Atlas of eastern Canadian seabirds

Supplement 1

Halifax – Bermuda transects

by R. G. B. Brown
Canadian Wildlife Service

Fisheries and Environment Canada
Pêches et Environnement Canada

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Supplement I

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by R. G. B. Brown[2]

Canadian Wildlife Service
Environmental Management Service
Department of Fisheries and the Environment

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This Supplement to the Seabird Atlas is dedicated to David Wingate, MBE, who has done much to preserve the remaining Bermudan seabirds, and whose patient work on Nonsuch Island is restoring a fraction of the original Bermudan habitat.

Thanks for the Cahows.

Contents

Summary

This report is a supplement to the CWS "Atlas of eastern Canadian Seabirds". It presents data on the pelagic distribution of seabirds in the subtropical northwest Atlantic south of 40°N and west of 28°W, collected mainly on oceanographic cruises between Halifax and Bermuda.

Distribution maps are plotted for Cory's Shearwater *Calonectris diomedea*, Greater Shearwater *Puffinus gravis* and Audubon's Shearwater *P. lherminieri*, Leach's Storm Petrel *Oceanodroma leucorhoa* and Wilson's Storm Petrel *Oceanites oceanicus* and the White-tailed Tropicbird *Phaëthon lepturus*, for the period June–September. These maps follow the format used in the "Atlas"; the symbols show the average number of birds of a species seen in each 1°N X 1°W block during 10-minute watches from a moving ship. The effort maps show the number of watches on which these averages are based. Observations at other times of year and of other species are listed in Appendix 1.

We discuss seabird distributions with reference to the physical and biological oceanographic characteristics of the area, and to the hazard presented by the accumulation of tar particles in the Sargasso Sea. The literature on seabird distributions in the subtropical northwest Atlantic is reviewed.

We describe the destruction of the formerly large seabird colony on Bermuda, and attempt to reconstruct the former pelagic range of the nearly-extinct Cahow *Pterodroma (hasitata) cahow*.

Appendix 2 lists some additions and corrections to the "Atlas".

Résumé

Le présent rapport constitue un supplément à l'*Atlas des oiseaux de mer de l'est du Canada* préparé par le Service canadien de la faune. Y figurent des données sur la distribution pélagique des oiseaux de mer dans la zone subtropicale du nord-ouest de l'Atlantique, au sud du 40e parallèle et à l'ouest de la longitude ouest de 28°, recueillies principalement lors d'expéditions océanographiques entre Halifax et les Bermudes.

Des cartes y montrent la distribution des Puffins cendré et d'Audubon (*Calonectris diomedea* et *Puffinus lherminieri*), du Grand Puffin (*Puffinus gravis*), des Pétrels cul-blanc et océanique (*Oceanodroma leucorhoa* et *Oceanites oceanicus*) et du Paille-en-queue à bec jaune (*Phaëton lepturus*), durant la période de juin à septembre. Ces cartes suivent le même modèle que celles de l'Atlas; les symboles indiquent le nombre moyen d'oiseaux d'une espèce aperçus dans chaque quadrilatère de 1° N. X 1° O. par période d'observation de 10 minutes à partir d'un navire en mouvement. Des cartes d'effort indiquent le nombre de périodes d'observation sur lesquelles ces moyennes sont fondées. Les observations d'autres espèces et celles faites à d'autres périodes sont traitées à l'annexe 1.

Nous examinons la répartition des oiseaux de mer par rapport aux caractéristiques océanographiques, physiques et biologiques de la région et par rapport aux dangers que constitue l'accumulation des particules de goudron dans la mer des Sargasses; de plus, nous passons en revue des ouvrages portant sur la distribution des oiseaux de mer dans la zone subtropicale du nord-ouest de l'Atlantique.

Nous décrivons la destruction de la colonie des Bermudes qui était auparavant très peuplée, ainsi que les tentatives de reconstitution de l'ancien habitat pélagique du Diablotin des Bermudes (*Pterodroma (hasitata) cahow*) presque complètement disparu.

L'annexe 2 contient quelques additions et corrections à l'Atlas.

1. Introduction

The mapping of pelagic seabird distributions has two interrelated objectives. Knowing where the birds are is the first step towards understanding what ecological factors control their distributions, and how they are integrated into marine food webs. It is also the first step towards assessing the effects of pollution—not just on the birds themselves but also on the marine communities to which they belong, and for which birds serve as a convenient and easily studied indicator.

In both cases the maps provide a baseline for measuring the extent of natural or man-induced changes in ranges and numbers. Since we usually only recognize pollution hazards rather suddenly and rather late, baseline information of any kind ought to be available well before the event. The Atlas of Eastern Canadian Seabirds (Brown *et al.* 1975*b*), referred to throughout this book as "the Atlas", presented this information for seabird distributions in the Atlantic and eastern Arctic north of 40°N and west of 40°W. Surveys were undertaken south of 40°N, usually on transects between Halifax and Bermuda. Information on seabird distributions in those waters would be useful in assessing the effects of the increasing concentrations of tar particles and other chemical residues in the Sargasso Sea and adjacent areas, so we feel it should also be put on record.

In this report we summarize CWS information on seabird distributions in the subtropical northwest Atlantic, south of 40°N and west of 28°W collected between 31 March 1969 and 13 April 1976, and suggest some of the factors which may be controlling these distributions; we also discuss the possible hazards of the tar particle concentrations and the changes brought about by the destruction of seabird breeding habitat on Bermuda. The coverage cannot compare with the pioneer work of Jespersen (1924, 1930), or with surveys by Moore (1951) and Butcher *et al.* (1968). On the other hand the application of the quantitative standards and formats followed in the Atlas allows some wide comparisons of seabird distributions and numbers from the subtropics to the Arctic.

2. Oceanographic background

The dominant feature of the central North Atlantic is its clockwise gyre of current systems. This can be said to start at about 15°N where the strong westerly South Equatorial Current merges with the weaker North Equatorial. A branch of the latter flows by the east side of the Lesser Antilles, but the main flow enters the Caribbean, to come out through the Florida Straits, and north parallel to the east coast of the United States. It then flows east to the south of Newfoundland and towards northwestern Europe. The section between the Florida Straits and the Newfoundland Banks is known as the Gulf Stream. A section of the gyre turns southeast in mid Atlantic, flows down the west coast of Africa, and eventually completes the circuit by rejoining the North Equatorial Current. Seaweed, tar particles and other flotsam carried by these currents drift into the relatively still centre of the gyre, the Sargasso Sea, and are trapped there (Hachey 1961, Teal and Teal 1975).

This report deals with the northwest section of the gyre. A transect from Bermuda to Nova Scotia shows the arrangement of the water bodies at the surface in more detail. The Sargasso Sea, highly saline and with surface temperatures of 18–20°C year round, extends to about 39°N. Its limit is the Gulf Stream proper, a narrow highly saline ribbon of water at 20–22°C. Beyond this the temperature drops fairly abruptly to about 13°C; this is the Slope Water, a zone of eastward flowing surface water of variable depth, which is a mixture of water from the Gulf Stream and the coastal zone. South of Nova Scotia, the change from the Slope Water to the cooler, less saline coastal water occurs at about 42°N (Hachey 1961, Yentsch 1974, Dr. P. C. Smith, pers. comm.)

As one would expect, these physical boundaries are also faunistic ones. Backus *et al.* (1970) and Jahn and Backus (1976) use the distributions of mesopelagic fish species to divide this part of the Atlantic into five regions. Their Labrador Region extends south to the inshore boundary of the Slope Water; then come the Slope and Gulf Stream Regions. They divide the Sargasso Sea into the Northern and Southern Regions at about 20°N, both of which extend east to approximately 40°W. Grice and Hart's (1962) work on epizooplankton distributions also helps in the identification of five faunal regions, similar to those described by Backus *et al.* (*loc. cit.*).

These authors show that the regions differ not just in the distributions of species and species diversity but also in biomass, which declines sharply from north to south. Thus Backus *et al.* report volumes of 687 cm^3/h from night-time tows at depths of less than 200 m in the Labrador Region, compared to 74 cm^3/h in the Slope, 34 cm^3/h in the Northern Sargasso and only 15 cm^3/h in the Southern Sargasso. Similarly, Grice and Hart (1962) found the highest epizooplankton volumes on the continental shelf off New York and the lowest in the Sargasso Sea near Bermuda; the Slope was intermediate, although the volumes were often not much above the Sargasso values.

