The Genus *Sula* in the Carolinas: An Overview of the Phenology and Distribution of Gannets and Boobies in the South Atlantic Bight

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Five of the eight recognized species of the genus *Sula* are known from the southeastern United States. Of these only the Northern Gannet (*Sula bassana*) occurs regularly in the Carolinas, but both the Masked Booby (*S. dactylatra*), formerly Blue-faced, and the Brown Booby (*S. leucogaster*) have been reported from North and South Carolina. Of the two remaining species, the Red-footed Booby (*S. sula*) is generally restricted to the Caribbean and disperses northward into the Florida Keys and Gulf of Mexico, whereas the Blue-footed Booby (*S. nebouxii*) is an eastern Pacific species with one accidental and astonishing record from south Padre Island, Texas (5 October 1976, photograph Amer. Birds 31:349-351).

Generally the records for locally occurring *Sula*, excluding wintering Northern Gannets, are less than adequate as conclusive evidence of seasonal or geographical occurrence. Most problems result from confusing plumages of the various species and the general lack of experience of North American bird students with boobies. An additional problem is the fact that until very recently most ornithologists believed that boobies occurred off the south Atlantic states, outside Florida, only as rare accidentals, causing many records to be viewed with excessive caution and skepticism. Potter et al. (1980), for example, associated all records of boobies in the Carolinas with storms. In recent years few groups of birds have caused as many interpretive problems for the Carolina Bird Club's North Carolina Records Committee as have the *Sula*. Even photographic records are hard to decipher. The number of published summer sight records for Northern Gannets is particularly troublesome because in the past they were accepted without any scrutiny. Subsequent sightings of boobies became suspect because of the "documented" occurrence of summer gannets. Detailed records of any sulids seen in the southeast between late May and early October would be valid and perhaps important contributions to our understanding of the local distribution of this genus. Although all of the species reported from the region are now documented with specimens and photographs, detailed record keeping is still necessary. Much useful information could become masked by assumptions based on season, previous literature, or emphatic statements of unsupported identifications. Because different age groups have characteristic plumages, detailed record keeping will eventually provide us with needed insight on local seasonal population structure.

In many ways the offshore environment of Georgia is similar to that of South Carolina. Because it is reasonable to assume that records for occurrence of at least the tropical sulids in all three states are comparable, we have included some data gathered during recent Georgia offshore surveys as well. These collective records provide a better picture of our local understanding of these birds. For Florida the status of each species is reasonably well documented by a substantial number of records, and we see no need to repeat them at this time.

NORTHERN GANNET

The Northern Gannet occurs commonly as a migrant and winter resident in the Carolinas between late October and mid-April, but a few are encountered outside these dates (Fig. 1 and 2). However, the species is abundant only from late November through early March, and during this season numbers are sometimes phenomenal. J. Fussell, A. Bryan, and R. Davis reported 10,000+ at Cape Hatteras Point (Dare County, N.C.) on 13 February 1982 (Chat 46:82). This single observation represents about 16% of the total western Atlantic breeding stock. Winter counts of 1000 to 3000 birds from single observation points are not uncommon for northeastern North Carolina, but in southeastern North Carolina and South Carolina high counts of only 100 to 200 have been reported. These lower numbers are generally typical of other coastal states in the Southeast. Most Georgia counts have involved fewer than 50 individuals, but during midwinter up to 500 have been observed at one location (Haney, pers. obser.). The Outer Banks of North Carolina seems to represent the southernmost area of regular high concentrations, and from January through March a significant proportion of the adult western Atlantic stock probably occurs along the Outer Banks.

The number of Carolina records from early October and from late May to early June is substantial. Although there are records from outside these periods, all but one (when age has been reported) are of migrating juveniles and subadults. Few summer specimens or photographic records exist, and there is a strong possibility that some—perhaps many—of these records represent other *Sula* species. The dates of occurrence

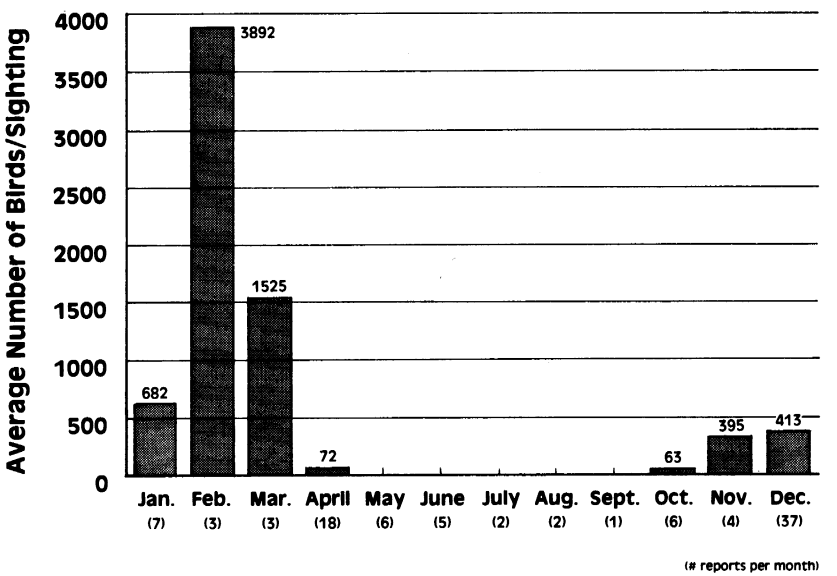

Fig. I. Seasonal distribution of Northern Gannets in North Carolina. Bars represent average numbers of birds seen per reported sighting (based on 97 sight reports of 39,443 birds).

