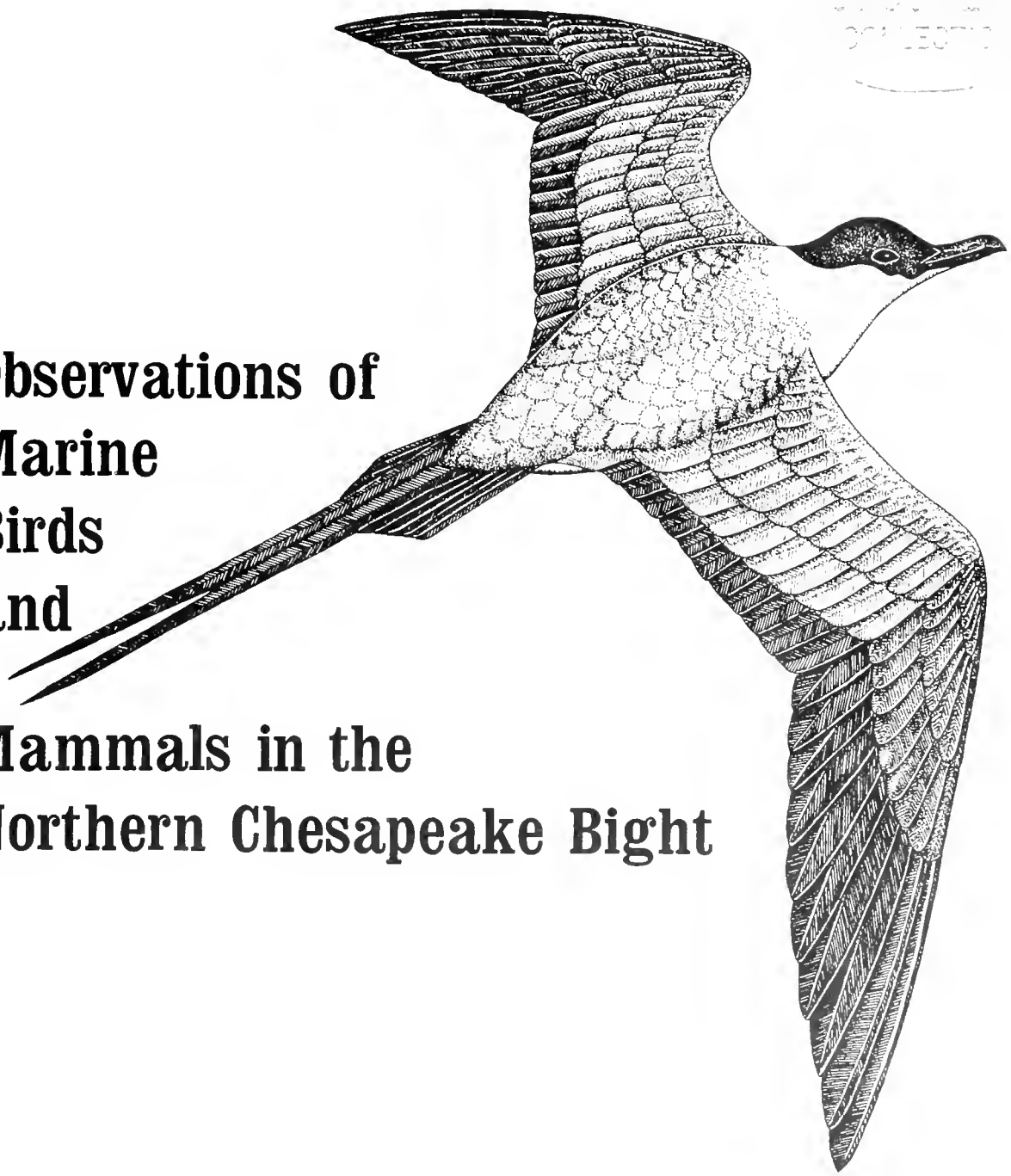
Biological Services Program

FWS/OBS-80/04
February 1980



Observations of Marine Birds and Mammals in the Northern Chesapeake Bight

Fish and Wildlife Service

U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.
- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

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FWS/OBS-80/04
February 1980

OBSERVATIONS OF MARINE BIRDS AND MAMMALS IN THE NORTHERN CHESAPEAKE BIGHT

by

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U.S. Fish and Wildlife Service
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ABSTRACT

Sightings of 56 species of marine birds and 11 species of marine mammals recorded from 1971 - 1977 are summarized to show species composition and spatial and temporal distribution over the Continental Shelf in the northern Chesapeake Bight. Distributional abundance of seabirds is indicated relative to sounding contours and to the average distance from shore. Cetaceans and pelagic birds are most abundant between the 30 and 40- fathom contour and along the edge of the Continental Shelf, especially Baltimore Canyon. Gulls of the genus Larus composed 71.8% of the offshore avifauna from November through March. Wilson's storm petrel (Oceanites oceanicus) accounted for 66.6% of all seabirds counted from May through September. Fishing vessel activity was responsible for winter seabird concentrations. Distribution of tropical and subtropical seabirds and cetaceans corresponds to the presence of warm slope water and Gulf Stream eddies spreading over the outer Continental Shelf during late summer months. The northern fulmar (Fulmarus glacialis) and Manx shearwater (Puffinus puffinus) may be extending their ranges and increasing in abundance in the western North Atlantic. Most cetacean sightings were seaward of the 20-fathom contour. The saddleback dolphin (Delphinus delphis) is the most common offshore cetacean. Grampuses (Grampus griseus) are often seen along the Continental Slope and in Baltimore Canyon. One population of Atlantic bottlenosed dolphins (Tursiops truncatus) occurs offshore along the Continental Slope, and another is usually found within 10,000 m offshore. A small population of fin whales (Balaenoptera physalus) resides over the Continental Shelf in the northern Chesapeake Bight. Fin whales and saddleback dolphins were most abundant each spring at about 38°15'N, between the 30 and 40-fathom contour.

The correct citation for this report is:

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ACKNOWLEDGEMENTS

More than 800 amateur naturalists and field ornithologists helped to cover expenses for boats, chum, and correspondence, and participated in the surveys. Without their inexhaustable enthusiasm, even when cold, wet, and suffering the effects of "mal-de-mer," these observations would not have been possible. I am indebted to Paul G. DuMont and Maurice V. Barnhill for helping less-experienced participants with field identification. They also maintained standards for recording observations during trips in my absence.

The captains of the charter boats at Ocean City, Howard Cleaver, Dale Brown, and Marvin Foxwell of the "Cap't Talbot," Darryl Nottingham of the "Mariner," Orlando Bunting of the "Cap't Bunting,"and Ed Brex of the "Taurus," were exceedingly helpful in providing information about the area, recording LORAN coordinates, and demonstrating discretion and skill at maneuvering the boats into position to observe animals under optimal conditions.

I extend my appreciation to the following persons and agencies for providing room and board and for permitting my observations during extended research cruises: Dr. Michael Champ, American University and the Marine Science Consortium, and the crew of the Research Vessel (R.V.) "Advance II" - ocean pollution cruises during August 1974 and 1975; Dr. Donald Lear, Environmental Protection Agency Field Office, Annapolis, Maryland, and the U.S. Coast Guard and personnel of the USCGC "Alert," Cape May, New Jersey - ocean pollution cruise in February 1975; and the Office of Biological Services (OBS) and the National Fish and Wildlife Laboratory (NFWL) - cruise aboard the R.V. "Gyre," from Galveston, Texas, to Woods Hole, Massachusetts, January - February 1977.

Several captains allowed me to ride on one-day fishing trips, and Jim Barlow and William Bunting provided passage aboard their lobster boat, "Jack Pot," during summer 1977.

Robert L. Pyle, United States Weather Service, provided photographs from infrared sensitive imagery of the Landsat satellite system, and arranged for my examination of weekly charts reconstructed from these satellite transmissions, a part of the Experimental Gulf Stream Analysis (EGSA) program of the Environmental Satellite Service (ESS). These were important in following the seasonal distribution of Gulf Stream, slope, and shelf waters.

The following people provided information from areas outside the study area: David S. Lee (North Carolina), Fred R. Scott (Virginia), and P. William Smith (New Jersey).

The most useful field guides for seabird identification were those by Alexander (1828), Bruun and Singer (1970), Peterson (1947,1966), Pough (1951), Robbins et al. (1966), and Watson (1966). Excellent references for plumages and behavior were those by Bent (1919, 1921, 1922), Cramp et al. (1974), Dwight (1925), Fisher (1952), Fisher and Lockley (1954), Murphy (1936), Palmer (1962), and Witherby et al. (1940, 1941). All common names of birds conform to the A.O.U. Checklist (1957) and A.O.U. Committee on Classification and Nomenclature (1973a, 1973b, 1976).

The most useful guides to identification of cetaceans were those by Katona et al. (1975), and Leatherwood et al. (1972, 1976). All common names of cetaceans conform to Leatherwood et al. (1976).

Alfred L. Gardner and Marshall A. Howe provided many helpful suggestions during the preparation of this report. The identifications of all marine mammal photographs were confirmed by James C. Mead, Smithsonian Institution, Washington, D.C.

Cover artwork was prepared by Charlotte Adamson, U.S. Fish and Wildlife Service. Editorial assistance was provided by Dr. Wiley Kitchens, USFWS.

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INTRODUCTION

Most information published to date on the marine bird and mammal faunas inhabiting outer Continental Shelf waters off the eastern seaboard states is based on scattered observations and dead or stranded animals washed ashore. Few observations of pelagic birds occurring off the east coast have been reported. Wynne-Edwards (1935) and Murphy (1967) summarized pelagic bird distributions in the North Atlantic. Moore (1951) described the seasonal distribution of birds in the western Atlantic based on observations accumulated by the Woods Hole Oceanographic Institution (WHOI). Butcher et al. (1968) charted most of the North Atlantic seabird records on file at WHOI. More recently, Brown et al. (1976) quantitatively summarized seabird distribution in the northwest Atlantic, and Rowlett (1973b) presented accounts of seabirds wintering off Maryland.

Most records of marine mammals from this area have been summarized by Handley and Patton (1947), Ulmer (1961), Paradiso (1969), Reeves (1976), Leatherwood et al. (1976), and Reeves and Ulmer (1976). Since the early 1970's, the Smithsonian Institution's marine mammal salvage program has added a wealth of information pertaining to the status of species along the coast from New Jersey to South Carolina. Rowlett (1974b) reported observations of cetaceans at sea off Ocean City, Maryland. Personnel on research vessels of the National Marine Fisheries Service (NMFS), the National Oceanic and Atmospheric Administration (NOAA), the WHOI, the U.S. Coast Guard, the U.S. Navy, and several educational institutions have recorded marine mammal observations. These latter records usually were gathered incidentally to the primary missions of these organizations.

Here I have summarized my observations on the spatial and temporal distributions of marine birds and mammals observed in Atlantic Ocean waters over the Continental Shelf between latitudes 37°N and 39°N. These records were gathered from 1971 - 1977 off the coasts of Delaware, Maryland, and Virginia (Delmarva Peninsula).

STUDY AREA AND METHODS

The Chesapeake Bight overlies the Continental Shelf between Cape Hatteras (35°10'N, 73°32'W) and the mouth of the Delaware Bay (ca. 39°00'N, 75°00'W) at Cape May, New Jersey (Fig. 1). The northern half of this area was surveyed with most extensive coverage given to the coast of Maryland between latitudes 38°30'N, seaward to Baltimore Canyon and the edge of the Continental Shelf along the 100-fathom (183-m) contour. This contour lies an average of 111 km (60 nautical miles) offshore (Fig. 2).