3. Species distributions

Seabirds are scarce in these waters. Distribution maps for the six commonest species were drawn up in the same way as in the Atlas. The symbols show the average numbers of birds seen from a moving ship during 10-minute watches; each average refers to a 1°N X 1°W block. The Effort maps (Maps 1a and b) show the number of watches on which these averages are based. Species maps are plotted only for June–September; sightings at other times of year were too few to be plotted on a map, but are listed in Appendix 1. The Effort map for November–May (there are no observations for October) shows the extent of coverage south of 40°N. The maps show approximate positions of the Gulf Stream and Slope Water, although these of course change seasonally and from year to year (*e.g.* Hachey 1961).

As in the Atlas, the maps show where each species is relatively most abundant. It is possible to go beyond this and estimate absolute population sizes and seabird biomass in the different areas, but this would require a number of assumptions, some of them debatable. The subject is beyond the scope of this report, and will be discussed elsewhere.

Further information on the pelagic distributions of seabirds in the area covered here can be obtained from Baker (1947), Buckley and Wurster (1970), Davis (1950), Gordon (1955), Grayce (1952), Jespersen (1924, 1930), Kramp (1913), Moore (1941, 1951), Murphy (1915, 1918), Murray (1935), Myers and Falla (1925), Nichols (1913), Nicholson and Nicholson (1931), Philipson (1940), Phillips (1963), Post (1967), Roberts (1940), Rowlett (1973), Venables (1940) and Voous and Wattel (1963); from data published or summarized in the journals *Sea Swallow*, *Audubon Field Notes* and *American Birds;* and from the handbooks or atlases of Butcher *et al.* (1968), Fisher and Lockley (1954), Murphy (1967), Palmer (1962) and Watson (1966). Observations from transatlantic crossings which went south of 40°N only when approaching New York are listed in the Atlas and not here.

Cory's Shearwater	*Calonectris diomedea*
Greater Shearwater	*Puffinus gravis*
Audubon's Shearwater	*Puffinus lherminieri*

Greater and Cory's Shearwaters are large, non-breeding summer visitors to the northwest Atlantic, the Greater from the South Atlantic and Cory's from the Azores and farther east (see Maps 2 and 3). Their distributions in this area are complementary. Usually Greaters are only seen in the cool waters north of the inshore edge of the Slope Water (the Sargasso Sea records, mostly from June, are probably late migrants.) Their summer range extends southwest to about 75°W, but only in the cooler waters close to the coast (Grayce 1952, Voous and Wattel 1963). By contrast, Cory's Shearwater is rarely seen north of the Slope Water and is perhaps commonest in or near the Gulf Stream proper. Its distribution also extends southwest to 75°W, but apparently only in the Gulf Stream and Slope Water (Baker 1947, Butcher *et al.* 1968).

Audubon's Shearwater is a smaller species which breeds in the Caribbean and Bahamas, and elsewhere in the tropics; the once-large colony on Bermuda is now almost extinct (Palmer 1962, D. B. Wingate *in litt.*). Map 4 shows it is common in the breeding season close to the Bahamas. Otherwise Audubon's, like Cory's, is commonest in the Slope Water and Gulf Stream proper, where it occurs from 60°W at least as far southwest as Florida (Butcher *et al.* 1968, Grayce 1952, Post 1967). The eastern limit of this warm-water bird may in fact be at 50–55°W, south of Newfoundland, where the Gulf Stream system mixes extensively with the cold Labrador Current (see Hachey 1961). However, birds are also sometimes seen in cooler waters closer to the New England coast (*e.g.* Gordon 1955); these might be following Gulf Stream eddies, or be storm-driven birds.

Despite their similar distributions it is very unlikely that Cory's and Audubon's Shearwaters compete for food at sea. Audubon's is only two-thirds the size of Cory's, and therefore presumably takes smaller prey; it also hunts by diving, whereas Cory's is a surface feeder which rarely dives (Palmer 1962). What is at first sight paradoxical is that both should be commonest in the relatively barren Gulf Stream and Slope Water, although neither reaches the densities of Greater Shearwaters in the cooler, more productive waters to the north. However, Grice and Hart (1962) show that epizooplankton densities can in fact be quite high in the Gulf Stream at this time of year. It is also likely that there are local concentrations of food at the sharp boundaries between the Sargasso Sea and the Gulf Stream, or between the Slope Water and the cooler water inshore. Tuna, and by implication the fish that tuna feed on, tend to be commonest at such fronts, for example, that between the warm Kuroshio and cool Oyashio Currents, the North Pacific counterparts of the Gulf Stream and Labrador Currents (Blackburn 1965). The presence of tuna is important to seabirds for another reason. By driving their prey to the surface they make it accessible to the birds; Cory's Shearwater is known to take advantage of this behaviour in the eastern North Atlantic (de Naurois 1969).

Leach's Storm Petrel *Oceanodroma leucorhoa*
Wilson's Storm Petrel *Oceanites oceanicus*

Leach's is the only storm petrel to breed in the northwest Atlantic, where the centre of its range is eastern Newfoundland (Brown *et al.* 1975*b*). In summer it is commonest in the adjacent waters and also off eastern Nova Scotia (see Map 5). The pelagic range east of Newfoundland very roughly coincides with the southern end of the cool Labrador Current. Yet the birds are also quite common in the warm Slope Water south of Nova Scotia and southwest to 72°W in that zone (Butcher *et al.* 1968). Perhaps collecting might show that these warm-water birds are the very similar Harcourt's Storm Petrel *Oceanodroma castro*, which replaces Leach's in tropical and subtropical areas.

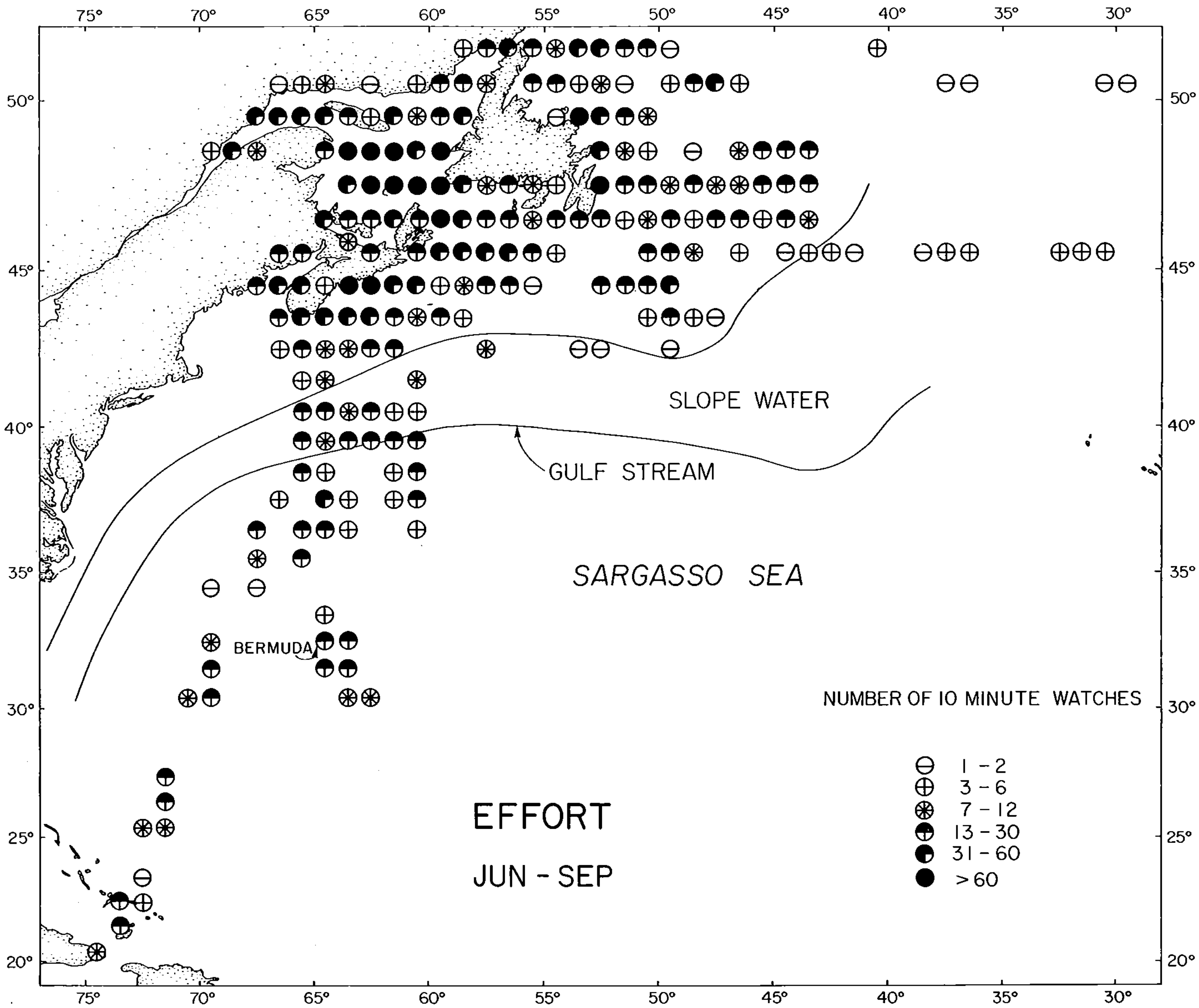
Wilson's Storm Petrel is a migrant from the Antarctic and Subantarctic. During the northern summer it is commonest both in the Slope Water and in cooler inshore areas about 35–43°N; the eastern limit is at about 55–60°W (see Map 6; Butcher *et al.* 1968, Palmer 1962, Roberts 1940). The Sargasso Sea sightings plotted on the map were all made in mid-June and presumably were of migrants still in passage.