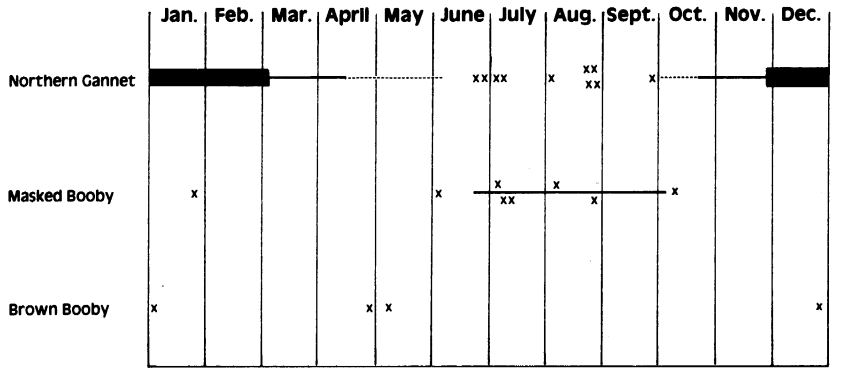

Fig. 2. Documented seasonal distribution of sulids in the Carolinas (based on all sources). Many summer gannet records are not verified.

TABLE 1. Unseasonal records of Northern Gannets in the Carolinas.

Date	*State*	*Location/Age*	*Source*
June 1948	N.C.	New Hanover County; 1 juvenile male	NCSM 2968
24 June ____	S.C.	_____	Clapp et al. 1982
24 June 1973	N.C.	Hatteras Island; 1 immature	AB 27:857, Chat 37:108
28 June ____	N.C.	_____	Clapp et al. 1982
7 July 1950	N.C.	New Hanover County, Masonboro Inlet; 1 adult female	NCSM 2967
9 July 1972	N.C.	Cape Lookout; 1 subadult	Chat 36:111
23 July 1963	N.C.	Shackleford Banks; 1 adult	Wilson Bull. 76:187
19 August 1962	N.C.	New River Inlet; single bird	Chat 26:102
20 August ____	N.C.	_____	Pearson et al. 1959
28 August 1957	N.C.	Long Beach 1 immature	Chat 22:29
30 August ____	N.C.	_____	Clapp et al. 1982
28 September 1972	N.C.	Carolina Beach; 1 immature	Chat 27:29

generally imply late lingering rather than early fall arrival of the species. Known records from mid-June through September are summarized in Table 1. Northern Gannets have been reported only between late October and early May in Georgia.

Based on observations from Lee's offshore surveys, Northern Gannets do not commonly occur far out at sea off the North Carolina coast. The birds are regularly encountered only within a few miles of the beach. Few sightings of gannets have been made over water deeper than 15 fathoms, most of single birds. However, Helmuth (1920) noted that gannets were very common off the Carolinas, 50 to 80 miles from shore on 24 February 1918. Nevertheless, he noted in a previous paragraph that his ship passed within 8 miles of Diamond Shoals, and he was in deep water only off Cape Fear. To the north Rowlett (1980), on the other hand, has found gannets to be regular and abundant inhabitants of deep-water zones (up to 500 fathoms). Feeding flocks were found associated with Fin Whales (*Balaenoptera physalus*) and Boston Mackerel (*Sarda sarda*). Off North Carolina the birds often gather in numbers around working trawl boats, but otherwise most feeding activity occurs within a mile of the beach. They have also been seen foraging over schools of porpoises (probably *Tursops*) at Myrtle Beach, S.C. (Chat 26:49). In Georgia, Haney has encountered the species between 1 and 25 miles offshore for the periods October to December and March to May. During midwinter, however, gannets were most abundant between 25 and 50 miles offshore in the mid-shelf area (20 to 40 fathoms), but occasional individuals were found out to the edge of the continental shelf (100 fathoms), 90 miles offshore. Gannets were occasionally observed foraging over schools of Spotted Dolphins (*Stenella plagiodon*) and very large flocks were associated with schools of Round Scad (*Decapterus punctatus*) or Atlantic Menhaden (*Brevoortia tyrannus*).

Although from time to time gannets are encountered in the extensive sounds of North Carolina, this is unusual. The only reported records of which we are aware are for early March 1980 when at least 75 were in Bogue Sound during a blizzard (Chat 43:83) and for 18 January 1958 at Swanquarter (Chat 22:24). Certainly gannets must occur in sounds far more frequently than these two reports indicate. The June 1948 specimen (NCSM 2968) came from Greenfield Lake, Wilmington, and is our only inland or freshwater record. The storm-blown bird was alive but in poor condition when discovered.

Except for the spring and fall migration periods, adult birds predominate in northern North Carolina waters; however this may not be true for southeastern North Carolina or South Carolina. It is well documented that the younger birds migrate earlier and farther south than adults and return later (see Nelson 1978), but specific records of aged birds for the Carolinas are few. Unfortunately, during most of Lee's offshore bird observations (Hatteras area) the different age classes of gannets were not tallied separately. Table 2 lists the few available North Carolina records for which age classes were recorded.

The information in Table 2 is sketchy at best and would have little meaning if it were not for the general migration pattern of the age groups being already documented for both sides of the North Atlantic. The problem is further compounded locally by several terms often being used interchangeably for the younger age classes. Most of Lee's records are from far offshore, thus leaving the bulk of the population along the beach uncounted. Between October and late December, southward migration is still under way. The adult population does not appear to dominate or stabilize until January. By mid-April,

TABLE 2. Age-class composition of Northern Gannets reported for North Carolina. (All observation by Lee unless otherwise stated.)