I recorded sightings of marine birds and mammals during 784 hours (80 days) of observation in the northern Chesapeake Bight from 1971 - 1977. Most observations were recorded from chartered sports fishing boats which carried an average of 30 "birders" and naturalists (37 days from 1973 - 1977) from Ocean City, Maryland, to near Baltimore Canyon. Additional observations were recorded during extended cruises on oceanographic research and U.S. Coast Guard vessels (22 days) and small commercial fishing boats (21 days). Tables 1 and 2 summarize days and hours of observation, the majority of which occurred from 1974 - 1977.

Spatial distribution of seabirds over the Continental Shelf in the northern Chesapeake Bight is graphically illustrated for each species observed ten or more times during the 784 h of observation. Hours shown in Table 2 were used to compute an average number of birds seen per hour.

Most of my observations were made with Zeiss 8 X 10 dialyte binoculars. Nearly continuous watches were maintained during daylight hours from time of departure to return. Individuals of all species of birds and cetaceans were recorded at half-hour intervals. Boat-following birds were noted in an effort to minimize duplication. Specific notes on behavior and species associations were also recorded.

Regular LORAN (LOng RAnge Navigation) "A" and "C" position coordinates were recorded as described by Rowlett (1977c) at regular intervals or at stops or course changes for transect plotting (Appendix A). Observation intervals for bird counts corresponded to intervals between sounding contours (fathoms) on National Ocean Survey Nautical Chart No.1109. LORAN positions were recorded for all cetacean sightings, locations where animal life was concentrated, and for sightings of avian species whose statuses were inadequately documented off the mid-Atlantic States.

To attract birds, coarsely ground beef suet, ground fish, stale bread, fish oil, and mashed shark liver were dispersed as "chum" on all 37 charter trips and occasionally on other vessels when it did not interfere with research or fishing activities. Generally, 200 lb (908 kg) of beef suet and 30 loaves of stale bread were dispensed daily during winter surveys. Unless kept cool, the beef suet became rancid and the gulls ignored it. During the summer months, when gulls were not a part of the offshore avifauna, chumming with oily, slick-forming substances including ground fish, fish oil, and mashed shark liver attracted Wilson's storm petrels and, occasionally, shearwaters. Chumming during the summer was successful only when the boat was stationary or moved in tight circles so that a single slick could be maintained. Birds

Table 1. Number of observation days conducted per month in the northern Chesapeake Bight, 1971-1977. Letters A-V refer to 30 X 30 quadrats indicated in Figure 2.

Quadrat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A													0
B													0
C		1											1
D													0
E								3					3
F		1						4					5
G		1						5					6
H		1						5					6
I		1						1					2
J	4	6	6	8	6	5	3	5	4	1	3	5	56
K	4	8	6	8	5	3	2	5	7	1	3	4	56
L	1	7	5	5	4	2	1	8	6	1	1	3	44
M		5	4	3	4	1	1	1	4			3	26
N		1											1
O													0
P		2				1	1	2					6
Q		2				2	1		1				6
R									1				1
S													0
T													0
U						1	1	1					8
V						1	1	1					3

Table 2. Observation hours per month by zone in the northern Chesapeake Bight, 1971 - 1977. Zones correspond to sounding contours (in fathoms)[a] printed on LORAN "A" and "C" nautical chart No. 1109. Number of days in parenthesis.

	ZONE (Fathom contours)								
Month	00-10	10-20	20-30	30-40	40-100	100-500	500-1000	Total	(Days)
January	9.0	18.0	3.0	1.0				31.0	(4)
February	17.5	34.5	31.0	16.0	15.5	2.5		117.0	(14)
March	11.0	15.0	12.5	8.5	5.5	2.0		54.5	(6)
April	25.0	18.0	19.5	8.5	4.0	3.5		78.5	(8)
May	12.5	8.0	9.0	9.0	14.0	5.0		57.5	(6)
June	10.5	7.5	4.0	5.5	12.0	1.0		40.5	(5)
July	3.5	3.5	3.0	5.5	15.5	5.5		36.5	(3)
August	9.0	25.0	111.5	66.5	6.5	11.5		230.0	(19)
September	15.5	11.0	11.5	8.0	11.5	4.5	6.0	68.0	(7)
October	2.0	2.5	2.5	2.5				9.5	(1)
November	16.5	2.5	2.0	1.5	1.5			24.0	(3)
December	10.0	7.5	5.0	6.0	7.5	1.0		37.0	(4)
Total	142.0	153.0	214.5	138.5	93.5	36.5	6.0	784.0	(80)

[a] 1 fathom = 1.83 meters

gradually gathered at slicks and lingered until all of the chum were consumed. The longer I remained at one slick, the greater the number of birds usually seen.

Representative photographs of most species of pelagic birds and marine mammals, plus five specimens (providing carroborative evidence of certain species first reported in the northern Chesapeake Bight) are deposited at the National Museum of Natural History (USNM), Washington, D.C.

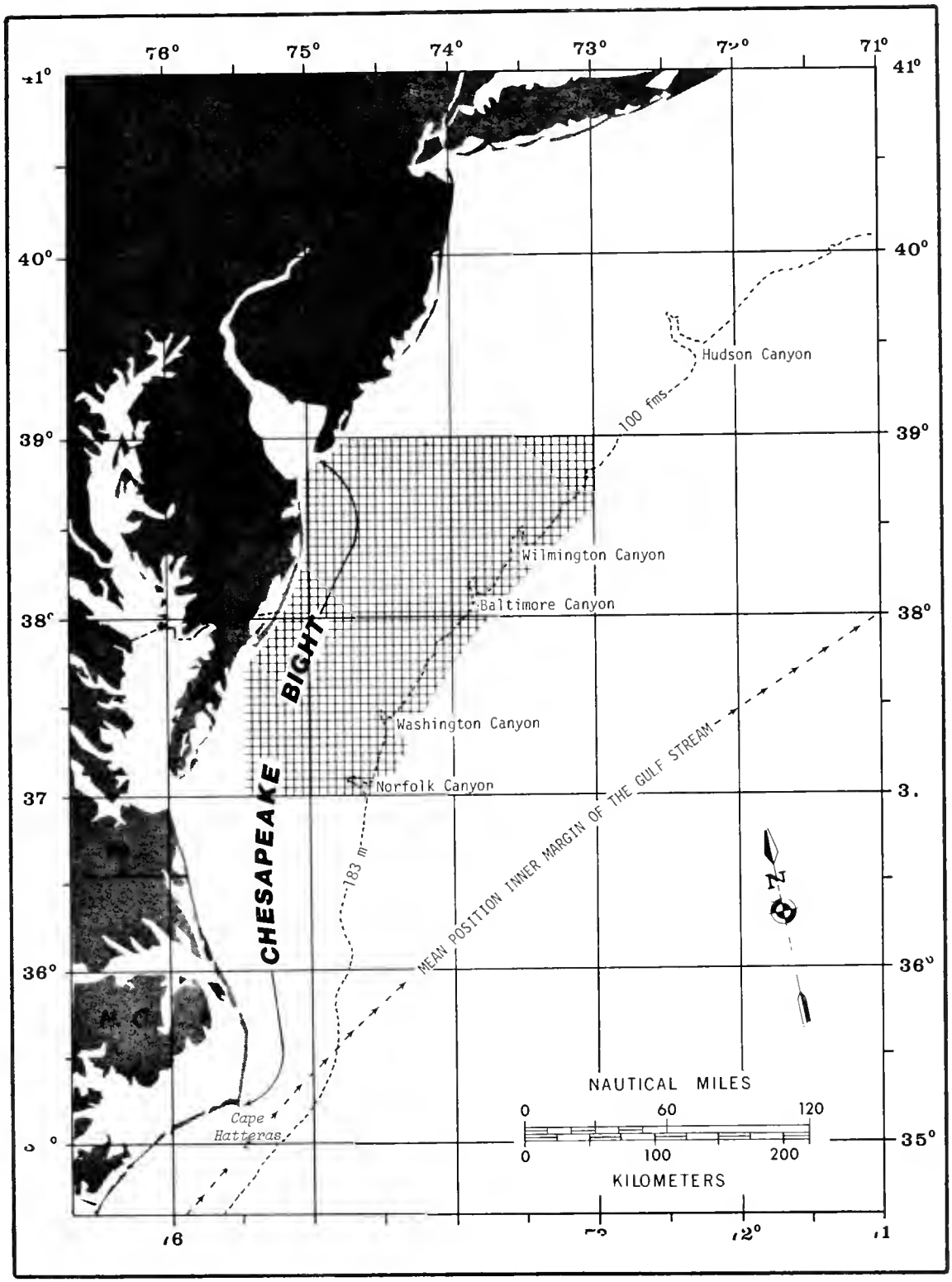


Figure 1. The Chesapeake Bight area along the Mid-Atlantic Coastal States. The cross-hatched area represents the northern half of the Chesapeake Bight in which observations of marine birds and mammals are recorded.

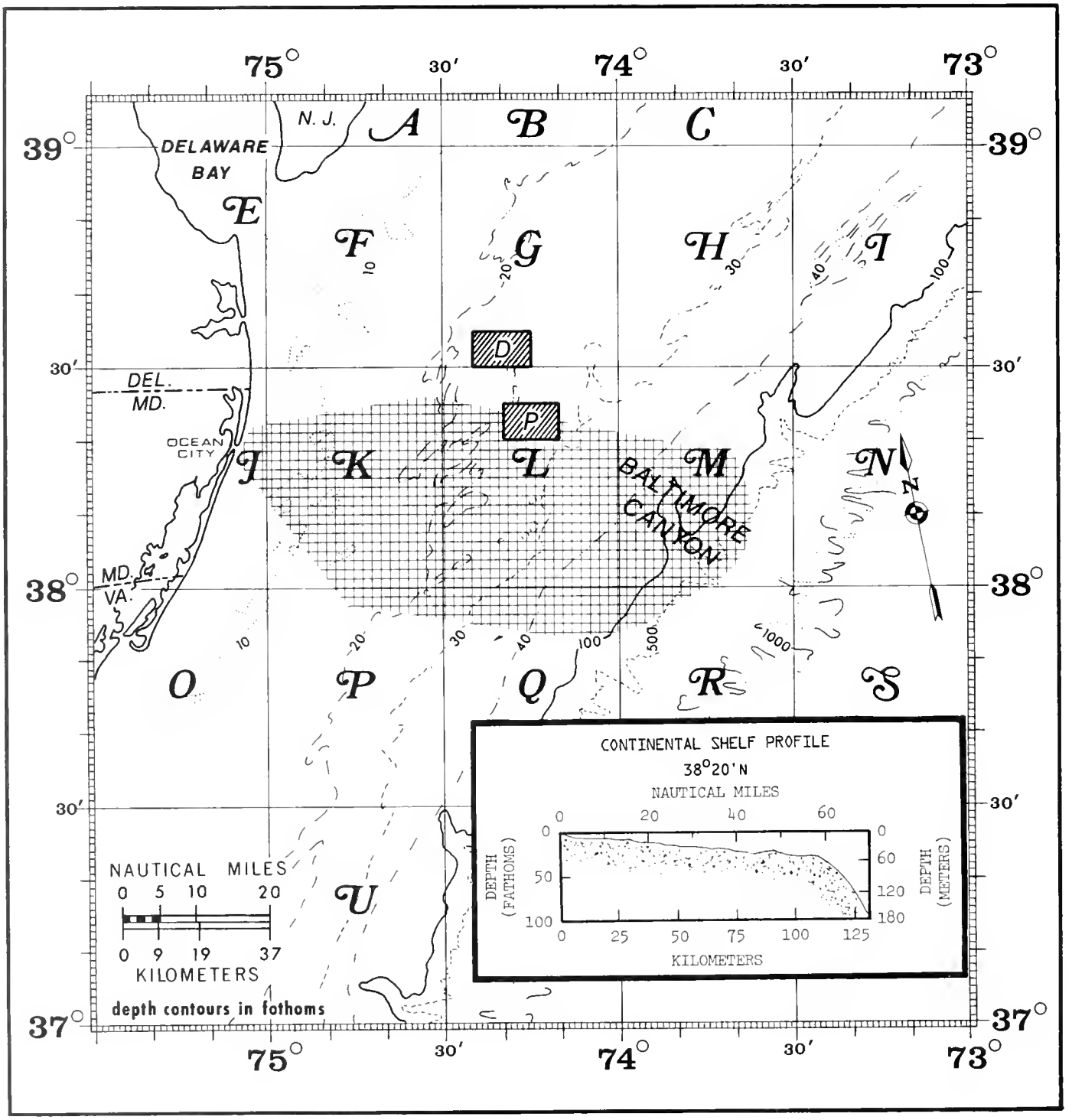


Figure 2. Details of survey area in the northern Chesapeake Bight, 1971-1977. Cross-hatching shows area most extensively surveyed. Shaded rectangles "D" and "P" indicate dump zones for DuPont acid and industrial waste and Philadelphia sewage sludge, respectively. The number of observation days in each of the lettered 30-minute quadrats is presented in Table 1.