Wilson's shows a striking difference between the preferred surface water temperature ranges of its summer and winter quarters. The birds "wintering" off New England do so in waters at 15–25°C; yet in the austral summer they are commonest in waters below 10°C, and most of their colonies are beside near-freezing waters south of the Antarctic Convergence (Brown *et al.* 1975*a*, Watson 1975). But, as Bourne in Palmer (1962) pointed out, both summer and winter habitats are in areas of up-welling or mixing where plankton densities are high. Availability of food rather than water temperature is the important factor. One such common factor may be the occurrence of euphausids at the surface both in the Antarctic and off New England. *Euphausia superba*, the dominant surface-swarming crustacean south of the Antarctic Convergence, is an important food of breeding Wilson's Storm Petrels (Palmer 1962, Roberts 1940). *Meganyctiphanes norvegica* commonly swarms off New England during the boreal summer (Mauchline and Fisher 1969); perhaps the birds take it as a substitute.

White-tailed Tropicbird *Phaëthon lepturus*

This was the only seabird seen regularly over the barren waters of the Sargasso Sea. Numbers were always small which probably reflects the reduction of the Bermudan breeding population (see below). Tropicbirds were most often seen near Bermuda and the Bahamas but they may also be found in the Slope Water, as far west as about 72°W (Butcher *et al.* 1968, Jespersen 1930).