Date	*First-winter*	*Immature*	*Adult*	*Total*	*Source*
28 October 1974	192	7	1	200	Chat 42:45
6 November 1940		20		20	Pea Island records
9 November 1979	3	1	19	21	pers. obser., offshore counts only
14 November 1978	8	1	1	10	pers. obser., offshore counts only
5 December 1978	2		3	5	pers. obser., offshore counts only
27 December 1946		3	125-150*	125-150	Chat 11:15
28 December 1982	3	29	1	33	pers. obser., offshore counts only
27 January 1982	35*	45*	720*	800	pers. obser., off beach
2 March 1984		6	28	34	pers. obser., offshore
16 March 1984	2	4	102	108	pers. obser., inshore and offshore
26 March 1983		2	17	19	pers. obser., offshore counts only
2 April 1978	1		4	5	pers. obser., offshore counts only
2 April 1984	6	10	104	120	pers. obser., inshore and offshore
4 April 1978		1	19	20	pers. obser., offshore counts only
17 April 1978	3			3	pers. obser., offshore counts only
27 April 1983	(mostly immature, migrating north)			91	Brittin, comm. to LeGrand

*estimated

however, many of the adult birds are back on the breeding grounds (Nelson 1978), and juveniles and subadults again make up the bulk of the population off our coast. Additional information on different age classes, normal seasonal variations, and how the age composition of local birds is affected by unseasonable weather would be desirable and relatively easy to obtain.

As expected, banding records substantiate that only New World stock (nesting colonies in Quebec [Bonaventure; Bird Rocks, Magdelen Islands] and Newfoundland [Cape St. Mary's]) occurs in the western Atlantic (Moisan and Scherrer 1973; see Nelson 1978 for discussion). Several of the gannets banded as chicks at Bonaventure Island have been recovered along the coast of the Carolinas.

On one specimen (NCSM 9101) the radius of the left wing was obviously broken and had healed. The bird was an adult male in good health (2990 g) when collected. Apparently the wing broke and healed while the bird was still on the nest, as it would be difficult to imagine a post-fledging bird surviving a broken wing.

Information on the general plumage development is well known, but much is yet to be learned about the sequence and timing of feather molt, particularly while birds are away from nesting areas. Gannets exhibit marked individual variation in plumage appearance and probably in the timing and sequence of molt. The plumage development of the females is advanced when compared to males of the same age. Some of the specific molt information obtained from North Carolina specimens seems to contradict previous attempts to summarize molt patterns. This is further complicated by the protracted molt period of the birds and the continuous-stage-descendant pattern (Stressman and Stressman 1960), which makes it difficult to find feather replacement on prepared study skins. Overview information provided here to keep continuity in the descriptions is from Nelson (1978).

Juvenile birds in their first year are, from a distance, nearly uniformly dark. This varies considerably in degree; some being sooty while others are light gray and quite pale beneath. This apparently has little to do with season, for the variation can be seen in individuals prior to fledging. Birds of this plumage class do not begin to molt until early March, perhaps later. Their tail feathers are extremely worn, probably as a result of the abrasion from nesting ledges during their preflight period. The V-shaped white areas on the dorsal body feathers vary in size, and on many birds they wear off by late winter. By April some first-winter birds are well advanced in postjuvenal molt. A 28 April female specimen (NCSM 9826) already has the 1st, 2nd, and 3rd primaries new, the 4th is half grown, and the rest are old (both wings). The first secondaries on each wing are new. The head and neck are becoming quite light, and feather replacement is well advanced. The back has moderate molt and the belly, although already rather pale, is only molting lightly. Four new tail feathers are emerging; the remainder are the worn original ones.

Plumage of postjuvenile (immature) gannets is extremely variable. Dorsally, they are a mixture of dark and light with dark dominating. Within this age class older birds are basically white with dark markings, younger birds are dark with white markings. In the following molt the plumage is the most variable. At this age some of our wintering birds begin to develop the blue striping of the legs and toes characteristic of adult Northern Gannets. Tails remain black, and individuals molting tail feathers continue to replace them with dark feathers. The head and neck are normally white with scattered dark feathers, but often a ventral collar of dark feathers is apparent at the base of the neck. The ventral surface is light except for the flanks. Birds in this plumage exhibited variable molt patterns. Some had new outer primaries emerging (25 November) or a few molting secondaries and tail feathers (27 January), but most were taken from migration periods and showed no active molt.

Subadult birds, probably most in the third to fourth years, are recognized by the presence of some black tail feathers and secondaries. Occasionally single black tail feathers remain for several more years into early adulthood. Some birds of this plumage class still retained bursas as late as 26 March (NCSM 7900), though others had lost them as early as 27 January (NCSM 9161). This probably reflects differences between the third- and fourth-year birds. All birds in younger plumage classes had bursas, but those in

older plumage classes did not. Typically birds in third- to fourth-year plumage had a combination of some dark secondaries (piano-key effect) and dark central tail feathers. One specimen (NCSM 6414), a male from 29 December, had only one black tail feather. Molt sequence of two males is as follows: NCSM 7900, 26 March, 7th primary of each wing in sheath and remainder new, some molt in secondaries, heavy molt of head and neck and wing coverts, moderate ventral molt, light molt of back, some new tail feathers emerging; NCSM 9161, 27 January, 2nd through 9th and 11th primaries (both wings) new, 1st very new, and 10th three-quarters grown, some molt of secondaries but no molt on the remainder of the bird.

Adult plumage is typically obtained near the end of the bird's fifth year. Adult male birds of unknown age collected on 27 January 1983 were actively molting. Examples of molt sequence are presented for two birds. On NCSM 9175 the 1st and 5th primaries of the right wing were half grown, 10th three-quarters grown, 2nd and 8th old, and the remainder new. On the left wing the 3rd and 7th were half grown, 10th three-quarters grown, 4th and 8th old, and the remainder new. The secondaries had no sign of molt except for 4th and 11th on the right wing, which were three-quarters grown, and the 2nd and 11th on the left wing, which were half grown. The primary and secondary coverts were in similar sequence. Six of the twelve tail feathers were being replaced, three in sheath and three one-quarter grown. On NCSM 9101 the 2nd and 6th primaries on both wings were half grown, the 10th on the left wing was in sheath, and the rest appeared new; 8th and 10th secondaries on the left wing and 7th and 11th on the right wing where each only about half grown. Only one tail feather was being replaced.