RESULTS: SPECIES ACCOUNTS

MARINE BIRDS

Forty-nine species of marine birds were recorded at sea in the northern Chesapeake Bight during 784 h from 1971 - 1977. Seven additional species reported by other observers between latitudes 37°N and 30°N during the same period are presented at the conclusion of these accounts. Omitted are waterbirds characteristic of the inshore coastal and littoral zone habitats (within 8 km of shore) including pelicans, cormorants, brant, eiders, scoters, and all other anseriformes.

The following accounts follow the format of Stewart and Robbins (1958). Three categories for status are:

Transient.--Those species that are probably migratory and spend little or no time resting or feeding in the northern Chesapeake Bight during the seasons designated in the accounts.

Visitant.--Those species that spend time feeding or resting in the northern Chesapeake Bight.

Vagrant.--Those species that are probably outside of their usual range.

Terms describing relative abundance conform to Stewart and Robbins (1958) as follows:

Abundant, Common, Fairly Common, Uncommon, Rare.Species found in decreasing order of abundance, taking into account habits and conspicuousness.

Casual.--A species occurring slightly beyond its usual range for the season indicated and seldom recorded.

Accidental.--A species recorded well beyond its usual range and herein recorded only once.

Hypothetical.--Published but questionable sight record; no photographic or specimen documentation exists from the west-central North Atlantic and herein recorded only once.

Due to infrequent trips and the irregular distribution of species, these designations may be modified with the accumulation of more data. Relative abundance modified by "probably" means that information is lacking from the northern Chesapeake Bight, but observations recorded in adjacent waters to the north off New Jersey, and south off southeastern Virginia and North Carolina support the designation.

In the following accounts for each species, the information following "maximum counts" is given in the sequence: number seen, hours of observations, location (either place name or average distance from shore), and date.

Normal period of occurrence generally applies to non pelagic seabirds for which hundreds of sightings from Maryland recorded during the past century have been analyzed and reported by Stewart and Robbins (1958). Earliest and latest records are those I recorded at sea.

COMMON LOON (Gavia immer)

Status.Common spring and fall transient and winter visitant within 50 km of shore, becoming less common toward the edge of the Continental Shelf (Fig. 3).

Normal period of occurrence.--Mid-September to late May.

Earliest fall record.--19 October 1974.

Latest spring record.-- 1 June 1975.

Maximum counts.--FALL: 85 in 8 h, 2-20 km from shore, 19 November 1972; 64 in 2 h, 2-60 km from shore, 3 December 1977. SPRING: 240 in 6 h, 2-90 km from shore, 30 April 1977; 102 in 6 h, 2-90 km from shore, 27 April 1974; 97 in 11 h, 2-177 km from shore, 11 April 1976. WINTER: 23 in 3 h, 2-20 km from shore, 12 January 1975; 26 in 4 h, 2-90 km from shore, 1 February 1975.

Remarks.--During fall and winter, most common loons were solitary, but during the height of the spring migration (mid-April to early May), they were occasionally seen in rafts of up to 100. Migrating loons were most conspicuous during the first three hours of daylight, and to a lesser extent, during the last two hours of the day. All loons generally avoided the vessels and showed no interest in chum.

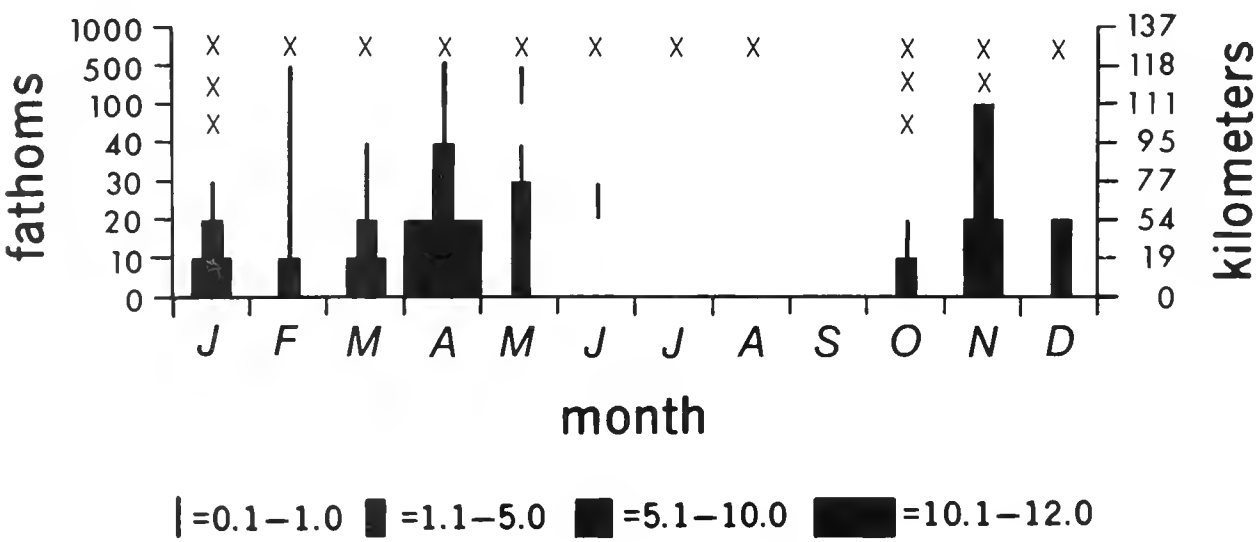


Figure 3. Seasonal abundance and seaward patterns of the common loon in the northern Chesapeake Bight, 1971-1977.

RED-THROATED LOON (Gavia stellata)

Status.--Fairly common spring and fall transient, and winter visitant within 20 km of shore. Rare beyond 50 km from shore (Fig. 4).

Normal period of occurrence.--Late October to mid-May.

Earliest fall record.--14 November 1971.

Latest spring record.--1 June 1975.

Maximum counts.--SPRING: 16 in 1 h, 2-9 km offshore, 25 March 1973. FALL: 14 in 1 h, 2-9 km offshore, 14 November 1971. WINTER: Although insufficient observation time was spent in the shallow zones which this species frequents, 0-15 (x = 3.9) birds were observed in the 0-10 fathom zone (19 km offshore) along 23 transects from December through March.

Remarks.--Habits similar to common loon. However, Palmer (1962) noted that the red-throated loon is more gregarious than the common, and several hundred may gather at productive feeding areas in shallow waters.

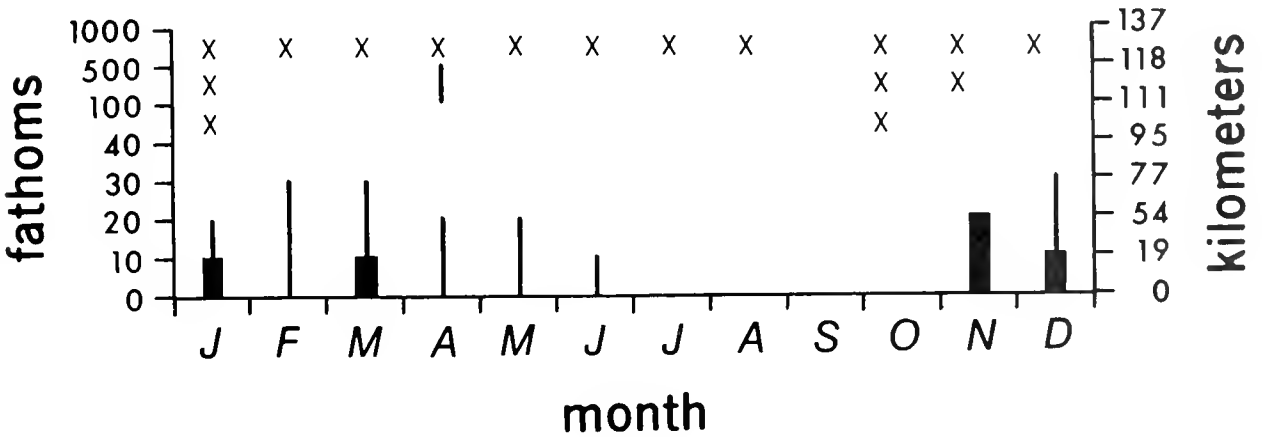


Figure 4. Seasonal abundance and seaward distribution patterns of the red-throated loon in the northern Chesapeake Bight, 1971-1977.

RED-NECKED GREBE (Podiceps grisegena)

Status.--Rare spring and fall transient and winter visitant in coastal waters.

Normal period of occurrence.--Early November to early April.

Records.--1, 9 km E Ocean City, 25 March 1973 (Rowlett 1973b).

HORNED GREBE (Podiceps auritus)

Status.--Fairly common spring and fall transient and winter visitant in shallow coastal waters. Rare beyond 50 km from shore (Fig. 5).

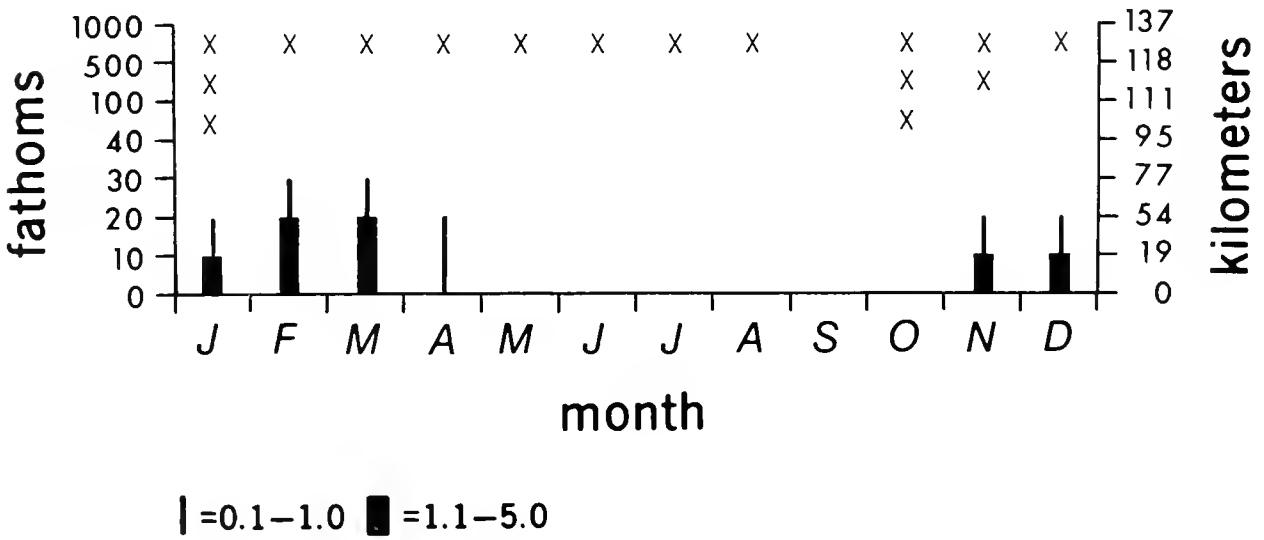
Normal period of occurrence.--Mid-October to mid-May.