Flying-fish (Exocoetidae) are an important tropicbird prey both in Bermuda and elsewhere (Palmer 1962, Stonehouse 1962). The distributions of fish and birds coincide quite closely. The northwest Atlantic summer limit for both is at about 39°N (Map 7; Bruun 1935, fig. 19). Bruun put the northern winter limit of flying fish at about 35°N, but in February 1975 I found them to be common only south of 26°N, the northern limit of tropicbirds at that time (Brown, unpublished). It seems that either the presence of the fish controls the distribution of the birds, or both are controlled by some common factor.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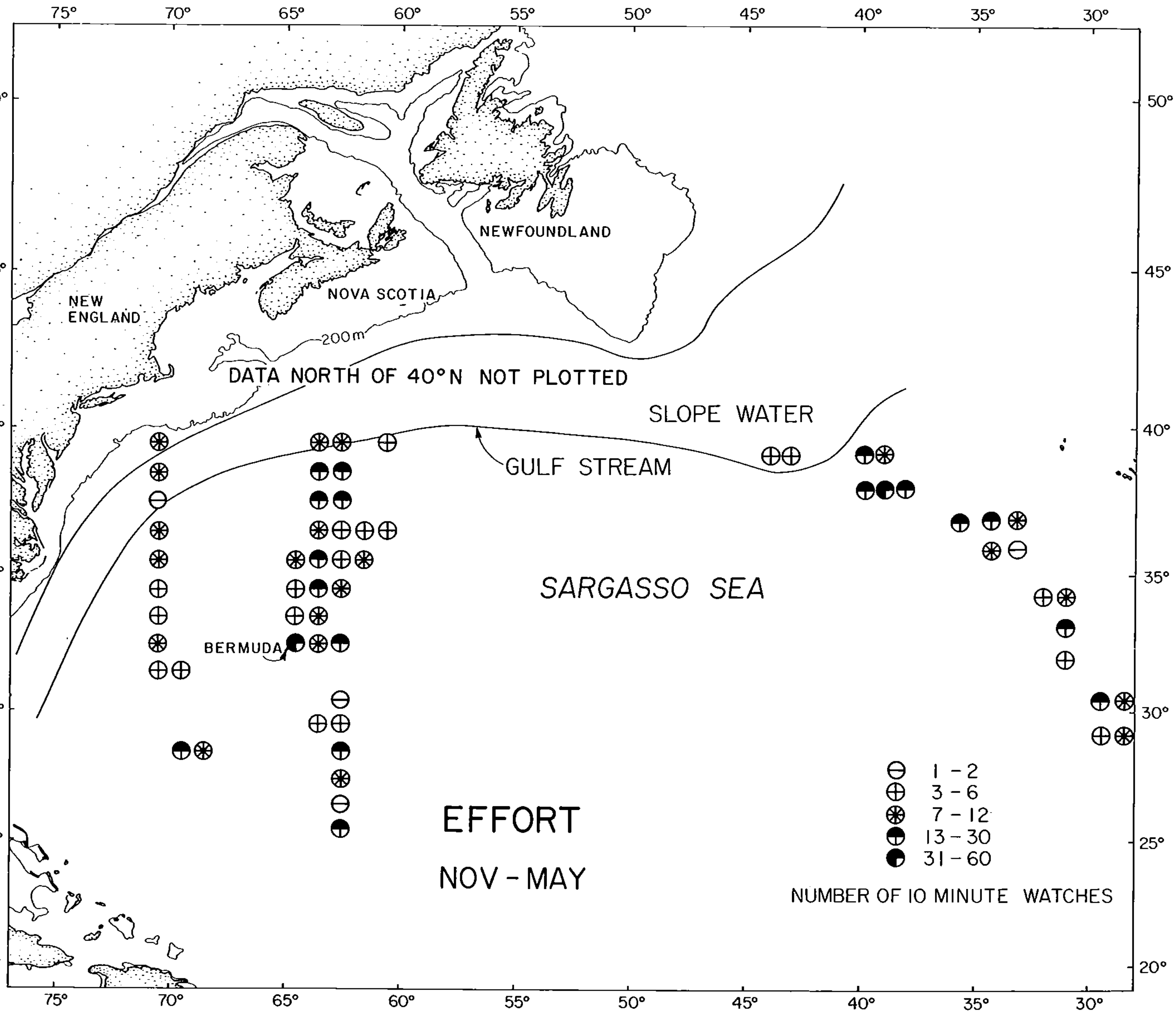
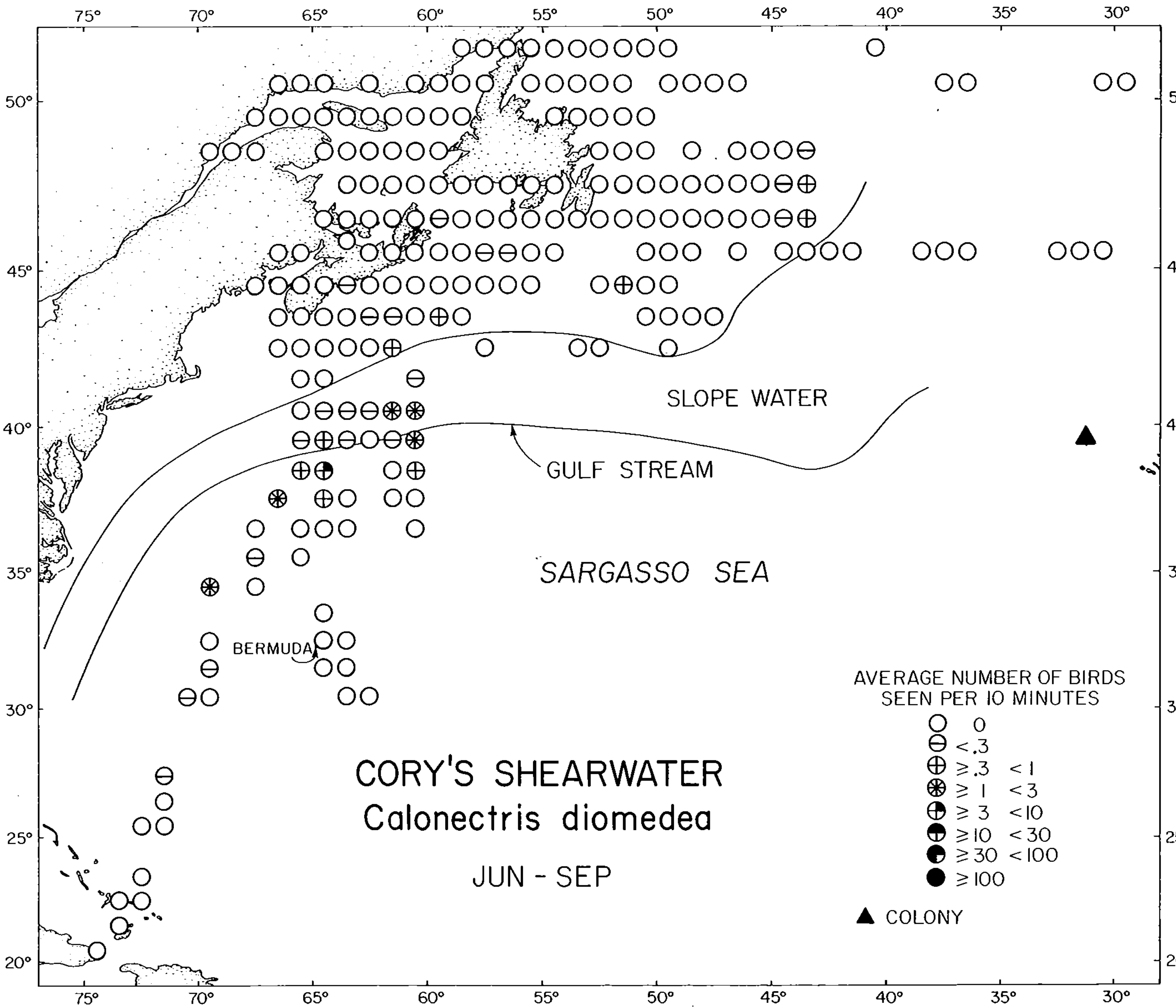
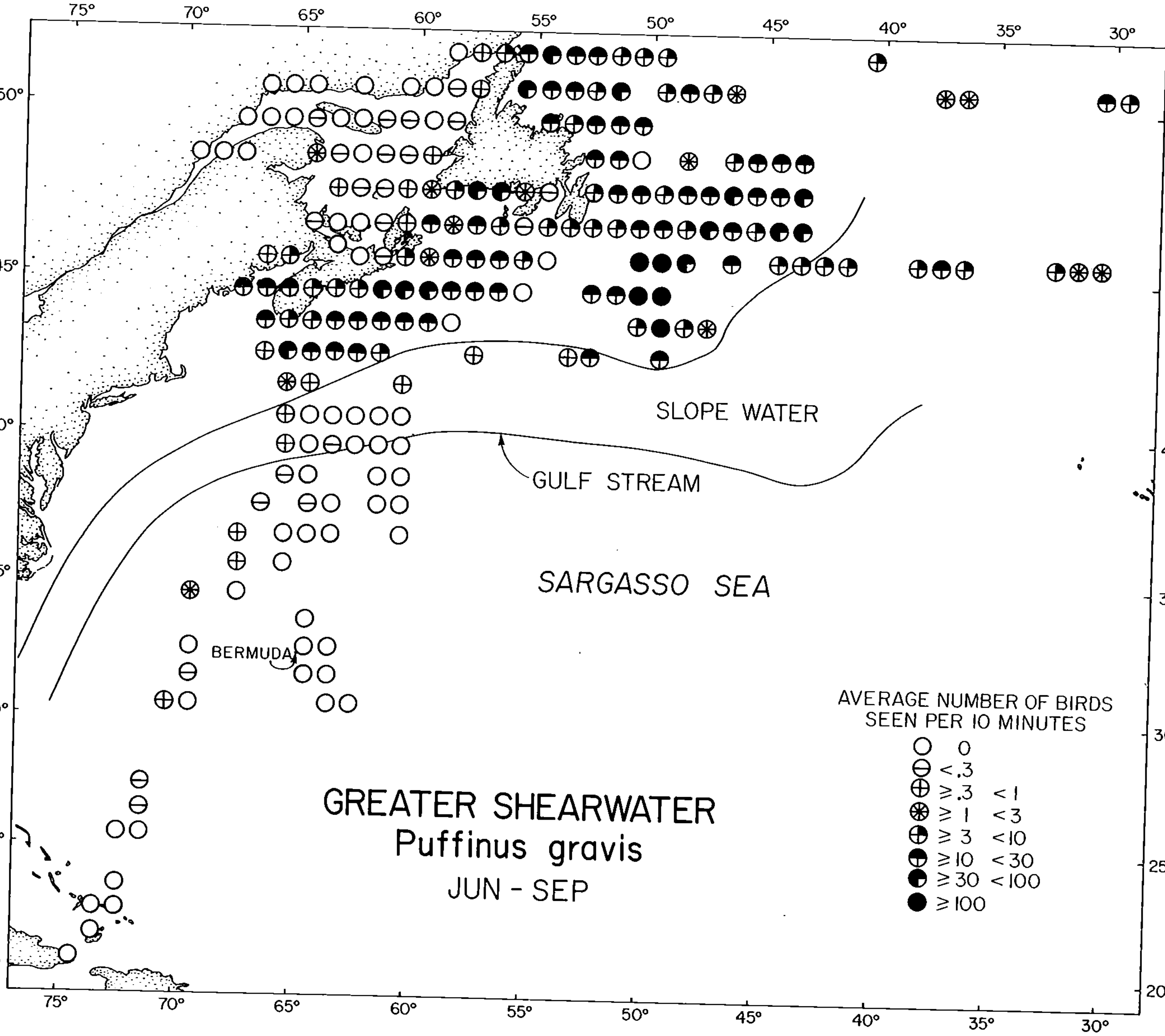
70°
65°
60°
55°
50°
45°
40°
35°
30°
50°
45°
40°
35°
30°
25°
20°
SLOPE WATER
GULF STREAM
SARGASSO SEA
BERMUDA
NUMBER OF 10 MINUTE WATCHES
1 - 2
3 - 6
7 - 12
13 - 30
31 - 60
>60
EFFORT
JUN - SEP

