Bulweria bulwerii</i>			Hass in press
<i>Calonectris diomedea</i>	x		
<i>Puffinus gravis</i>	x		
<i>Puffinus griseus</i>	x		
<i>Puffinus puffinus</i>	x		
<i>Puffinus assimilis</i>			Lee 1988b
<i>Puffinus lherminieri</i>	x		
<i>Oceanites oceanicus</i>	x		
<i>Pelagodroma marina</i>	x		
<i>Oceanodroma leucorhoa</i>	x		
<i>Oceanodroma castro</i>	x		
<i>Phaethon lepturus</i>	x		
<i>Phaethon aethereus</i>	x		
<i>Sula dactylatra</i>	x		
<i>Sula leucogaster</i>		x	
<i>Morus bassanus</i>	x		
<i>Fregata magnificens</i>	x		
<i>Pelecanus erythrorhynchos</i>	x		
<i>Pelecanus occidentalis</i>	x		
<i>Phalacrocorax carbo</i>	x		
<i>Phalacrocorax auritus</i>	x		
<i>Phalaropus lobatus</i>	x		
<i>Phalaropus fulicaria</i>	x		
<i>Stercorarius pomarinus</i>	x		
<i>Stercorarius parasiticus</i>	x		
<i>Stercorarius longicaudus</i>	x		

Species	Specimen NCSM	Archived Photograph NCSM	Detailed Published Report
<i>Catharacta skua</i>	x		
<i>Catharacta maccormicki</i>	x		
<i>Rissa tridactyla</i>	x		
<i>Xema sabini</i>	x		
<i>Larus atricilla</i>	x		
<i>Larus pipixcan</i>	x		
<i>Larus minutus</i>		x	
<i>Larus ridibundus</i>	x		
<i>Larus philadelphia</i>	x		
<i>Larus canus</i>		x	
<i>Larus delawarensis</i>	x		
<i>Larus argentatus</i>	x		
<i>Larus hyperboreus</i>	x		
<i>Larus glaucooides</i>		x	
<i>Larus 'thayeri'</i>		x	
<i>Larus fuscus</i>	x		
<i>Larus marinus</i>	x		
<i>Pagophila eburnea</i>			Lee 1980
<i>Sterna nilotica</i>	x		
<i>Sterna caspia</i>	x		
<i>Sterna maxima</i>	x		
<i>Sterna sandvicensis</i>	x		
<i>Sterna dougallii</i>	x		
<i>Sterna hirundo</i>	x		
<i>Sterna paradisaea</i>	x		
<i>Sterna forsteri</i>	x		
<i>Sterna antillarum</i>	x		
<i>Sterna anaethetus</i>	x		
<i>Sterna fuscata</i>	x		
<i>Chlidonias niger</i>	x		
<i>Anous stolidus</i>	x		
<i>Alle alle</i>	x		
<i>Uria lomvia</i>	x		
<i>Alca torda</i>	x		
<i>Fratercula arctica</i>			LeGrand & Dias 1995