Earliest fall record.--14 November 1971.

Latest spring record.--25 March 1973.

Maximum counts.--49 in 2 h, 15-25 km ENE Ocean City, 12 February 1977.

Remarks.--Undoubtedly many grebes were overlooked because they are wary and difficult to detect on choppy and rough seas. The observations on 12 February 1977 were made when viewing conditions were optimal.



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 5. Seasonal abundance and seaward distribution patterns of the horned grebe in the northern Chesapeake Bight, 1971-1977.

YELLOW-NOSED ALBATROSS (Diomedea chlororhynchos)

Status.--Vagrant (accidental).

Records.--1 recorded, 111 km E Ocean City (38°19'N, 73°52'W), 1 February 1975 (Rowlett 1975, Finch et al. 1978).

Remarks.--McDaniel (1973) summarized 13 records of the yellow-nosed albatross in the northwestern Atlantic between 1885 and 1972. At least five have been reported since then. The species normally ranges over the sub-Antarctic Oceans, and its occurrence in the Northern Hemisphere may be the result of storms, disorientation, or even having been carried aboard a ship (Bourne 1967).

NORTHERN FULMAR (Fulmarus glacialis)

Status.--Irregular, rare to uncommon fall and spring transient and winter visitant, generally seaward of the 30-fathom contour (Fig. 6).

Earliest fall record.--26 September 1976.

Latest spring record.--9 May 1976 (100 were sighted at Hudson Canyon, off New Jersey, on 1 June 1974 Scott and Cutler 1974b).

Maximum counts.--76 in 5 h in the vicinity of Baltimore Canyon, 7 March 1976; 48 in 3 h in same area, 9 May 1976.

Remarks.--The northern fulmar was first reported off the coast of Maryland by Rowlett (1973b). Only three previous records are known from the northern Chesapeake Bight, all along coastal beaches in Delaware (Broun 1953) and Virginia (Murray 1957, Sykes 1964).

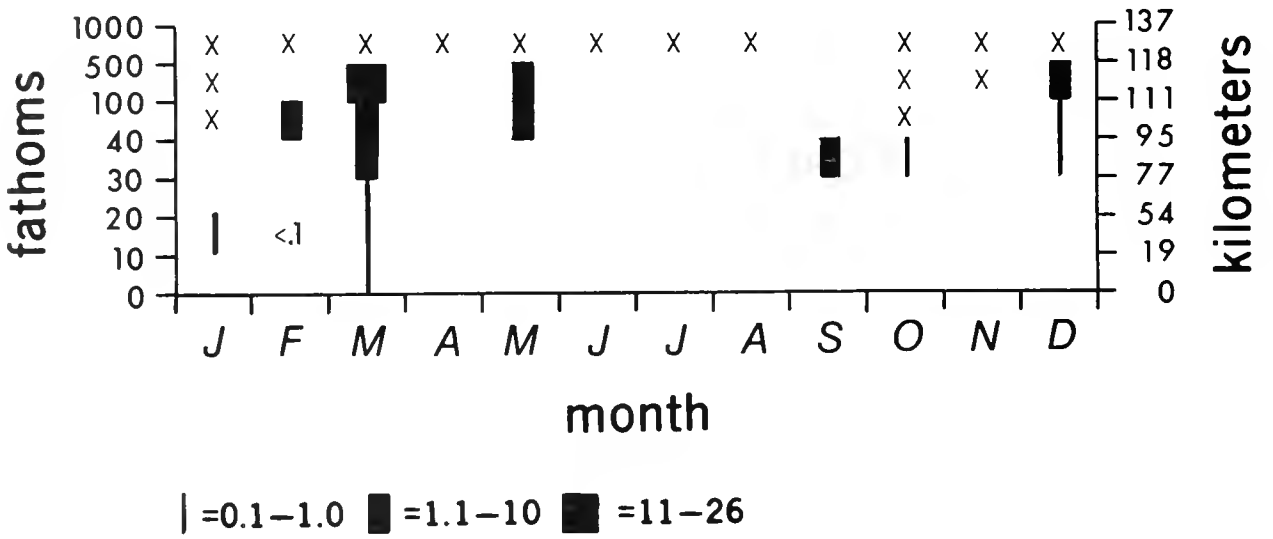
Wynne-Edwards (1935) noted that the northern fulmar is one of the most pelagic North Atlantic seabirds, seldom wandering inshore of 100 fathoms. He suggested that their diet of macroplankton was associated only with deep oceanic waters. Most northern fulmars were seen along the Continental Slope over the 40-500 fathom zones. Their occurrence may be related to an upwelling of nutrients along the edge of the Shelf and along Baltimore Canyon, as well as the coincidental presence of foreign fishing vessels that regularly work this area from early December to May.

Fisher (1952) suggested that the fulmar's southward range expansion to the northeast Atlantic during the past 200 years might be attributed to the growth of the commercial fishing industry and concommitant increase in the abundance of fish offal as a food source. Historically, enormous concentrations of fulmars have gathered among the North Atlantic whaling and fishing fleets to feed on their wastes.

The fulmar has experienced a rapid expansion in the northwest Atlantic during the past 10 years. A decade ago, the species was generally scarce south and west of boreal and sub-Arctic Canadian waters. Within the past few

years, counts on Georges Bank off Massachusetts, have yielded up to 3,000 in one day (Vickery 1977).

Chumming with coarsely ground beef suet and bread generally didn't appeal to fulmars, although they did mingle with the flocks of gulls which vigorously fed on the chum. Most northern fulmars exhibited the pale color phase.



| =0.1–1.0 ▮ =1.1–10 ▮ =11–26

MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 6. Seasonal abundance and seaward distribution patterns of the northern fulmar in the northern Chesapeake Bight, 1971-1977.

CORY'S SHEARWATER (Puffinus diomedea)

Status.--Fairly common, but widely dispersed summer visitant over the Continental Shelf from late May to mid-October. Occasionally locally common over feeding areas (Fig. 7).

Earliest record.--29 May 1977.

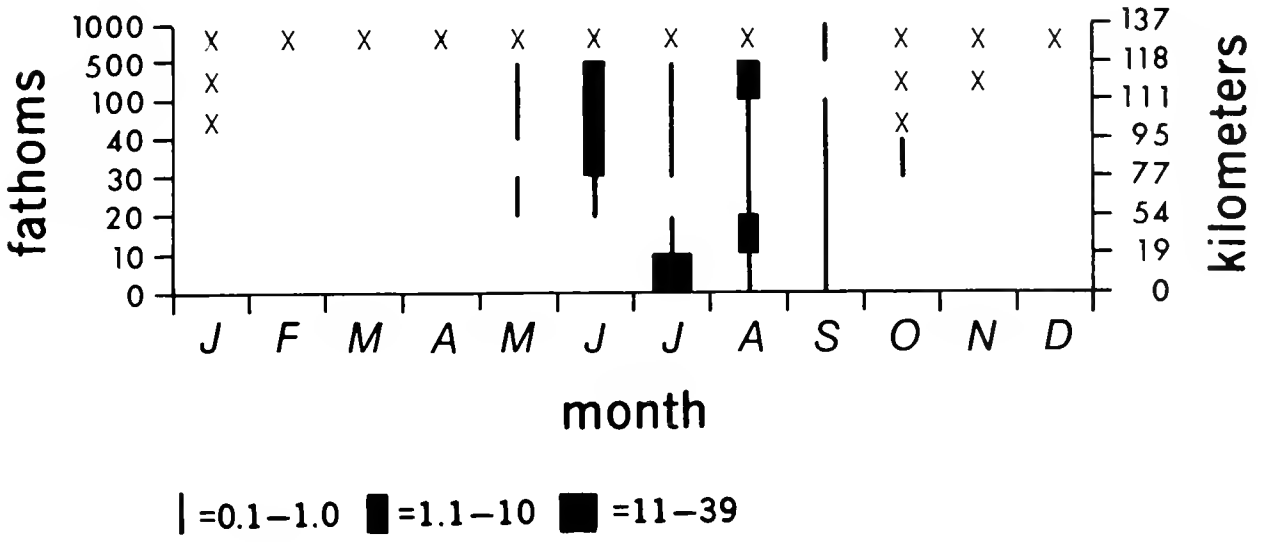
Latest record.--19 October 1974.

Extraseasonal record.--1 at Ocean City, 18 March 1972.

Maximum counts.--At least 125 in a feeding flock, 9 km ESE Ocean City (39°18'N, 74°58'W), 4 July 1977; 130 gathered around fishing vessels, along the edge of the Continental Shelf, 154 km SE Cape May, New Jersey (38°39'N, 73°11'W), 14 August 1975.

Remarks.--At least one individual was observed on all but 3 of the 32 days spent beyond 15 km offshore between 1 June and 26 September. They were usually solitary or less often in pairs, except when resting or feeding.

Unlike other shearwaters, chumming efforts with beef suet, fish oils, bread, and garbage generally failed to draw Cory's shearwaters near the vessel for more than a passing glance. However, once several gathered to feed on fresh mashed bits of the oily liver of a dusky shark (Carcharhinus obscurus).



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 7. Seasonal abundance and seaward distribution patterns of the Cory's shearwater in the northern Chesapeake Bight, 1971-1977.

GREATER SHEARWATER (Puffinus gravis)

Status.--Uncommon late spring, summer, and fall visitant from mid-May to early December (Fig. 8). It may be locally abundant during June and early July and is occasionally fairly common during late October and early November.