Food and Feeding: Examination of stomachs of 10 individuals collected off the North Carolina coast revealed little information concerning food habits. Five stomachs were completely empty and three contained only well-digested spinal columns and disarticulated fin rays of small fishes. Of the remaining two stomachs one (27 January) contained large beak segments (20 mm) and a quill of a recently consumed squid and the other (28 April) nine small (100-200 mm) Atlantic Menhaden. One Georgia specimen (UGAMNH 2060) had two Atlantic Silversides (*Minidia minidia*) and one Atlantic Menhaden in its stomach. Based on orientation in the stomach, fish were swallowed head first. Birds we have watched at sea are attracted to chum (fish offal or bread) and on occasion feed on it. In most cases gannets followed our boats when chum was offered, but they were perhaps attracted as much by the activity of feeding gulls as by the chum itself. Gannets regularly concentrate around working trawl boats, feeding on undersize fish and scraps discarded by the crew. Individuals Haney observed on the Georgia outer shelf during bottom longline surveys often dived for fish offal that had sunk out of reach of accompanying Herring Gulls (*Larus argentatus*).

Weights and Sex Ratios: Poulin (1968) provides data on weights of Bonaventure gannets. Weights of eastern Atlantic populations are summarized by Nelson (1978). Thirty-eight Bonaventure males averaged 3153 g and 24 Bonaventure females averaged 3284 g. These averaged heavier than eastern Atlantic populations. Weights away from nesting areas are not well known. Stewart and Skinner (1967) provide weights for one immature male (2948 g) and one immature female (3062 g) from Alabama. Weights on 17 North Carolina specimens (excluding sick birds and beach wrecks) are as follows:

adult male (4) 3006 (2899-3170) g, adult female (2) 3675 (3100-4250) g, subadult male (3) 3126 (2892-3402) g, juvenile male (2) 2889 (2663-3115) g, immature male (2) 2627 (2363-2891) g, immature female 3101 (2903-3300) g, immature—sex not known (2) 3682 (3629-3735) g. A juvenile female from South Carolina in the Charleston Museum weighed 3310 g. Females averaged heavier than males, and there was no seasonal correlation of weights of local birds, although the birds average below weights of birds at breeding colonies. Young birds generally weighed less than older ones.

Available information for North Carolina suggest that males predominate except during migration periods. Of a total of 12 winter specimens of known sex at the NCSM, only one is a female, and it is an immature bird from 14 November when some migration is still evident. Of five winter specimens at the University of Georgia (UGAMNH), three are males and two are not labeled to sex. Spring migrants seem evenly divided between the two sexes. There is no previous information on sexually different migration patterns, and a larger sample would be most informative.

MASKED BOOBY

The Masked Booby has been reported from the Carolinas on only a few occasions. Sprunt (in Sprunt and Chamberlain 1949) watched two adults for half an hour that "swam, dived, and flew about" on 23 January 1937 off Folly Island, S.C. The birds were in good plumage and "the black tails showed in sharp contrast to the white body plumage." There are no other published records for that state. On 14 July 1983 Haney observed and photographed (Fig. 3a) a subadult Masked Booby at 32°08′N, 79°29′W approximately 70 miles due east of Hilton Head Island, Beaufort County, S.C., in 32 fathoms of water. He observed the bird intermittently for 45 minutes as it flew and dived near two very large (ca. 1 acre) patches of *Sargassum*. This individual closely resembled the illustration of a subadult Masked Booby in Tuck and Heinzel (1980:167), but with somewhat less ochre-brown on the head. The bird's flight was gannet-like, generally at heights of 10 feet or more, but with occasional glides to within a few feet of the ocean surface. Diving was vertical, from heights greater than 20 feet, and the bird rested for several minutes on the surface after completing a dive. Large concentrations of filefish (*Monacanthus*) and dolphin (*Coryphaena*) were associated with the *Sargassum* at this location.

Three published reports exist for North Carolina. Holmes (1966) described two immatures seen on 7 June 1966, 300 yards off Bogue Banks. These were associated with tropical storm Alma. Clapp et al. (1982) discredit this record because of its being far north of all other known records for the species and stated it is quite likely that the birds seen were misidentified Northern Gannets. Obviously Clapp and his associates are not familiar with Dr. Holmes's proven ability as a careful field observer. Lee and Platania (1979) discussed birds that were almost certainly this species described to them by boat captains from the summer of 1979 (7 and 11 July) off Oregon Inlet. In one case the captain saw them for an extended period as they dived for fish next to his charter boat. They were described as adults ("smaller like gannets but with dark tails"). The captains were later able to recognize them from illustrations in books. Davis and Needham (1983) photographed and reported on an adult Masked Booby that took up residence in a nesting colony of Brown Pelicans (*Pelecanus occidentalis*), Royal Terns (*Sterna maximus*),

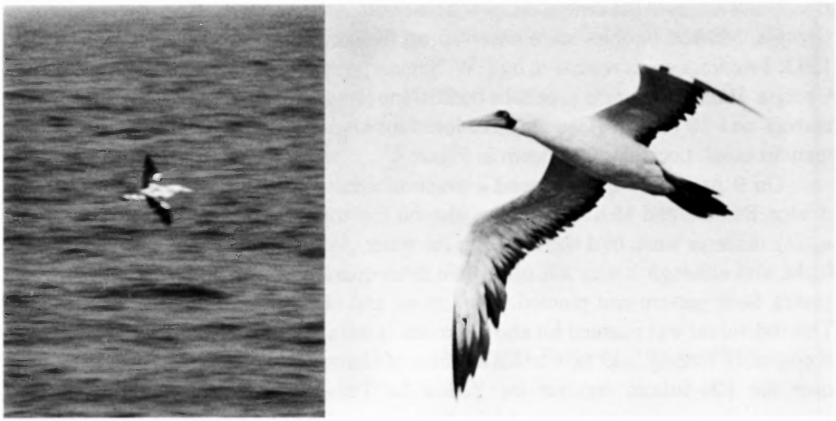

Fig. 3. (a) Subadult Masked Booby (left) flying over *Sargussum* 70 miles E of Hilton Head, S.C., on 14 July 1983. (Photo by J.C. Haney) (b) Adult Masked Booby (right) at mouth of Cape Fear River, summer 1981. (Photo by J.F. Parnell)