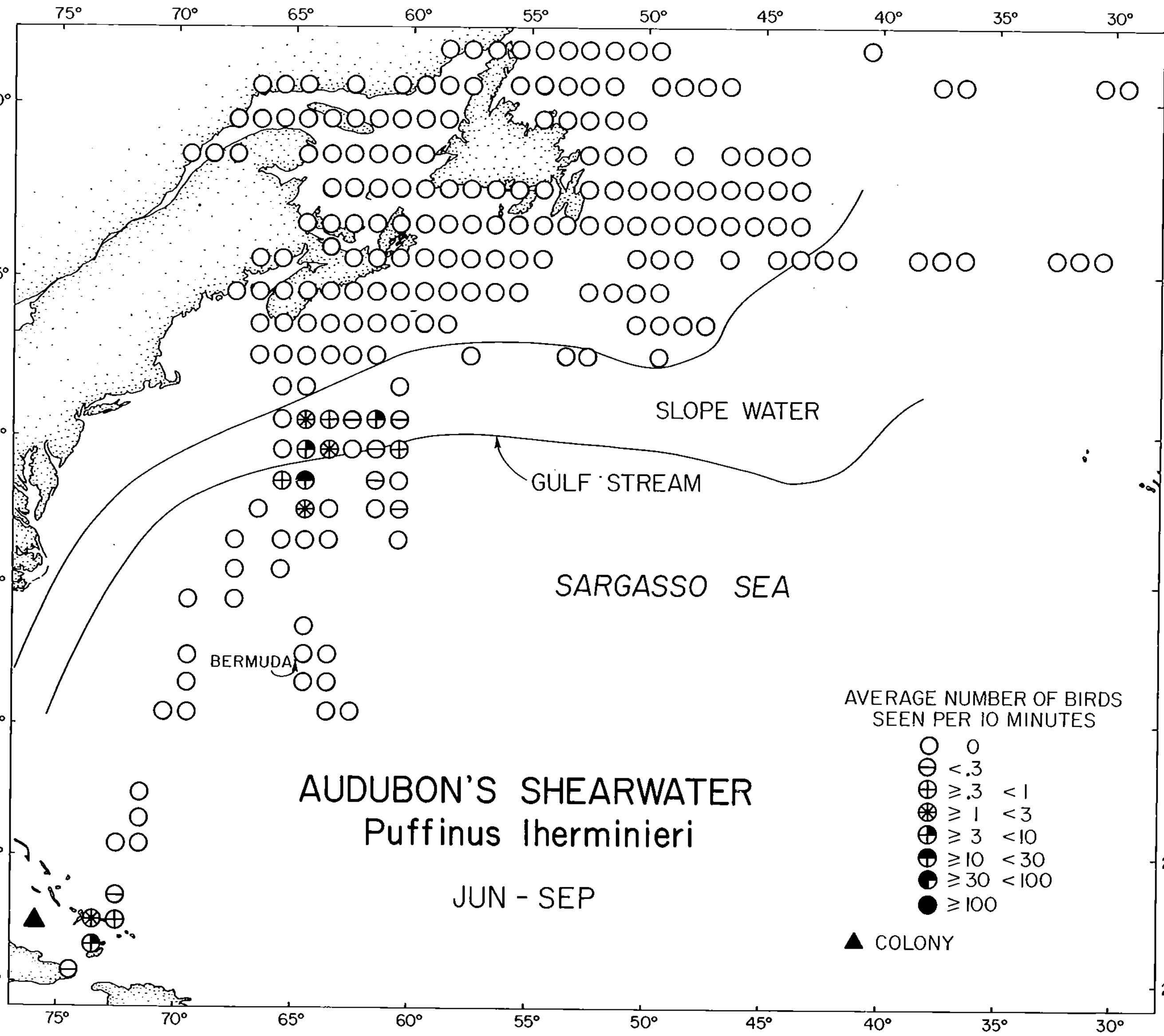
Map 1b
Effort, November–May




75°
70°
65°
60°
55°
50°
45°
40°
35°
30°
25°
20°
SLOPE WATER
GULF STREAM
SARGASSO SEA
BERMUDA
AVERAGE NUMBER OF BIRDS SEEN PER 10 MINUTES
0
<.3
≥.3 <1
≥ 1 <3
≥ 3 <10
≥10 <30
≥30 <100
≥100
COLONY
CORY'S SHEARWATER
Calonectris diomedea
JUN - SEP