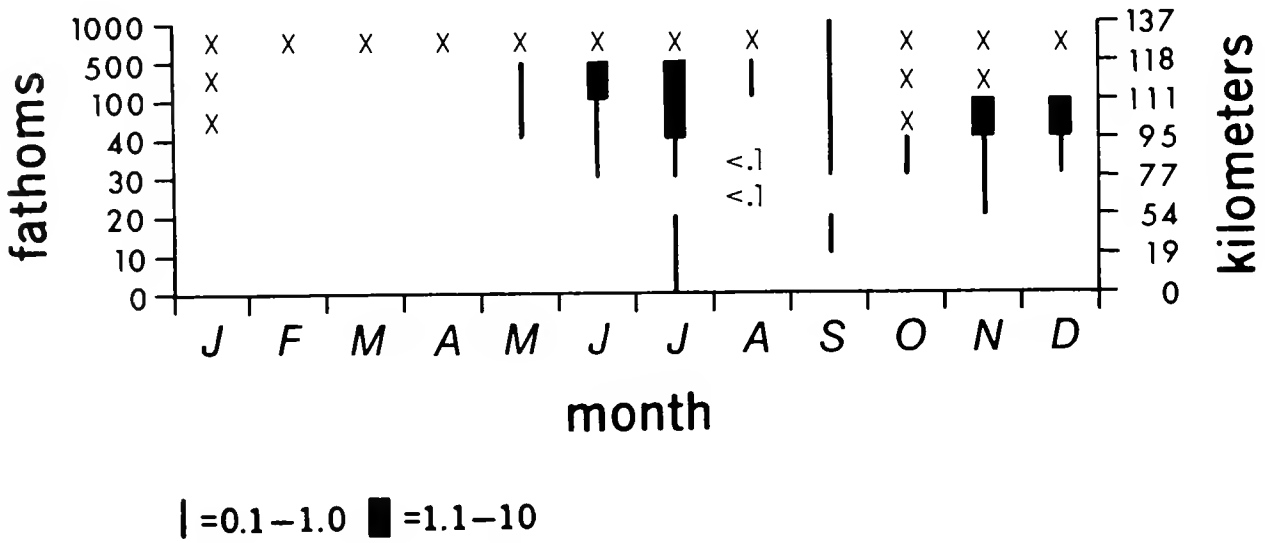
Earliest record.--16 May 1976.

Latest record.--6 December 1975.

Maximum counts.--39 in 15 h, along the edge of the Continental Shelf, 91-102 km SE Chincoteague, Virginia, 3 July 1977; 14 in 0.5 h at Baltimore Canyon (38°14'N, 73°52'W), 23 November 1974; 12 in 5 h at Baltimore Canyon, 4 December 1976.

Remarks.--The greater shearwater, like the Cory's, was widely dispersed and often solitary over the Continental Shelf, but appeared to be more numerous over waters between the 40 and 100 fathom contours. Northward passage in spring probably reaches its peak in early summer as revealed by counts of 1,000 at Hudson Canyon, off New Jersey (Scott and Cutler 1973b), and 10,000 greater and sooty shearwaters approximately 130 km S of Fire Island Inlet, New York, 5-7 July 1975 (Buckley et al. 1975). The latter concentration corresponded with a "heavy die-off" of greater shearwaters along the Delmarva coast in late June (Scott 1975). Further investigation in the northern Chesapeake Bight may reveal other large concentrations in areas that afford prolonged feeding activity. My counts of up to 350 at Hudson Canyon in late October and early November 1975, and the continued presence of small numbers into early December off the Delmarva Peninsula contradict the popular notion that greater shearwaters are generally absent in fall.

Greater shearwaters readily respond to chumming, often approaching so close to the boat that they can be caught with a dip net.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 8. Seasonal abundance and seaward distribution patterns of the greater shearwater in the northern Chesapeake Bight, 1971-1977.

SOOTY SHEARWATER (Puffinus griseus)

Status.--Uncommon spring and early summer transient from late April to mid-June over all areas of the Continental Shelf (Fig. 9).

Earliest record.--24 April 1977.

Latest record.--10 June 1976.

Maximum counts.--100 feeding in a flock, 94 km ESE Ocean City (38°15'N, 74°00'W), 1 June 1975.

Remarks.--Most sooty shearwaters probably pass through the northern Chesapeake Bight (within a narrow span of time) (Teulings 1972). Few were seen in April, May, and June. They readily respond to chumming, and sometimes get hooked when diving for baited fishing lines.

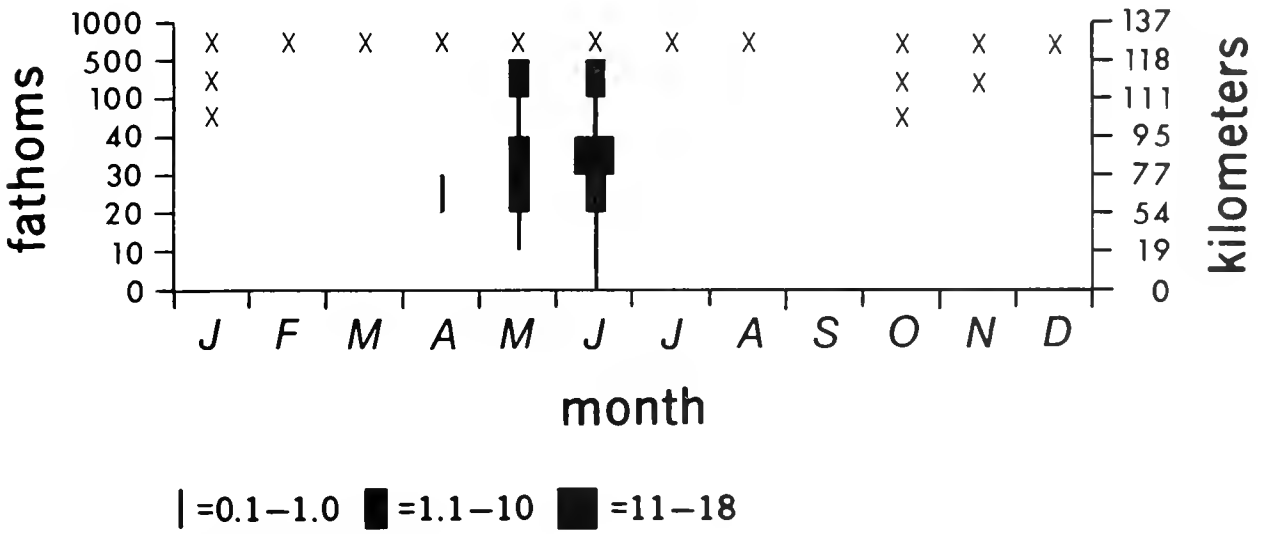


Figure 9. Seasonal abundance and seaward distribution patterns of the sooty shearwater in the northern Chesapeake Bight, 1971-1977.

MANX SHEARWATER (Puffinus puffinus)

Status.--Rare transient in spring (mid-April to early June) and fall (August and early December), with a single record in January (Fig. 10).

Earliest record.--SPRING: 23 April 1977. FALL: 8 August 1974.

Latest record.--SPRING: 1 June 1974. FALL: 6 December 1975.

Maximum counts.--3 in 1 h, 74 km ESE Ocean City (38°08'N, 74°16'W), 23 April 1977; 2-4 in 8 h, 17-70 km ESE Ocean City, 30 April 1977.

Remarks.--The Manx shearwater is an inhabitant of cold water zones and in recent years has extended its range across the northern Atlantic to the northwest Atlantic coast (Post 1967). The first breeding activity in North America was discovered in Massachusetts in 1973 (Bierregaard et al. 1975). This species was first sighted in the northern Chesapeake Bight off Maryland in 1974 (Rowlett 1976a).

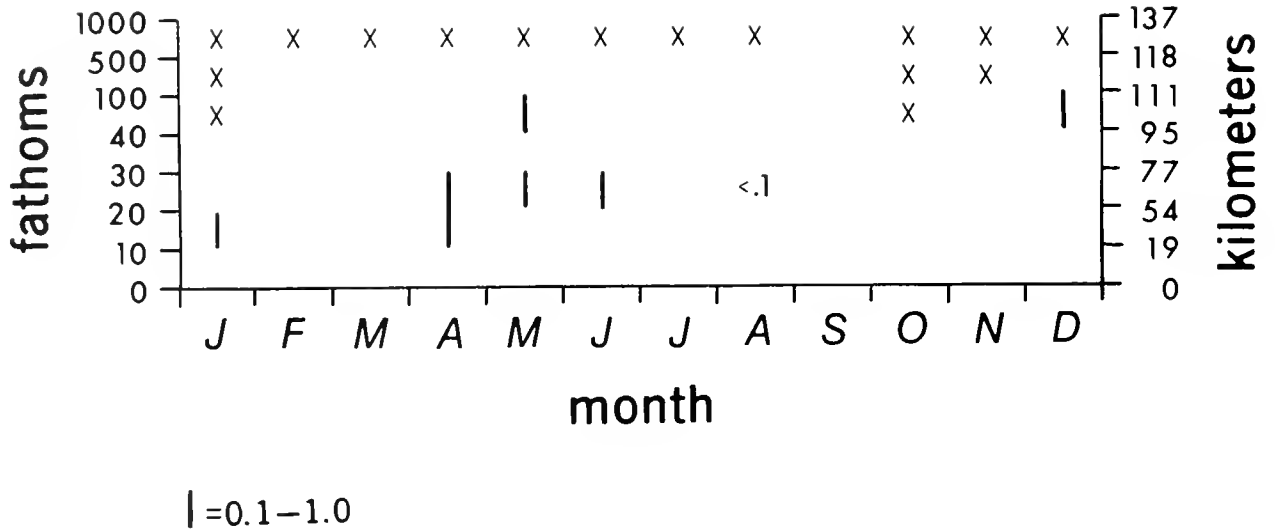


Figure 10. Seasonal abundance and seaward distribution patterns of the Manx shearwater in the northern Cheseapeake Bight, 1971-1977.

AUBUDON'S SHEARWATER (Puffinus Iherminieri)

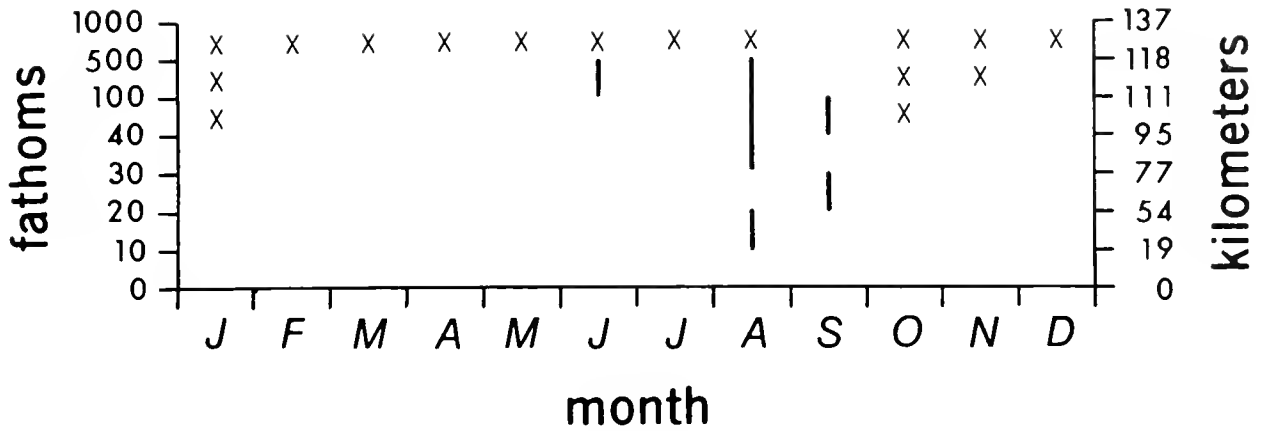
Status.--Rare summer and early fall visitant. One recorded in June in extreme southern portion of study area (Fig. 11).

Earliest record.--10 June 1976.

Latest record.--26 September 1976.

Maximum counts.--3 seen 46 km ESE Ocean City (38°15'N, 74°34'W), 26 September 1976.

Remarks.--Audubon's shearwater, the small black and white counterpart to the Manx, is a tropical and subtropical wanderer to the warm waters over the Continental Shelf in mid- and late summer. Its arrival in the northern Chesapeake Bight corresponds to the period when slope waters spread inshore over the Continental Shelf and when surface water temperatures reach their peak for the year.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 11. Seasonal abundance and seaward distribution patterns of the Audubon's shearwater in the northern Chesapeake Bight, 1971-1977.