Sandwich Terns (*S. sandvicensis*), and Laughing Gulls (*Larus atricilla*) at the mouth of the Cape Fear River. The bird was present almost continuously betwen 23 June and late August 1981. During this time it exhibited some territorial and nest-building behavior. It was last seen on 3 October 1981, and there is no indication that it returned to the colony in 1982 or 1983. Prior to this paper this represented the only substantiated record for the Carolinas, but moreover it is an important documented occurrence both geographically and behaviorally for this species.

Subsequently Lee has obtained additional records of this species from North Carolina's waters. In the midsummer of 1981 while Lee was offshore, a captain on another boat called and described perfectly two adult Masked Boobies that were fishing around his charter boat. Although the birds remained with that boat for some time, it was 15 miles to the north; long before Lee reached the boat the captain called to report the birds had flown off. On 9 October 1983 Captain Allen Foreman, on a boat chartered by Paul DuMont and Bob Ake out of Hatteras to observe seabirds, encountered a single nearly adult Masked Booby. [For details see "Briefs for the Files" in this issue.—ED.] A record of a single Masked Booby collected on 9 August 1983 is described in detail below. Thus there are the three 1983 records, the Cape Fear bird (Davis and Needham 1983), Holmes (1966) and Sprunt and Chamberlain (1949) records, and three (+) records reported by reliable captains. This makes a total of at least nine positive or apparently valid records (11+ individuals) ranging between 23 January and 3 October.

Additionally, Lee was told by Richard Harris (Oregon Inlet fishing fleet) that he saw several different birds during the 1983 summer fishing season off Oregon Inlet, but he did not have specific dates. He also reported a single Masked Booby in mid-August 1980. At least two other sight records of sulids that were considered Masked Boobies by the observers have been reported in the last few years. Although the birds seen were almost certainly not gannets, the records committee had problems with the descriptions of the birds, and the reports were retracted. During monthly seabird surveys conducted by

Haney and others in the central and southern South Atlantic Bight off South Carolina and Georgia, Masked Boobies were observed on five occasions between May and August 1983. Two immatures were seen by P.W. Stangel (pers. comm.) on 3 and 4 May 1983 off Georgia. Haney had single subadults on 20 June (Georgia), 14 July (South Carolina, see above), and 30 August (Georgia). All locations were well offshore at distances greater than 50 miles. Locations are shown in Figure 4.

On 9 August 1983 Lee found a single subadult Masked Booby off Oregon Inlet. Benton Basham and M.K. Clark were also on this trip. First seen from a mile (possibly more), the large white bird was sitting on the water. As the boat approached, the bird took flight, and although it was still more than three-quarters of a mile distant, the flapping-gliding flight pattern and pointed wings, head, and tail made it recognizable as a sulid. This individual was pursued for about 6 miles. It left a large sargassum bed, where it was presumably feeding, and flew toward a fleet of charter fishing boats that were working over the 100-fathom contour for Yellow-fin Tuna (*Thunnus albacares*). The bird approached several of the boats and finally landed on the water next to a floating board. In flight and on the water the bird was noticeably smaller than a gannet. The booby was collected while it was trying to catch small fishes that had schooled under the board.

During the last few minutes of pursuit, we saw the bird well and were certain of its identity. In addition to its small size, its dark tail contrasted with its white body but not to the extent expected based on illustrations in field guides (see plumage description below). Because the bird was at all times flying away from the boat, no one was able to observe the head very well. When it landed, however, the dark area on the face and throat was most noticeable and seemed more pronounced than on a gannet.

The specimen (NCSM 9538) is a male (1284 g) in advanced subadult plumage and appears to be molting into adult plumage. The bird possessed very light accumulations of subcutaneous fat. The left and right gonads measured 12 x 4 mm and 10 x 3 mm respectively. A bursa measuring 14 x 28 mm was present, further confirming its youth. The bird's size is as follows: wingspan 1574 mm, total length 740 mm, wing cord 410 mm, tail 145 mm, tarsus 52 mm, and bill 101 mm. It should be noted that the Atlantic populations (*S. d. dactylatra*) are about 20% smaller than those of the Pacific (*S. d. californica, granti, personata*) and the Indian Ocean (*S. d. bedouti* and several other less distinct forms) in nearly all measurements (see Murphy 1936, Palmer 1962), although sizes of Pacific birds are most often cited in popular identification guides. We can find no information on weights of Atlantic birds, but ones published for Pacific males averaged 200 to 600 g more than the North Carolina specimen.