Map 3
Greater Shearwater

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45°
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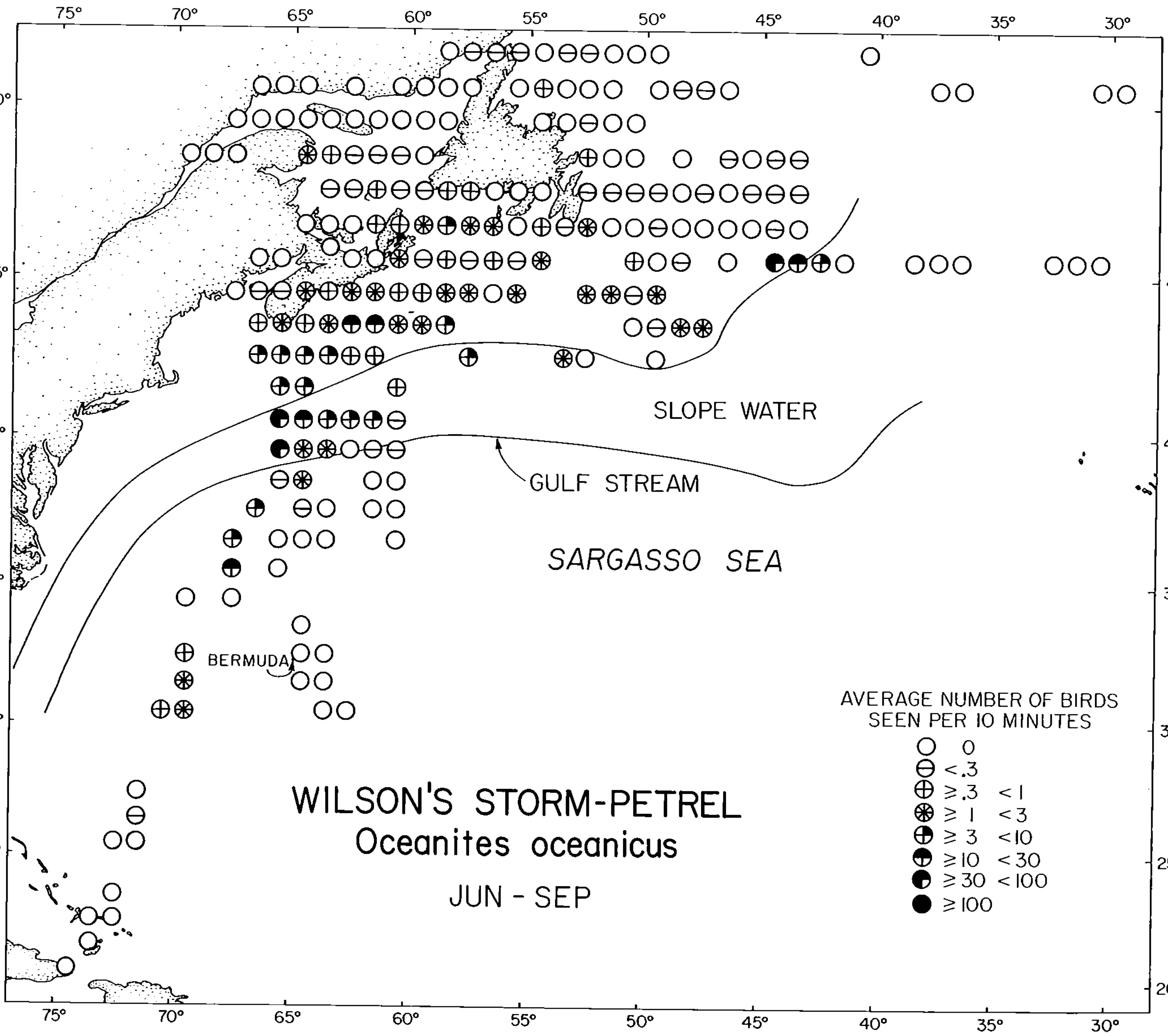
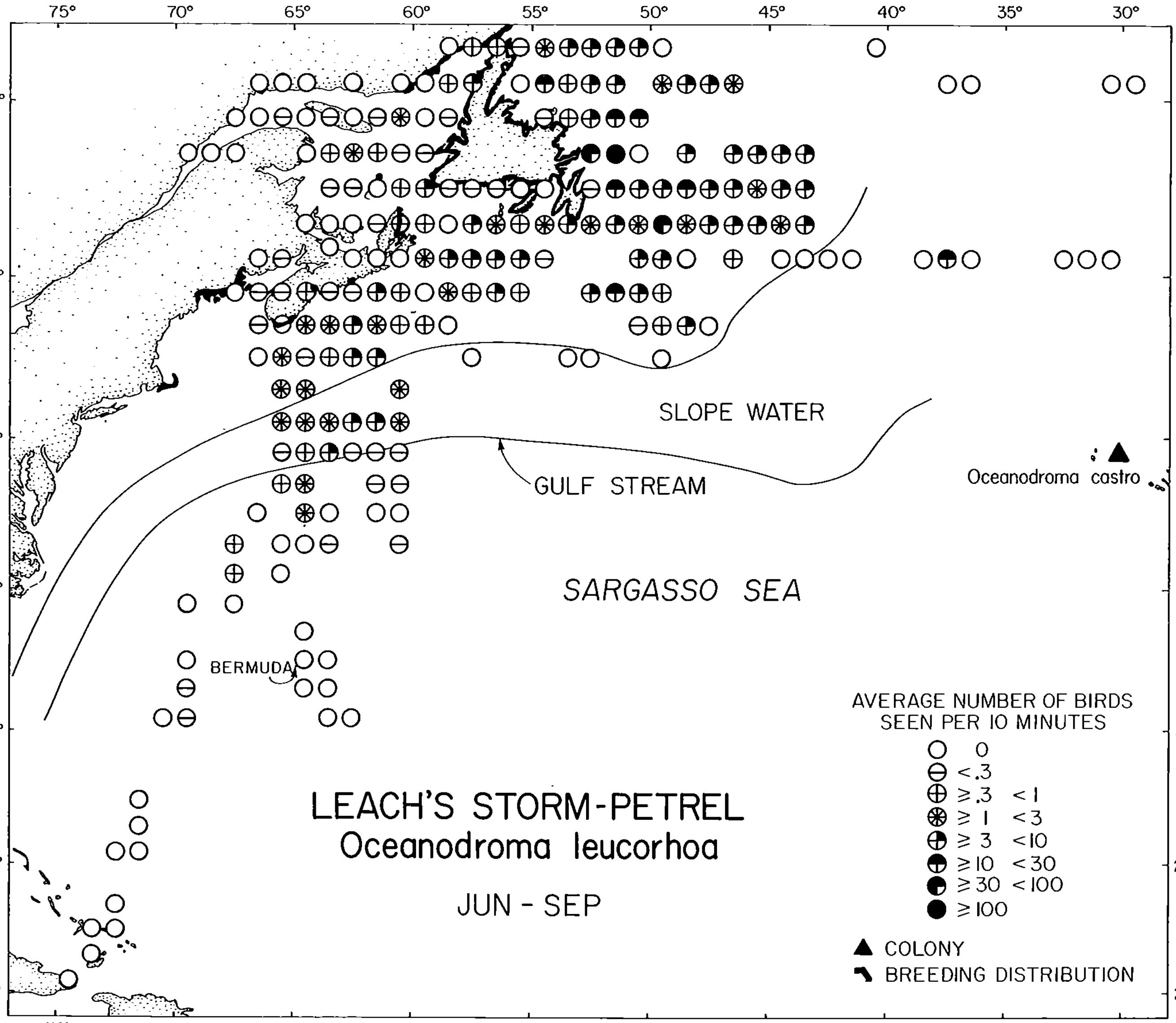
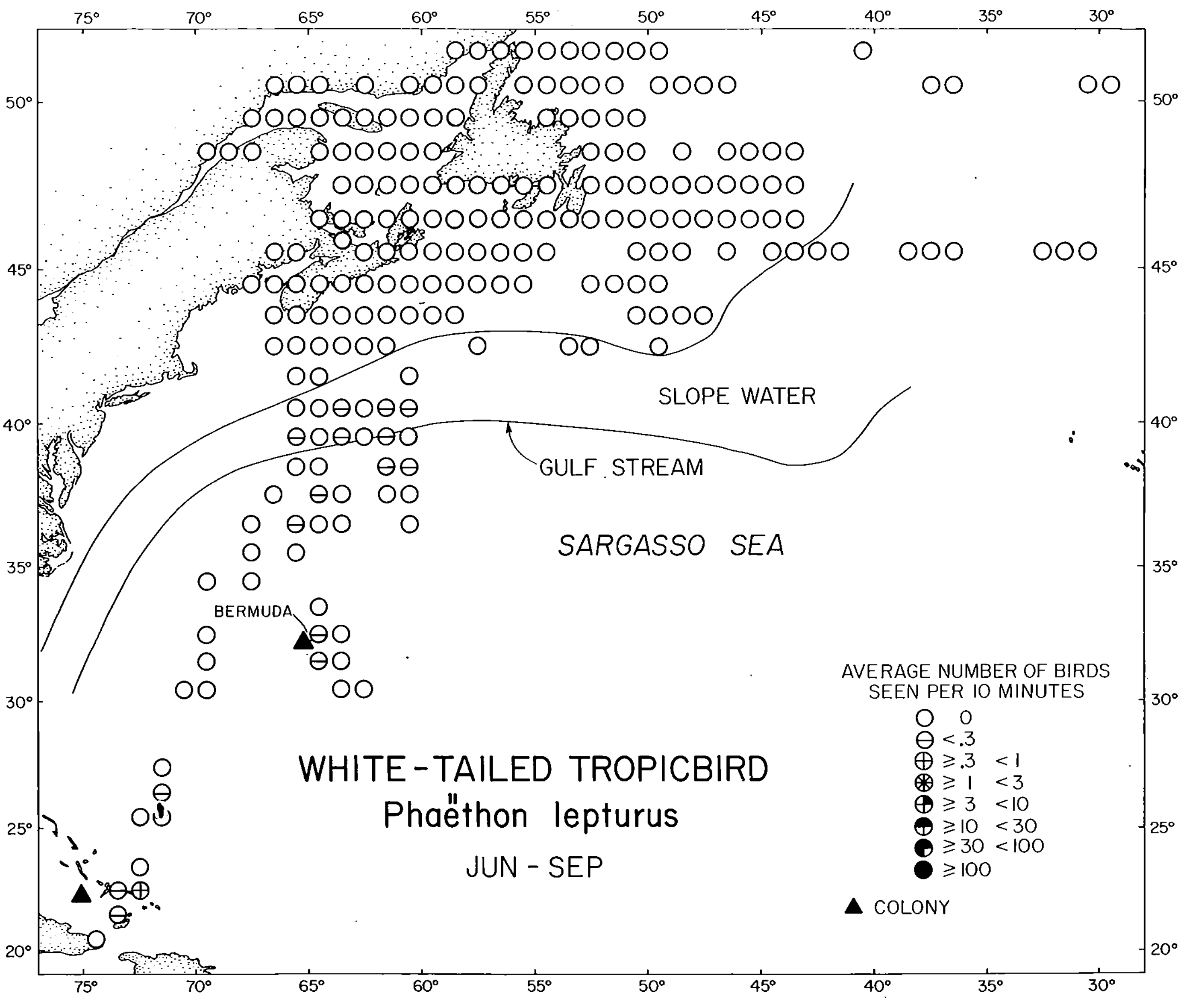
25°
20°
SLOPE WATER
GULF STREAM
SARGASSO SEA
BERMUDA
AVERAGE NUMBER OF BIRDS
SEEN PER 10 MINUTES
0
<.3
≥.3 <1
≥ 1 <3
≥ 3 <10
≥10 <30
≥30 <100
≥100
COLONY
AUDUBON'S SHEARWATER
Puffinus lherminieri
JUN - SEP

Map 5
Leach's Storm Petrel




75°
70°
65°
60°
55°
50°
45°
40°
35°
30°
20°
25°
SLOPE WATER
GULF STREAM
SARGASSO SEA
BERMUDA
Oceanodroma castro
AVERAGE NUMBER OF BIRDS
SEEN PER 10 MINUTES
0
<.3
≥.3 <1
≥ 1 <3
≥ 3 <10
≥10 <30
≥30 <100
≥100
COLONY
BREEDING DISTRIBUTION
LEACH'S STORM-PETREL
Oceanodroma leucorhoa
JUN - SEP

Map 7
White-tailed Tropicbird



4. Sargasso Sea: the missing seabirds

The seabird maps show that densities decline sharply as one goes south towards Bermuda. Table 1 summarises this. The data suggest that at any time of year the population in the coastal zone is an order of magnitude greater than that in the Sargasso Sea. It may also be that the population in the Gulf Stream and Slope Water is higher in summer than in winter; however, this apparent result may be a consequence of a shift in the boundary between that system and the coastal zone. In general, the decline is very similar to the decline in fish and plankton biomass documented by Backus *et al.* (1970), Jahn and Backus (1976) and Grice and Hart (1962) and discussed above.

The scarcity of seabirds in the Sargasso Sea is also partly the result of man's presence. Before settlement, Bermuda was a major breeding station for Audubon's Shearwater, White-tailed Tropicbird, Manx Shearwater *Puffinus puffinus*, Cahow *Pterodroma (hasitata) cahow*, which were especially abundant (Bent 1922), at least two species of terns and perhaps others (Bourne 1957). The first settlers and their domestic animals quickly wiped out this community in the 17th century. There seems little chance their habitat will ever be re-established. By 1975 numbers were reduced to 3000 pairs of tropicbirds, 30 pairs of Cahows, 25 pairs of Common Terns *Sterna hirundo* and one pair of Audubon's Shearwaters (D. B. Wingate, *in litt.*)

The waters around Bermuda must therefore once have supported a large seabird population, and it is worth attempting a little speculative reconstruction of the prehistoric pelagic distributions. All but the Cahow bred in summer. One would suppose that when breeding they were commonest close to the colony as the tropicbird is today, and as Audubon's Shearwater is at its surviving breeding stations in the Bahamas (Maps 4 and 7). A convergence forms in summer just outside the Bermuda reefs (Boden 1952); this, by concentrating food close to the surface (*e.g.* Pingree *et al.* 1974), may have provided an important feeding area, as may the shallow waters enclosed by the reefs. In general the waters around Bermuda are markedly richer in zooplankton than are those of the Sargasso Sea (Bé *et al.* 1969); this, as much as the existence of land to breed on, probably accounts for the size and diversity of the prehistoric seabird community.