BLACK-CAPPED PETREL (Pterodroma hasitata)

Status.--Probably a casual vagrant in late summer and early fall, when warm waters intrude northward along the edge of the Continental Shelf.

Records.--1 recorded 128 km E Chincoteague (37°54'N, 73°54'W), Virginia (Rowlett in press b).

Remarks.--Formerly believed to be a casual visitor off the east coast of the U.S. as a result of tropical storms (Robbins et al. 1968), but recent evidence indicates that this rare gadfly petrel of the Caribbean regularly forages in small numbers along the Gulf Stream off North Carolina (Lee 1977, Rowlett in press d). The numerous sightings off North Carolina and the one off Virginia were on choppy to rough days when winds ranged from 15 - 20 knots (28-37 km/hr). The black-capped petrel is a swift flyer and seldom lingers around vessels for more than a few seconds.

LEACH'S STORM PETREL (Oceanodroma leucorhoa)

Status.--Rare and widely dispersed from late April to mid-August. Probably present in fall with perhaps a few stragglers in winter, especially over deeper waters along the edge of the Continental Shelf (Fig. 12).

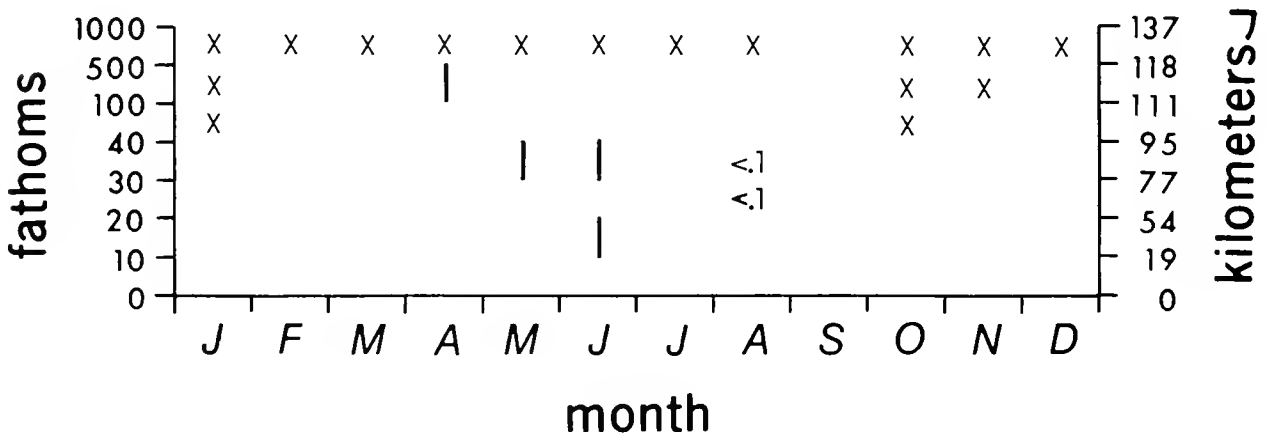
Earliest record.--30 April 1977.

Latest record.--14 August 1974. 2 recorded on 14 October in the Maryland area (Stewart and Robbins 1958).

Winter record.--1 seen from the Chesapeake Bay Bridge-Tunnel, Virginia on 10 January 1971 (Scott and Cutler 1971).

Specimen records.--1 found alive on the beach at Assateague Island, Worcester Co., Maryland, 16 August 1972 (USNM 566273); 1 found at night on the deck of the R.V. "Advance II", anchored 133 km E Rehoboth Beach (38°41'N, 73°34'W), Delaware, 11 August 1975 (USNM 567713).

Remarks.--All sightings of Leach's storm petrels were of single individuals. Unlike the Wilson's storm petrel they are not boat-followers. A single Leach's, associated with a large feeding aggregation of Wilson's on 1 June 1975, remained on the periphery of the flock.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 12. Seasonal abundance and seaward distribution patterns of the Leach's storm petrels in the northern Chesapeake Bight, 1971-1977.

HARCOURT'S STORM PETREL (Oceanodroma castro)

Status.--Casual; waifs have been picked up after the passage of tropical storms in eastern North America, occurring most frequently from mid-summer through fall.

Specimen record.--The first confirmed record for the western North Atlantic was found on the deck of the R.V. "Advance II," anchored 133 km E Rehoboth Beach (38°41'N, 73°34'W), Delaware, 14 August 1975 (USNM 567714). This was not attributed to a tropical storm.

Remarks.--The extent of the post-breeding range in the North Atlantic is unknown. The species is nearly impossible to identify in the field.

WILSON'S STORM PETREL (Oceanites oceanicus)

Status.--Summer visitant from late April to late September; locally abundant in areas beyond 50 km offshore. Uncommon to common in shallow near-shore areas, but usually absent in waters within 15 km of shore (Fig. 13).

Earliest record.--23 April 1977.

Latest record.--26 September 1976; but probably lingers into October.

Maximum counts.--SPRING: 1,708 in 6 h, 90-120 km E Ocean City, 9 May 1976; 3,076 mostly 96 km E Ocean City (38°15'N, 74°00'W), 1 June 1975.

SUMMER: 310 in 13 h, 112-154 km SE Cape May, New Jersey, 14 August 1975; 425 in 10 h, 55-115 km E Ocean City, 3 September 1976.

Remarks.--From May through early September, Wilson's storm petrels made up 66.6% of the total offshore avifauna. Beyond 50 km from shore, they are almost always in view. I attempted to learn how long individuals remained near the vessel by capturing and color marking the rumps of nine birds with Rhodomine-B pink dye during the extended ocean pollution cruises of August 1974 and 1975. Only two of the nine marked storm petrels remained near the boat where they were seen intermittantly throughout the day of release. The experience of being captured may have inhibited the seven other birds from remaining near the vessel.

Wilson's storm petrels are gregarious when feeding and at rest. Feeding aggregations of at least 3,000 on 1 June 1975, (38°15'N, 74°00'W), and 1,000 on 9 May 1976, (38°10'N, 74°24'W), closely attended 20-30 fin whales (Balaenoptera physalus), gathering on the slicks or "whale tracks" left after a whale submerged. Concentrations were sometimes so thick as to blacken the surface. Nearly all of the petrels observed on 1 June 1975 were at the same site, suggesting that the whales attracted birds from a rather large area.

Chumming with oily substances including ground fish, vegetable oil, and shark liver was generally successful for attracting storm petrels.

On 13 August 1974, approximately 200 Wilson's storm petrels gathered over a slick created during the dumping of a barge load (1 million gallons) of sulfuric acid-iron sulfate waste at the duPont Acid Waste Dump Site (Fig. 2), 70 km E Indian River Inlet (38°33'N, 74°16'W), Delaware. The slick contained "flocs" of ferric oxide and phosphate absorbed by clumped plankton and detritus which floated on the surface. Although the slick remained visible for up to three days after dumping, the petrels were only seen feeding on portions less than 3 h old. The effects of ferric oxide and phosphate ingestion to storm petrels and other marine organisms may pose a threat to these species.

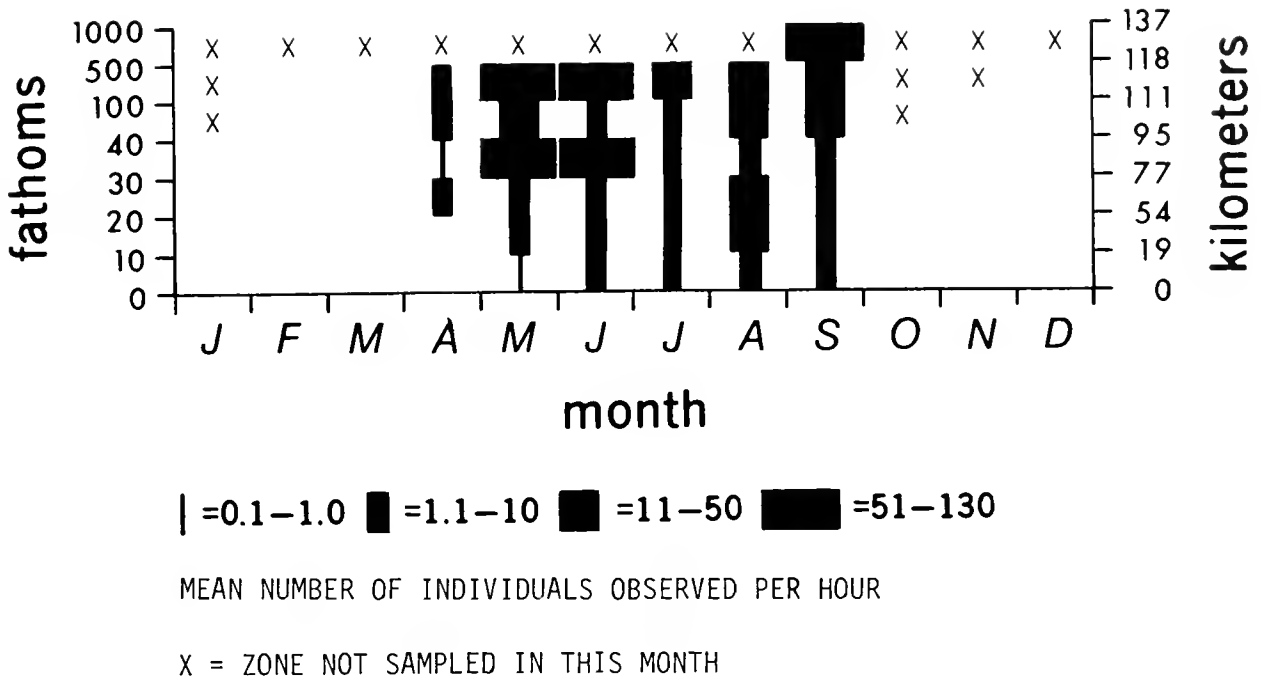


Figure 13. Seasonal abundance and seaward distribution patterns of the Wilson's storm petrel in the northern Chesapeake Bight, 1971-1977.

GANNET (Morus bassanus)

Status.--Common fall and spring transient and winter visitant from October to early May over the entire Continental Shelf (Fig. 14).

Earliest record.--19 October 1974; however, sightings from shore were recorded in mid-September.

Latest record.--15 May 1978; however, sightings from shore were recorded in late May.

Extraseasonal records.--1 sub-adult 61 km E Fenwick Island (38°31'N, 74°20'W), Delaware, 12 August 1974.

Maximum counts.--FALL: 1,480 (1,160 ad, 320 imm) in 8 h, 10111 km E Ocean City, 3 December 1977. Several hundred were gathered around fishing vessels at 38°06'N, 74°17'W and at 38°07'N, 74°14'W. WINTER: 301 (300 ad and 1 imm) in 6 h, 37-65 km offshore, 8 February 1975; 306 (275 ad and 31 imm) in 7 h, 20-125 km ENE Ocean City, 1 February 1976; 253 (158 ad and 95 imm) in 7 h, 25-115 km ESE Ocean City, 7 March 1976. SPRING: 232 (62 ad and 170 imm) in 11 h, 2-113 km ESE Ocean City, 11 April 1976; 290 (79 ad and 211 imm) in 11 h, 10-90 km ESE Ocean City, 27 April 1974; 140 (20 ad and 120 imm) in 6 h, 15-60 km ENE Ocean City, 27 April 1975.