Coloration of the soft parts is noteworthy because of the intermediate age/plumage of the bird. The unfeathered area around the face was lead gray with only a faint tinge of blue. The throat was dark blue. The bill was progressively more yellow toward the tip. The pupil was large (5 mm diameter) and the inner portion urine yellow. The feet and legs were a uniform lead gray. The ventral plumage is white on the body and neck. Some light brown spotting is evident above the secondary under wing coverts and at the wing joint, and a large brown area is apparent on the leading edge of the foremost primary coverts. These are obviously hold-overs from the juvenal plumage. The tail feathers are so worn that they appear gray to silverish. Dorsally the pattern is much more complex. It approaches definitive plumage except as noted. The secondary coverts are essentially white with dark tips that visually merge into the secondaries. About 20% of the lesser

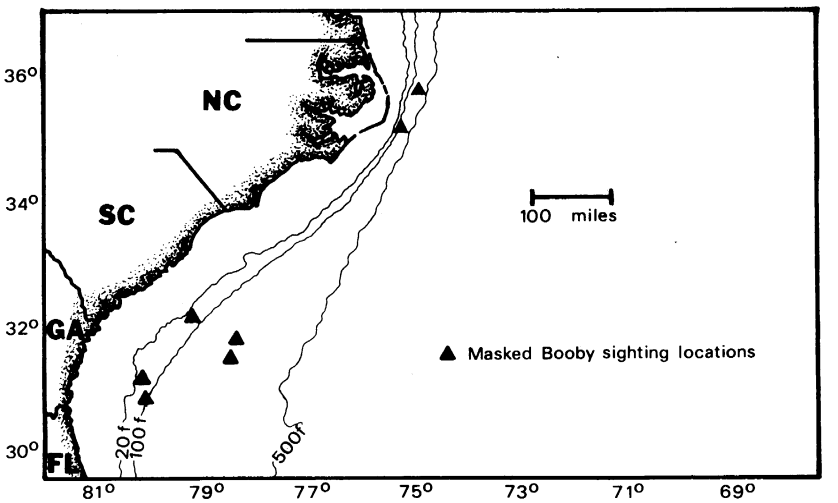

Fig. 4. Locations of 1983 Masked Booby records for the Carolinas and Georgia.

covert feathers contain elongated brown spots, which give the light portion of the wing a mottled appearance. The upper shafts and inner portions of the secondary and primary coverts are white. Normally they would be covered by overlapping feathers, but the wing is in such an advanced stage of molt that bases of many are exposed. The older dark feathers are so bleached that they would probably show silvery in flight. The posterior half of the back has an increasing number of dark feathers. Several new black feathers, some of the dark scapulars that are conspicuous at the base of the trailing edge of the wings on adult birds, are well formed. Just anterior to the new scapulars is a series of large, old feathers with dark shafts and varying amounts of faded brown. These extend out onto the wing. The remaining posterior portion of the bird and its flanks are dominated by light brown feathers. These extend into the upper tail coverts. The outer tail coverts are white and form a semidistinct white band between the body and the tail. The tail is somewhat darker dorsally than ventrally, but the badly worn feathers certainly are not black. Figure 5 illustrates dorsal and ventral aspects of this specimen as it compares to adult- and juvenal-plumaged birds. This plumage stage has not been previously described, and would certainly cause some identification problems.

The extensive molt of the bird is interesting from several aspects. First, this individual would probably have been reported as an adult if it had not been collected and closely examined. The immature features were hard to decipher from a distance. Second, information on this age and development of molt sequence is lacking. Palmer (1962) notes that stages succeeding the juvenal plumage are poorly known; although descriptions seem to be entirely lacking. Currently it is not known how many years it takes to achieve definitive plumage. Interestingly, Palmer notes one reference to a bird similar to the one described here begging for food from adults. Third, it is surprising to us that a bird in this stage of molt would be encountered at the extreme periphery of its known range. Molt

periods are generally considered stressful on seabirds and are not expected during periods of long-range movements or during nesting, although there is some evidence that sulids are exceptions.

This last point deserves some discussion. In that warm tropical seas are notoriously unproductive areas, it seems logical that long-range dispersal to subtropical/temperate seas during the nonbreeding period would be a valid strategy for many tropical seabirds. Off North Carolina this phenomenon is exhibited by the regular presence of Audubon's Shearwaters (*Puffinus lherminierii*), Black-capped Petrels (*Pterodroma hasitata*), Bridled Terns (*Sterna anaethetus*), and to a lesser extent tropicbirds (*Phaethon* sp.). In Masked Boobies this is demonstrated by a modest number of unconfirmed sightings off the Carolinas and by an impressive list of records off Florida and the Gulf Coast off the southeastern United States (see Clamp et al. 1980). These sightings cover all months, but 88% are between April and September with August having the largest number of reports (22%). To turn the argument around, it would in fact probably be more stressful for molting birds to remain in tropical waters where food sources are scarce. The molting specimen collected and the number of immatures and subadults reported suggest to us regular summer residence of Masked Boobies in the Gulf Stream off the southeastern United States. The infrequency of sightings is an artifact of limited offshore coverage, confusion concerning identification (resulting from inshore summer gannet records), and the general rarity of this booby in the Bahamas and Greater Antilles where presumably our locally occurring birds originate.

A large percentage of the northern records (Carolinas and Georgia) of this species are of juvenile/subadult birds. Because of the nature of the plumage development, several of the birds reported as adults could easily have had undetected traces of subadult plumage. It may be that the younger boobies are dispersing farther from the nesting colonies that do the adults. This would, as in the gannets, limit feeding competition between young and adults and would perhaps be even more important to birds living in nutrient-poor tropical systems. This would in part explain the discrepancy of long-range movement by the heavily molting specimen.

The seeming rarity of Masked Boobies at our latitude in the western North Atlantic may really be more an indication of the local rarity of the species than a reflection of frequency or regularity of northward movement. In other words, northward summer and postbreeding dispersal may not be aberrant, and occurrences of the species in Carolina offshore waters should not be regarded as accidental. The species has apparently been extirpated from the Bahamas (Palmer 1962; Sandy Sprunt, pers. comm.), and it is generally rare in Caribbean (Palmer 1962, Raffaele 1983). The birds encountered rather commonly in the northern Gulf of Mexico (Duncan and Harvard 1980) and regularly at Dry Tortugas are likely to be from the small colony off north Yucatan and on reefs in the southern Gulf. Contrary to previous published statements, the Carolinas seem to be well within the expected dispersal range of the Caribbean birds. Nelson (1978) regards this species as one of the three long-distance foraging species of sulids. Foraging trips of 300 miles or more from the nesting colonies are of regular occurrence. In the eastern Pacific off western Mexico, Masked Boobies are more pelagic than either Brown or Blue-footed Boobies and may be seen hundreds of miles from the nearest breeding colonies (Haney, pers. obser.). They have been found riding sunning marine turtles and sleeping while floating with heads tucked back between wings far at sea (Murphy 1936, Palmer 1962).