The surviving Cahows probably have a far wider pelagic range. They breed from November to May (D. B. Wingate in Palmer 1962). During this season, a different convergence forms at the edge of the Bermuda reefs (Boden and Kampa 1953). Cahows might feed there, but comparisons with other *Pterodroma* species suggest that they range much more widely. The Juan Fernandez Petrel *Pt. (hasitata) externa* is closely related to the Cahow and is probably its ecological counterpart in the subtropical southeast Pacific. During the breeding season this species ranges from the Juan Fernandez group to the edge of the cold Humboldt Current off the coast of Chile (Brown *et al.* 1975*a* and unpublished). In 10-minute watches we saw an average of more than 10 birds within 150 km of the colony, 3–10 birds at 150–500 km, and 1–3 birds 800 km away. On this analogy, breeding Cahows may therefore have once been common throughout the northern Sargasso Sea, perhaps even as far as the Gulf Stream. There is certainly food available for them at that time of year, assuming that Cahows, like other *Pterodroma* species, feed mainly on cephalopods (*e.g.* Palmer 1962). Large squid have been seen at the surface at night in February 170 km from Bermuda (Brown, unpublished).

Table 1
Seabird numbers between the Nova Scotian and New England coasts and the Bermuda area. Numbers are averages of seabirds of all species counted, during 10-minute watches from ships moving at 5 knots or more. Geographical boundaries and water bodies are as described on p. 6, and plotted in the maps. Parentheses indicate the number of watches on which each average is based

Period	No. cruises	Coastal zone	Slope Water + Gulf Stream	Sargasso Sea: North of Bermuda	Sargasso Sea: South of Bermuda
June–Sept.	2	18.7 (4)	17.8 (71)	3.6 (361)	0.6 (111)
Jan.–Feb.	4	19.5 (39)	1.6 (92)	1.3 (188)	0.3 (95)

5. Seabirds and tar particles in the Sargasso Sea

The presence of tar particles at the surface in the warmer parts of the North Atlantic was first noticed in the early 1950s, and has recently been the subject of much publicity and research (*e.g.* Bourne and Bibby 1975, Butler *et al.* 1973, Heyerdahl 1971, Levy and Walton 1976). Levy and Walton show that tar particle densities are especially high in the western Sargasso Sea near Bermuda, where up to 10 $\mu g/m^2$ of surface water has been collected. Much of this originates as oil washed from tankers in ballast, presumably on the routes between North America and Venezuela, and between Europe and the Cape of Good Hope, both of which cross the North Atlantic current gyre. It is also possible that some enters the gyre from the South Atlantic, drifting up on the South Equatorial Current. In warm seas the more volatile fractions of this oil quickly evaporate, and the residue remains as tar particles. These are carried by the North Atlantic current systems and accumulate in the Sargasso Sea.

Seabirds are particularly vulnerable to oil pollution, and it is worth considering whether these particles present a hazard to them. On the face of it, the chances of a seabird coming into contact with an oil particle seem small, since bird densities there are so low. Moreover, two factors should alleviate the effects of any contact. Tar particles are less likely to soil a bird's plumage than is an unreduced oil slick. Even if soiling does occur, hypothermia, the usual fate of birds oiled in colder waters, (see Bourne and Bibby 1975) is unlikely.

The chances of contact with oil are perhaps greater in the Gulf Stream and Slope Water, where seabirds are commoner than in the Sargasso Sea. Such birds might also come into contact with an unreduced oil slick which had drifted in from colder waters. If so, the diving Audubon's Shearwater is probably the species most at risk; the really vulnerable diving species which spend much time on the water—auks, grebes and diving ducks—do not occur so far south.

However, there are no grounds for complacency. Tar particles might well affect seabirds indirectly, through contamination of their food for example. Despite the low likelihood of direct contact with oil in the Sargasso Sea, such contact nonetheless does occur. At the start of each nesting season a proportion of the tropicbirds returning to Bermuda have oil-smeared plumage. The proportion is usually about one in twenty, but can be as high as one in four (D. B. Wingate, in Butler *et al.* (1973) and *in litt.*) The species could only have come into contact with oil in warm waters—presumably, therefore, in the form of particles. Wingate has also noted a slow decline in tropicbird numbers at an undisturbed Bermudan colony, which could perhaps be linked to this contamination. It would be particularly unfortunate if Cahows were similarly affected.

Acknowledgements

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Appendices

Appendix 1
Seabird observations omitted from the maps.

The Appendix lists cases where there are too few records to be worth plotting on a map; only definite identifications are included. All such records south of 40°N are listed, with the following exceptions:

a. The Herring and Great Black-backed Gulls *Larus argentatus* and *marinus* and Black-legged Kittiwakes *Rissa tridactyla* seen commonly just south of Cape Cod (block 39°N 70°W) on 31 Jan., 1 and 13 Feb. 1972.

b. The following species seen only on 18 June 1970, close to colonies in the Bahamas (c. 22°N 73°W): Brown Booby *Sula leucogaster*, Magnificent Frigatebird *Fregata magnificens*, Sooty and Least Terns *Sterna fuscata* and *albifrons*, Cabot's Tern *Thalasseus sandvicensis* and Brown Noddy *Anous stolidus.*

Northern Fulmar			*Fulmarus glacialis*		
i: 31:1972	39°58′N, 70°01′W	1	ii: 13:1972	38°27′N, 69°37′W	7
	39°18′N, 69°59′W	1		39°25′N, 70°03′W	1
ii: 2:1976	33°30′N, 31°43′W	1		39°52′N, 70°16′W	4
Cory's Shearwater			*Calonectris diomedea*		
iv: 6:1976	51°15′N, 35°33′W	1	xi: 7:1972	34°59′N, 63°58′W	3
iv: 7:1976	38°18′N, 38°33′W	2		35°21′N, 63°55′W	1
iv: 8:1976	38°50′N, 38°29′W	2	xi: 8:1972	38°30′N, 63°40′W	11
	38°35′N, 37°41′W	2		39°19′N, 63°34′W	33
Greater Shearwater			*Puffinus gravis*		
ii: 14:1975	32°36′N, 62°14′W	1	xi: 8:1972	39°00′N, 63°27′W	2
xi: 8:1972	38°31′N, 63°37′W	4		39°14′N, 63°34′W	1
	38°35′W, 63°34′W	1		39°19′N, 63°34′W	1
Sooty Shearwater			*Puffinus griseus*		
ix: 3:1969	39°01′N, 63°08′W	1	ix: 5:1969	39°39′N, 62°02′W	1
Manx Shearwater			*Puffinus puffinus*		
ii: 7:1975	25°58′N, 62°48′W	2	iv: 6:1976	36°52′N, 34°17′W	3
iv: 5:1976	34°36′N, 32°03′W	1	vi: 15:1970	37°10′N, 66°49′W	1
Audubon's Shearwater (Note: the possibility of confusion with Little Shearwater *P. assimilis* cannot be completely eliminated)			*Puffinus lherminieri*		
ii: 7:1972	28°01′N, 69°29′W	1	iv: 8:1973	38°10′N, 62°30′W	2
Soft Plumaged Petrel			*Pterodroma mollis*		
iv: 6:1976	36°51′N, 34°13′W	1			
Capped Petrel			*Pterodroma (hasitata) hasitata*		
iv: 8:1973	37°57′N, 62°30′W	1*	viii: 22:1969	36°43′N, 65°00′W	1
vi: 18:1970	20°15′N, 74°03′W	1			
*see Brown (1973)					
Leach's Storm-Petrel (Note: the possibility of confusion with Harcourt's Storm-Petrel *O. castro* cannot be completely eliminated)			*Oceanodroma leucorhoa*		
i: 31:1976	38°47′N, 39°36′W	2	iv: 5:1976	33°49′N, 31°27′W	1
	38°38′N, 39°05′W	1	iv: 8:1976	38°47′N, 38°19′W	1
	38°33′N, 38°49′W	3	iv: 25:1969	37°10′N, 63°27′W	1
ii: 1:1976	37°19′N, 34°44′W	1	iv: 26:1969	34°46′N, 63°32′W	1
ii: 3:1976	29°46′N, 29°10′W	1	iv: 27:1969	32°40′N, 63°05′W	1
ii: 9:1975	25°56′N, 62°43′W	1	iv: 30:1969	37°40′N, 63°32′W	1
ii: 10:1973	39°06′N, 62°24′W	10		38°43′N, 63°27′W	2
iv: 4:1976	30°38′N, 29°15′W	1	xi: 8:1972	38°37′N, 63°33′W	1