Remarks.--During the fall (October to early December) and spring (April to mid-May) migrations, most gannets were seen inshore of the 30 fathom

contour (77 km offshore). Gannets were especially widespread in winter and ranged progressively further offshore with the advance of the season; the highest counts were recorded near the edge of Continental Shelf in March. In April, feeding flocks were most conspicuous over pods of fin whales when Boston mackerel (Sarda sarda) were migrating northward. At the height of a mackerel "run," which might last up to 15 min, dozens of gannets gathered in a feeding frenzy during which some would dive from heights of 30 m or more in pursuit of small fish under the mackerel. The intrusion of the boat into their midst terminated this activity and the birds rapidly dispersed.

Observations from shore suggested that immature gannets passed southward along the coast in advance of an increasing number of adults, which followed in November and December. Adults far outnumbered immature birds during the winter months, but in April, this trend was reversed as adults returned to their northern latitude colony sites (Table 3). Most adults of the western North Atlantic population winter in the Chesapeake Bight. The immatures winter farther south off the southeastern and Gulf Coastal states where winters are not so severe. This age-dependent behavioral trait is characteristic of many North American migratory species.

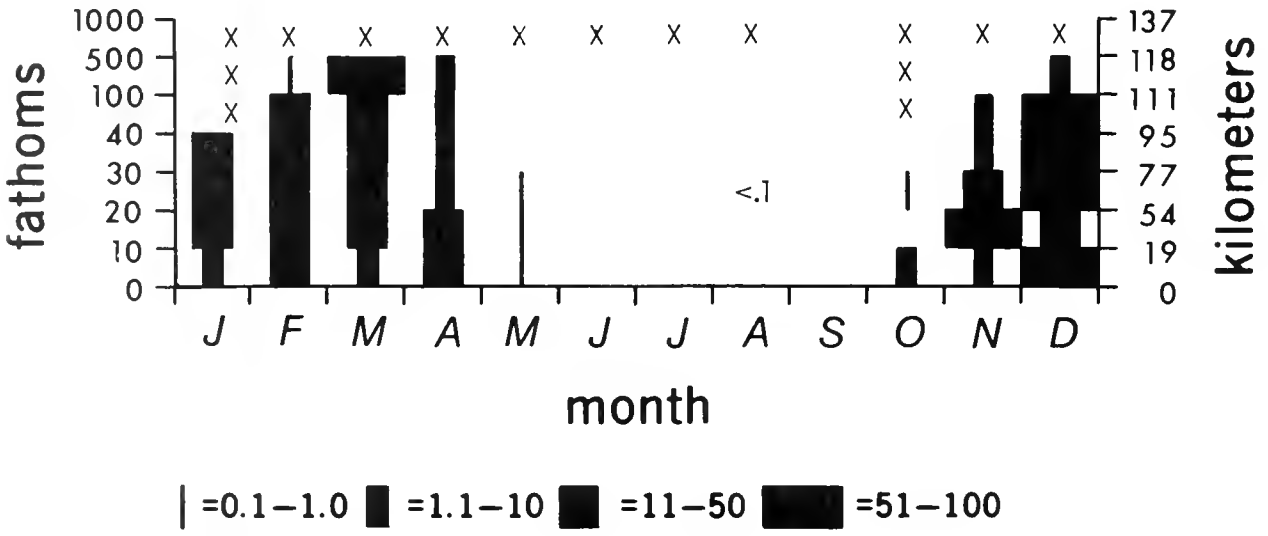


Figure 14. Seasonal abundance and seaward distribution patterns of the northern gannet in the northern Chesapeake Bight, 1971-1977.

RED PHALAROPE (Phalaropus fulicarius)

Status.--Fairly common spring and fall transient; uncommon and irregular winter visitant, usually beyond 70 km from shore (Fig. 15).

Earliest record.--SPRING: 27 April 1974. FALL: 11 August 1975.

Table 3. Numbers of gannets counted in the northern Chesapeake Bight, 1971-1977. Numbers of each age group, based on plumage characteristics, are listed for each month of occurrence. Hours of observation for each month in parentheses.

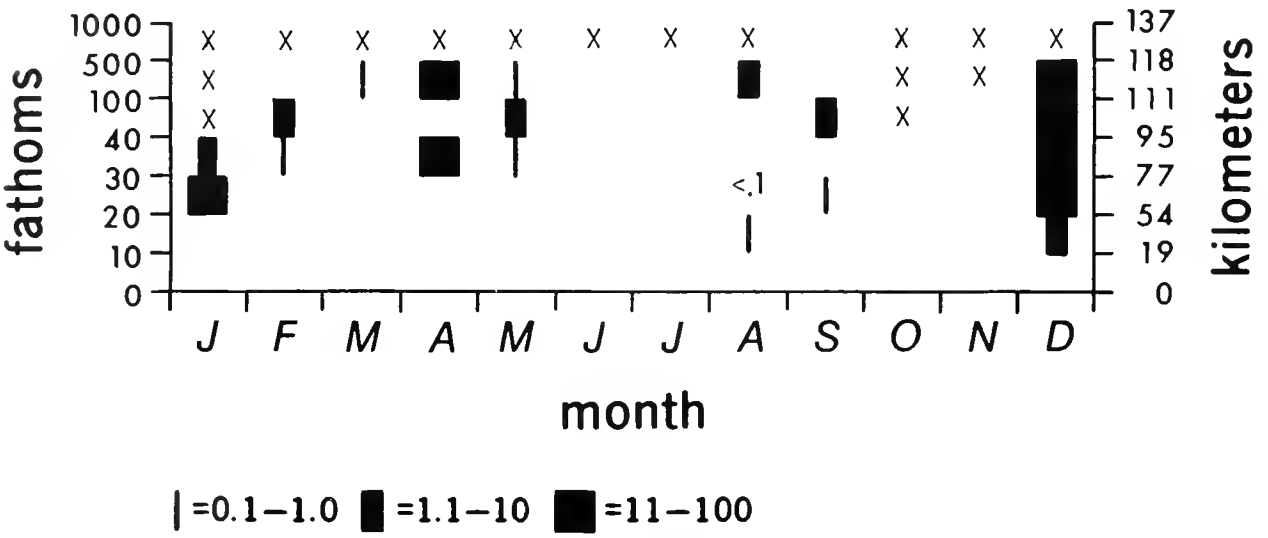
Month	Hours of Observation	Age			Total
		Adult	Sub-adult	Juvenile	
January	(31.0)	350	68	10	428
February	(117.0)	1,985	202	160	2,347
March	(54.5)	631	159	69	859
April	(78.5)	117	336	384	837
May	(57.5)		6	9	15
June	(40.5)				0
July	(36.5)				0
August	(230.0)		1		1
September	(68.0)				0
October	(9.5)			4	4
November	(24.0)	213	128	70	411
December	(37.0)	1,828	222	256	2,306

Latest record.--SPRING: 9 May 1976. FALL: 6 December 1975.

Maximum counts.--SPRING: 494 in 3 h, 80-85 km E Ocean City, 27 April 1974. FALL: 263 in 5.5 h, 75-110 km ESE Ocean City, 6 December 1975; 305 in 4.5 h, 90-110 km ESE Ocean City, 6 December 1976. WINTER: Flock of 113, 54 km E Ocean City (38°30'N, 74°31'W), 12 January 1975; 27 in 1 h, along the 40 fathom contour, ca. 83 km ESE Assateague Island, Virginia, 6 February 1975.

Remarks.--During April and December, red phalaropes were seen in flocks of 20 to 80. Undoubtedly, many were overlooked, especially when seas were rough and visibility was restricted by spray and a low observer angle. Occasionally, individuals were seen feeding around small clumps of sargasso weed (Sargassum sp.) and along rip tides containing detritus.

Peak spring numbers of red phalaropes pass through the northern Chesapeake Bight in late April, about two weeks before the northern phalarope peak.



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 15. Seasonal abundance and seaward distribution patterns of the red phalarope in the northern Chesapeake Bight, 1971-1977.

NORTHERN PHALAROPE (Lobipes lobatus)

Status.--Fairly common spring and fall transient, usually beyond 20 km from shore (Fig. 16).

Earliest record.--SPRING: 27 April 1974. FALL: 11 August 1974.

Latest record.--SPRING: 29 May 1977. FALL: 26 September 1976.

Maximum counts.--SPRING: 939 (900 in one flock) in 8 h, 65-115 km E Ocean City, 9 May 1976. FALL: 12 in 8 h, 76-116 km ESE Ocean City, 26 September 1976.

Remarks.--On 9 May 1976, 900 northern phalaropes and 1,000 Wilson's storm petrels attended a cetacean concentration, which included 30 fin whales and 300 saddleback dolphins (Delphinus delphis), 94 km E Ocean City (38°15'N, 74°01'W). The phalaropes and storm petrels concentrated on each new slick and swirl left by submerging whales.

Departures in fall are probably completed by mid-October (Robbins and Bystrak 1977).

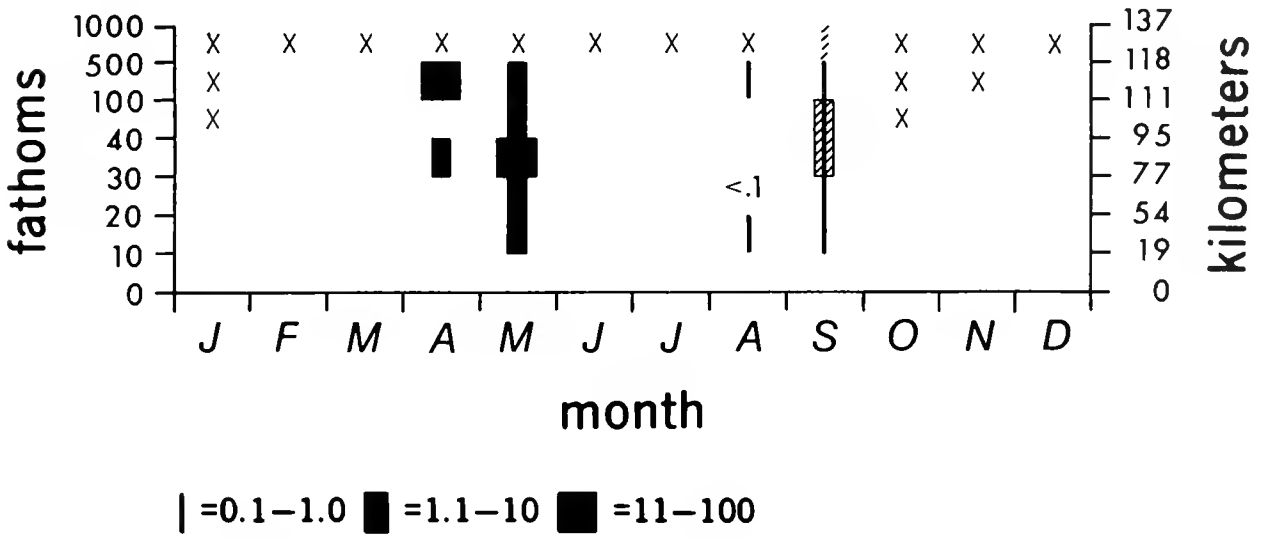


Figure 16. Seasonal abundance and seaward distribution patterns of the northern phalarope in the northern Chesapeake Bight, 1971-1977.

PARASITIC JAEGER (Stercorarius parasiticus)

Status.--Uncommon spring and fall transient. A few, presumably nonbreeders, may be seen during the summer (Fig. 17).

Earliest record.--SPRING: 23 April 1977. FALL: 11 August 1975.

Latest record.--SPRING: 16 May 1977. FALL: 6 December 1975.

Maximum counts.--SPRING: 2 in 2 h, 2-20 km E Ocean City, 23 April 1977; 2 in 2 h, 9 km E Ocean City, 14 May 1972. FALL: flock of 5, 28 km E Rehoboth Beach, Delaware, 11 August 1974; 5 in 1 h, 70 km E Ocean City, 3 September 1976; 4 in 6 h, 40-80 km E Ocean City, 23 November 1974; 3 in 1.5 h, 10-15 km E Ocean City, 4 December 1976.