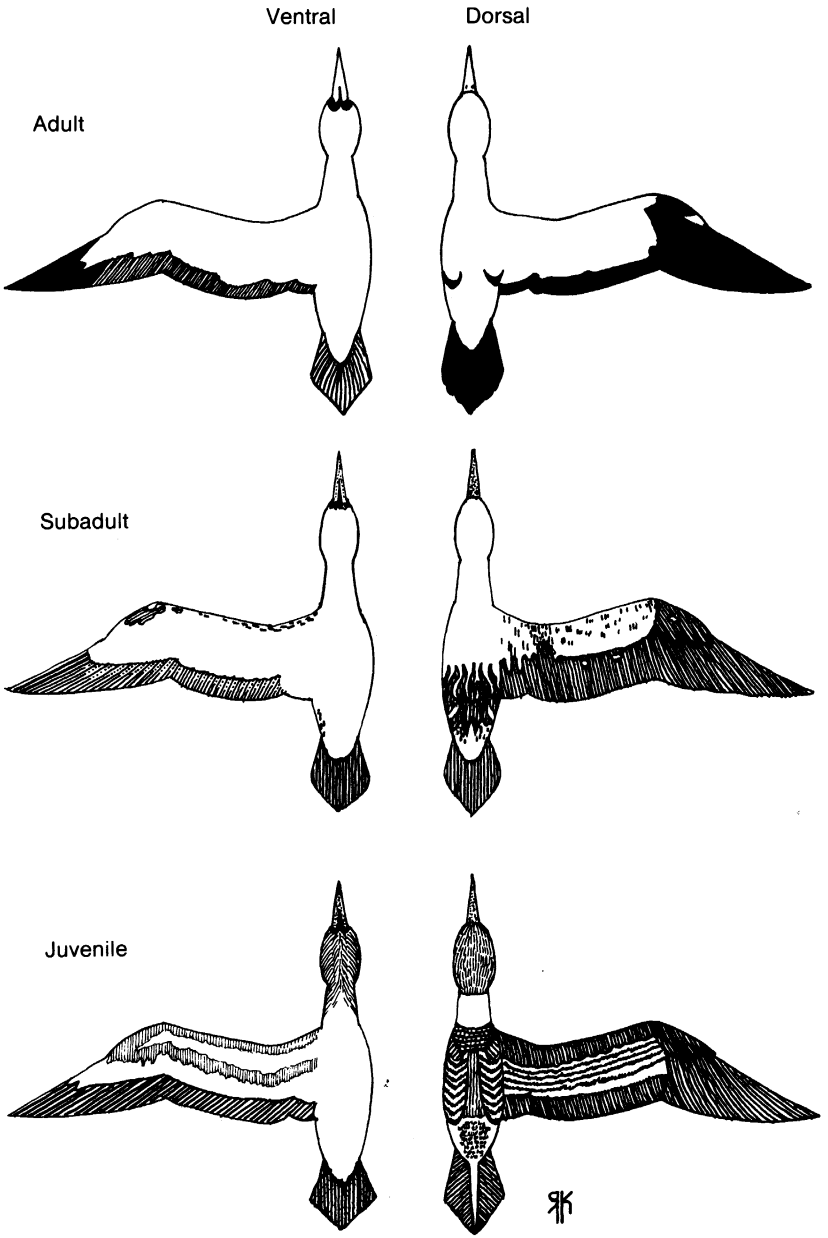

Fig. 5. Dorsal and ventral patterns of adult, subadult, and juvenile Masked Boobies, *Sula dactylatra*. The subadult is from NCSM 9538; others are modified from Nelson (1978).

The marine distribution nevertheless is not well known, with young spending much time at sea and being rarely encountered around breeding colonies. Palmer (1962) states that adults remain paired and do not appear to disperse after the breeding season, but Nelson (1978) notes dispersal for postbreeding adults and wide-ranging dispersal for young.

We can find no published information on the molt sequence of this species. In primaries on both wings the 1st through 6th are new, 7th is nearly grown, and 8th through 11th are old. The primary coverts are in the same sequence. The secondaries are a combination of old, new (R 1-3, 5, 10; L 1-5, 8-12), and growing (R 6). Tail feathers are predominantly old and extremely worn, with only three new feathers emerging. The head and back exhibit no molt, the neck is lightly molting, and the belly molt is moderate.

Because of their highly pelagic nature, most Masked Boobies in collections are from nesting grounds. Consequently, little information on seasonal molt sequence is available. Most specimens examined were in new plumage, although apparently a few individuals arrive at breeding areas in the last stages of molt. Lee examined specimens from various known breeding colonies, and a few in the Denver Museum of Natural History of *Sula d. californica* (Mexico) and *S. d. personata* (Laysan Island, Hawaii) were found in which all but the one to three outermost primaries were new. On these the preceding primaries were growing. Based on other specimens from the same colonies, however, these appear to be exceptions. On all specimens of nesting adults the tails were worn, but this is owing to their courtship activities and ground-nesting behavior, not to the age of the feathers. The specimen collected from North Carolina has a tail that appears to have been inserted into a fan. Perhaps these feathers are ones remaining from its fledging period. It is hard to imagine a seabird acquiring this feather condition away from land. Intermediate-aged gannets, for example, show no abrasive wear of tail feathers. Based on a photograph taken by Parnell of the adult that took up residence at the mouth of the Cape Fear River, it appears that molt of primary feathers had just started (Fig. 3b).