Harcourt's Storm Petrel		
ii: 3:1976	29°28′N, 28°55′W	1
	29°10′N, 28°41′W	2
Wilson's Storm-Petrel		
iv: 27:1969	32°40′N, 63°05′W	1
iv: 30:1969	37°40′N, 63°32′W	1
	38°45′N, 63°27′W	3
White-faced Storm-Petrel		
ix: 4:1969	39°21′N, 63°44′W	1
White-tailed Tropicbird		
ii: 5:1975	25°46′N, 62°51′W	2
ii: 6:1975	25°58′N, 62°58′W	3
Northern Gannet		
i: 31:1972	39°58′N, 70°01′W	1
ii: 1:1972	39°00′N, 70°00′W	1
Red Phalarope		
iv: 25:1969	37°10′N, 63°27′W	1
Pomarine Jaeger		
ii: 7:1972	27°59′N, 70°00′W	1
iv: 8:1973	36°47′N, 63°00′W	1
iv: 9:1973	39°06′N, 62°24′W	1
Parasitic Jaeger		
iv: 27:1969	32°39′N, 63°06′W	1
Skua		
i: 31:1972	39°58′N, 70°01′W	1
Glaucous Gull		
i: 31:1972	39°58′N, 70°01′W	1
Great Black-backed Gull		
i: 28:1973	32°08′N, 64°28′W	1
ii: 3:1972	36°15′N, 70°12′W	1
ii: 6:1975	25°57′N, 62°46′W	1

Oceanodroma castro		
iv: 4:1976	30°02′N, 28°51′W	1
iv: 5:1976	34°31′N, 31°56′W	1
Oceanites oceanicus		
iv: 30:1969	38°58′N, 63°25′W	7
	39°08′N, 63°24′W	4
	39°30′N, 63°24′W	1
Pelagodroma marina		
Phaëthon lepturus		
ii: 8:1975	25°54′N, 62°40′W	2
Morus bassanus		
ii: 13:1972	39°53′N, 70°16′W	1
Phalaropus fulicarius		
Stercorarius pomarinus		
iv: 26:1969	35°39′N, 63°25′W	3
iv: 27:1969	32°39′N, 63°05′W	1
vi: 15:1970	37°02′N, 66°55′W	1
Stercorarius parasiticus		
Catharacta skua		
Larus hyperboreus		
Larus marinus		
ii: 16:1975	38°00′N, 62°44′W	2
	38°32′N, 62°41′W	3
xi: 8:1972	38°31′N, 63°37′W	1

Herring Gull		
i: 26:1973	38°13′N, 62°37′W	1
	37°57′N, 62°45′W	5
i: 28:1973	32°12′N, 64°26′W	2
i: 29:1975	39°37′N, 62°12′W	1
i: 30:1975	37°23′N, 63°20′W	2
I: 31:1975	35°22′N, 64°03′W	4
ii: 1:1975	32°40′N, 64°40′W	1
ii: 2:1972	37°03′N, 70°24′W	3
ii: 2:1973	32°31′N, 64°36′W	6
ii: 3:1973	36°15′N, 70°12′W	15
Black-legged Kittiwake		
i: 26:1973	37°40′N, 62°52′W	1
i: 27:1973	35°31′N, 63°31′W	1
ii: 1:1976	37°22′N, 34°56′W	1
	37°21′N, 34°54′W	1
	37°19′N, 34°44′W	1
Dovekie		
xi: 9:1972	39°19′N, 63°34′W	1

Larus argentatus		
ii: 11:1972	31°42′N, 69°57′W	1
	32°56′N, 70°07′W	2
ii: 12:1972	33°59′N, 70°06′W	2
ii: 13:1972	38°25′N, 69°37′W	3
ii: 14:1975	32°36′N, 62°14′W	2
ii: 15:1975	34°31′N, 62°26′W	2
ii: 16:1975	38°00′N, 62°44′W	3
	38°32′N, 62°41′W	2
iv: 6:1976	37°08′N, 35°10′W	1
iv: 8:1973	36°50′N, 63°15′W	4
iv: 9:1973	37°33′N, 62°34′W	1
iv: 10:1973	39°06′N, 62°24′W	3
Rissa tridactyla		
ii: 2:1972	37°03′N, 70°24′W	2
	36°15′N, 70°12′W	1
ii: 16:1975	38°00′N, 62°44′W	2
Alle alle		

Notes

The exceptional southerly Northern Fulmar record of 2 Feb. 1976, at 33°30′N, should be noted. It is comparable only with a record "just north of Madeira" in January 1939 (Fisher 1952: 297).

The Soft-plumaged Petrel, seen under excellent conditions on 6 April 1976, seems unusually far north and west for a species which, in the North Atlantic, breeds only on Madeira and in the Cape Verde Islands. (*e.g.* Watson 1966).

The April and August sightings of Capped Petrels seem far north for a species which, at that season, ought to be on its breeding grounds in Haiti (D. B. Wingate *in* Palmer 1962).

The 14 Feb. 1975 sighting of a Greater Shearwater near Bermuda, along with another three days later at 42°31′N 63°08′W (Brown, unpublished), suggests that a few birds do not return to the South Atlantic during the austral summer.

Appendix 2
"Atlas of eastern Canadian Seabirds": some additions and corrections

a. Literature cited
The following papers should be added to the review of background information on p. 37:

Brown, R.G.B. 1976. Ivory Gulls off Labrador in summer. Amer. Birds 30:774.

Manikowski, S. 1975. The effect of weather on the distributions of Kittiwakes and Fulmars in the North Atlantic. Acta zool. Cracov. 20:489–497.

Moore, H.B. 1941. Notes on the distribution of oceanic birds in the North Atlantic, 1937–41. Proc. Linn. Soc. N.Y. 52–53: 53–62.

Moore, H.B. 1951. Seasonal distribution of oceanic birds in the western North Atlantic. Bull. Mar. Sci. Gulf Caribb. 1:1–14.

Venables, L.S.V. 1940. Birds seen on an autumn and a spring Atlantic crossing. Brit. Birds 33:152–154.

The references to "Thorn (1956)" (p. 37) and "Thorn, A.W. (1956)" (p. 210) should read "Thom (1956)" and "Thom, A.M. (1956)" respectively.

b. Unusual records
We wish to draw attention to the unusual concentration of Greater Shearwaters and Wilson's Storm Petrels shown in the July maps (Maps 4a and 9 respectively) in the western Gulf of St. Lawrence. A total of 53 Greaters and 27 Wilson's were seen off Gaspé, Quebec in the course of seven 10-minute watches on 18 July 1970; a Greater was seen next day at 49°07′N 64°25′W. There were no obvious meteorological abnormalities which would explain this unusually deep penetration into the Gulf.

Several records from Appendix 2 of the "Atlas" should also be given more emphasis. The April records of Sooty Shearwaters *Puffinus griseus* are earlier than anything cited by Phillips (1963); the sighting at 54°45′N on 26 April 1966 seems unusually far north for so early a date. The record of Leach's Storm Petrel at 59°43′N on 28 August 1970, and of three Northern Gannets north of 60°N in August 1971 are also unusually far north. On the other hand the two Ivory Gull sightings at c.60°N in August 1971 are unusually far south (see also Brown (1976), cited above). The records of Dovekies between June and August off eastern Newfoundland, along with several summer sightings off Sable Island, Nova Scotia (Dr. A. R. Lock, pers. comm.), suggest that some non-breeding birds spend the summer in Boreal waters off eastern Canada.