Food: The food items recovered from the stomach are in general agreement with what has been recognized as the basic diet of the species in other parts of the world (see Dorward 1962, Nelson 1978, and Schreiber and Hensley 1976). Portions of unworn squid beaks in two sizes (5 mm and 3 mm) indicate at least two recently ingested ommastrephid squid. The bulk of the stomach was filled with a partly digested Dolphin (*Coryphaena hippurus*), 135 mm TL. One other well-digested fish with a 60-mm body length (head decomposed) and some long fin rays that were probably from a small flying fish completed the stomach contents. Generally Masked Boobies eat larger fish and fewer squid than do Red-footed Boobies.

BROWN BOOBY

The Brown Booby is also represented by a small number of records from the Carolinas. This is somewhat surprising since, unlike other boobies, there are numerous records, from all months of the year, for the south Atlantic coast off peninsular Florida and the Florida Keys (see Clamp et al. 1982 for summary). The Brown Booby also has been documented to the north (Virginia, Buckley 1970; New York, Raynor 1976; Massachusetts, AOU Checklist 1957). Four immature specimens (now lost) in the Charleston Museum were labeled by Bachman as "South Carolina" (Wayne 1910), and a more recent specimen (ChM 1968. 30) was obtained on 4 January 1968. The bird, an immature, was found on a lawn in Charleston (Burton in Sprunt and Chamberlain 1970) after 4 days of fog.

Examination of the specimen provides this additional information: male, bill color blue gray, eye blue, feet yellow, little demarcation of the breast and neck (very young bird). The measurements are bill, 95 mm; wing cord, 383 mm; tail, 185 mm; tarsus, 38 mm. All feathers are old with no sign of molt, and the tail is frayed. The specimen was apparently a first-winter bird in its original juvenal plumage.

Three Brown Booby records are available from North Carolina. One is an unverified sighting reported from 10 May 1979 about 15 miles off Cape Hatteras (Lee and Platania 1979). The observed details strongly indicate that the bird in question was an adult Brown Booby. Nevertheless the viewing distance involved makes the record unconvincing. The second report is of an immature perched on a dune at Ocracoke, Hyde County, on 25 April 1983 (Amer. Birds 37:858). According to Mike Brittin, who provided a detailed written description to Harry LeGrand, the bird was approached within 35 feet. Yellow legs were evident, and a strong line of contrast was exhibited between the dark brown neck and the light brown breast and belly. Strong (15 to 20 mph) southwest winds had prevailed all day. (Brittin provided additional descriptive notes that leave no question as to the identity of the bird.) On 30 December 1981 Eloise Potter saw what she believes to have been an adult Brown Booby from the beach at South Nags Head, Dare County. The bird was uniformly very dark brown above and on the neck and upper breast. The white belly and under tail coverts were sharply defined. There was no white flash in the upper wings, but the under wings were not seen well. The bird appeared to be pointed at both ends, but the bill was never seen well; it just disappeared into the background of the ocean. The bird flew parallel to shore low over the waves with deliberate, even, moderately deep wing strokes. It was viewed in good light at a distance of one-quarter to one-half mile with a 30X Balscope. Also we should mention a single unsubstantiated listing of this booby (as [Sula] Fiber, L. Booby) by Curtis for North Carolina (Simpson and Simpson 1983). The Curtis manuscript was apparently written in 1866 or slightly earlier.

Other than a statement by Audubon (1840-1844) that the Brown Booby occurred off Georgia, there is but one record for this species in that state. Haney observed an immature on 14 May 1983 some 80 miles E of Ossabaw Island, Chatham County (Haney, in press). With all the trips taken off the Southeastern coast in pursuit of seabirds, it is surprising, to us, that additional records are unavailable.

DISCUSSION

Northern Gannets, Masked Boobies, and Brown Boobies occur in Carolina offshore waters. The Carolinas appear to represent the northernmost region of occurrence for Masked Boobies in the Atlantic. Additionally, it is feasible that the Red-footed Booby may eventually be encountered in the region. Most United States records, however, are from the Dry Tortugas and the Gulf of Mexico, and the only two existing sight records for the Atlantic coast of Florida are suspect (see Clamp et al. 1982). Therefore the probability of observing this species off the Carolina coast seems much less likely than for Masked or Brown Boobies.

The identification problems in recognizing species of *Sula* are considerable. This is particularly true of, but not limited to, the juveniles and subadults, and the different plumage morphs of the Red-footed Booby. Local bird students need only study closely the plumages of wintering Northern Gannets to appreciate the potential for individual

variation. This problem is further enhanced by the protracted migration period of juvenile and immature gannets combined with their occurrence as stragglers in the warmer months. The early arrival, late departure, and occasional summer records of Northern Gannets, thus, greatly overlap the period of expected occurrence for the tropical and subtropical boobies. Furthermore the documented dates of occurrence for boobies are not confined to the warmer months. Some of the best documented South Carolina booby records (Brown and Masked) are from January, and there are many Florida and Gulf Coast winter records for both these species. The seven+ Masked Boobies seen in 1983 off the Carolinas and Georgia were recorded during a season that had no hurricanes or tropical storms. It should be noted that most of the records, both well documented and provisional, are not storm related.

Offshore observations may present less confusing identification problems. Northern Gannets do not commonly venture far offshore, and under good sea conditions it is usually possible to study every *Sula* encountered. In over 1000 hours at sea off North Carolina, Lee has never seen a gannet far offshore except in the winter; so it appears likely that the few summer stragglers confine their activities to an area close to the beach.

There is still much to be learned about the distribution of *Sula* in Carolina's offshore waters. Specimens, photographs, and plumage descriptions are valuable because information for all of these birds, once they leave their breeding grounds, is scarce. Information on age classes of wintering or migrating Northern Gannets from different time periods and localities would be useful.

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