Remarks.--Parasitic jaegers are found in all zones over the Continental Shelf. In the shallow nearshore waters, smaller seabirds such as terns and Bonaparte's gulls are most common, and are suitable targets for pirating parasitic jaegers. The larger, less aggressive pomarines generally stay further offshore than the parasitic jaeger, and are often found in association with the larger more cumbersome gulls.

Approximately 30% of all immature jaegers could not be identified (Fig. 18). Medium-sized to small jaegers created the greatest identification problems.

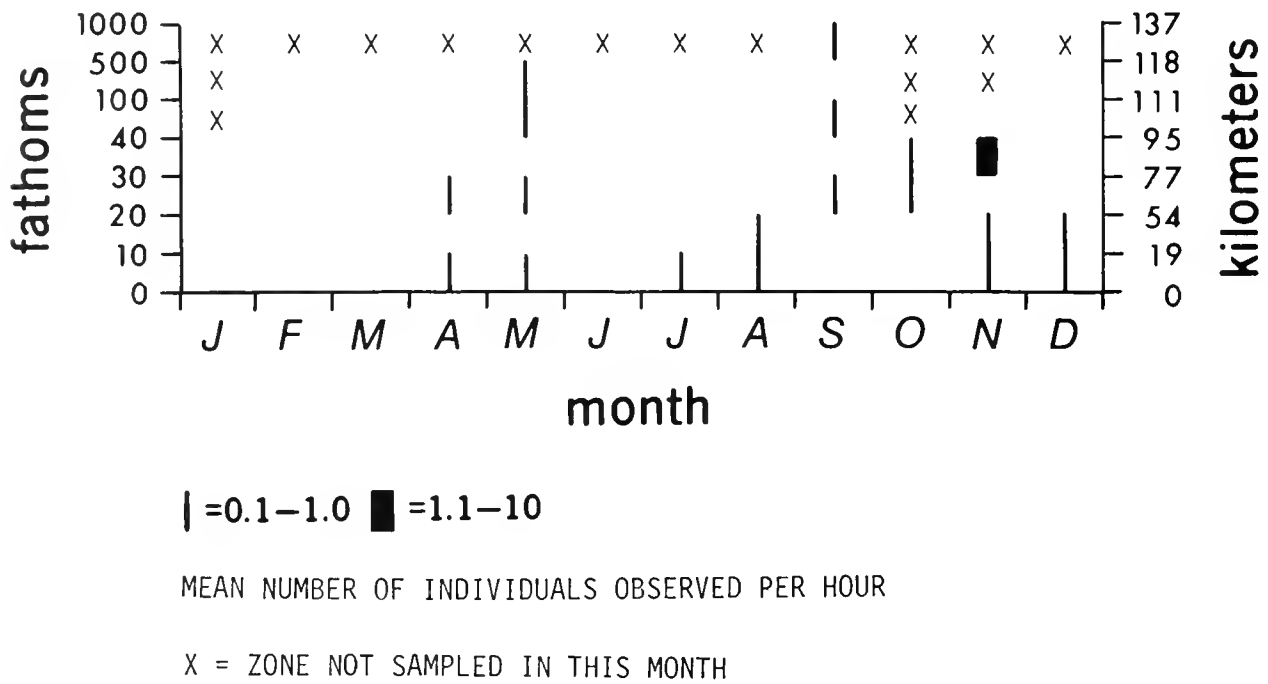


Figure 17. Seasonal abundance and seaward distribution patterns of the parasitic jaeger in the northern Chesapeake Bight, 1971-1977.

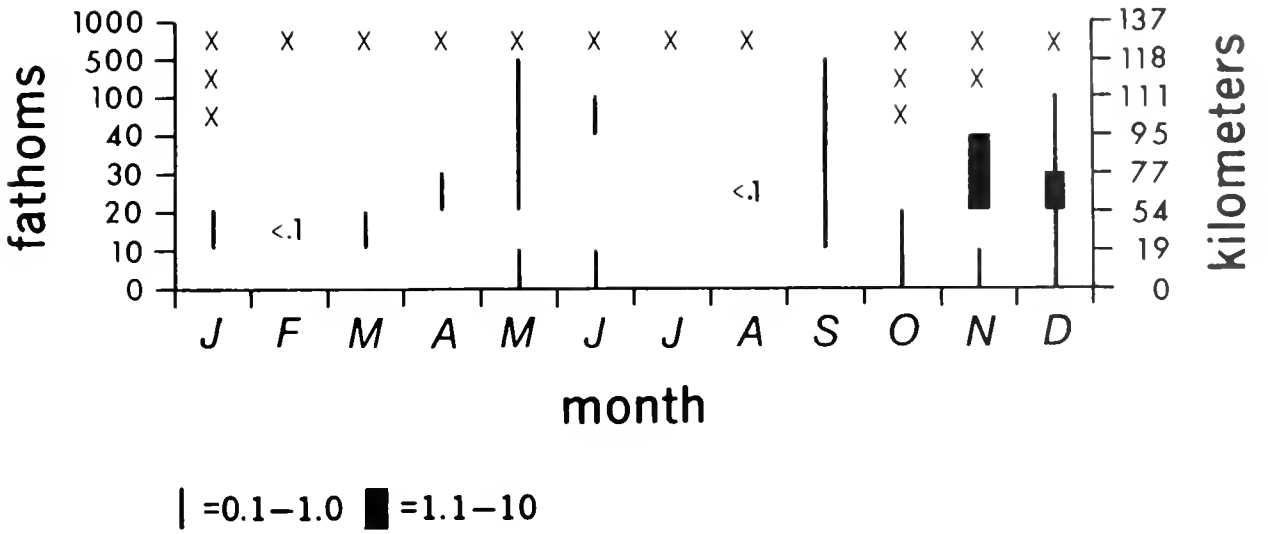


Figure 18. Seasonal abundance and seaward distribution patterns of the unidentified jaegers in the northern Chesapeake Bight, 1971-1977.

POMARINE JAEGER (Stercorarius pomarinus)

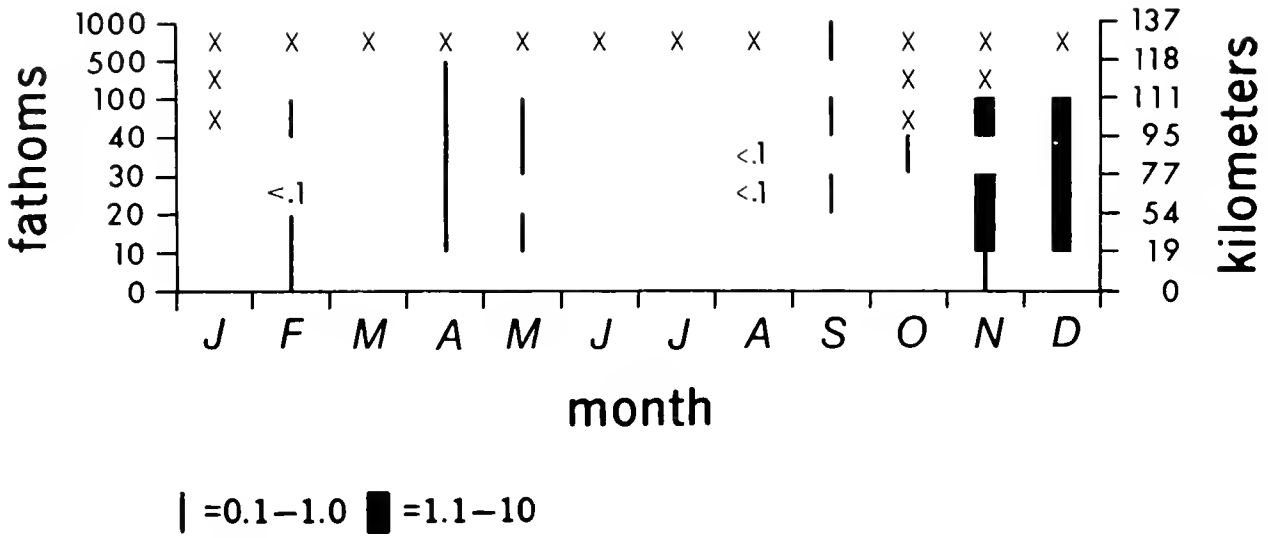
Status.--Probably present in small numbers year round; primarily a transient, uncommon in spring, and fairly common in fall (Fig. 19).

Earliest record.--SPRING: 25 March 1973. FALL: 8 August 1973.

Latest record.--SPRING: 29 May 1977. FALL: 6 December 1975.

Maximum counts.--SPRING: 6 in 3.5 h, 100-125 km E Ocean City, 8 May 1977; 5 in 7 h, 70-95 km E Ocean City, 29 May 1977. FALL: 8 in 11 h, 65-140 km ESE Ocean City, 26 September 1976; 37 in 8 h, 40-110 km ESE Ocean City, 4 December 1976; 38 in 8 h, 40-110 km ESE Ocean City, 3 December 1977.

Remarks.--Most pomarine jaegers were seen beyond 40 km from shore. During spring migration, single pomarine jaegers were usually seen flying northward, 1-2 m over the water. Most often, they ignored the boat and chum, although they occasionally lingered when the boat was stationary. The greatest concentrations of pomarine jaegers were recorded in early December with up to 15 in sight at one time, all of which were probably attracted by the flocks of gulls and gannets that gathered about the boat and chum. Most of these jaegers were immatures.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 19. Seasonal abundance and seaward distribution patterns of the pomarine jaegers in the northern Chesapeake Bight, 1971-1977.

LONG-TAILED JAEGER (Sterocorarius longicaudus)

Status.--Rare spring and fall transient.

Records.--SPRING: 1 adult, 126 km ESE Ocean City (38°14'N, 73°40'W), 8 May 1977. FALL: 1 adult, 70 km E Ocean City (38°21'N, 74°17'W), 8 August 1974.

Specimen record.--1 adult found dead on beach at Ship Shoal Island, Northamton Co., Virginia, 26 June 1975 (USNM 499381--Williams 1976).

Remarks.--The distribution of long-tailed jaegers is poorly known in the Atlantic. Wynne-Edwards (1935) suggested that the species is chiefly a migrant over the middle third of the North Atlantic.

SKUA (Catharacta sp.)

Status.--Rare but regular winter visitant, and probably spring transient, occurring chiefly seaward of the 20 fathom contour (54 km offshore) to the Continental Slope (Fig. 20).

Earliest winter record.--4 December 1976.

Latest spring record.--8 May 1976 (probably occurs into June).

Maximum counts.--Flock of 5, 61 km SE Ocean City (38°02'N, 74°30'W), 2 Febuary 1974; 5-9 in 3.5 h, 67-111 km E Ocean City, 1 Febuary 1975; 4-6 in 3 h, 78-113 km E Ocean City, 1 February 1976.

Remarks.--There is considerable uncertainty concerning the taxonomy and field identification of skuas in the western North Atlantic. Until recently, all skuas in this region were assumed to represent the North Atlantic breeding stock of the great skua (C. skua skua). However, the south polar skua (C. maccormicki) is a visitant, documented by specimens from Greenland (Solomonsen 1976) and North Carolina (Rowlett in press a), and by photographs taken in New Jersey (Brady 1976, Buckley et al.1976) and over Georges Bank (Veit in press). The brown skua (C. s. lonnbergi) also is a reported visitant from the southern hemisphere.

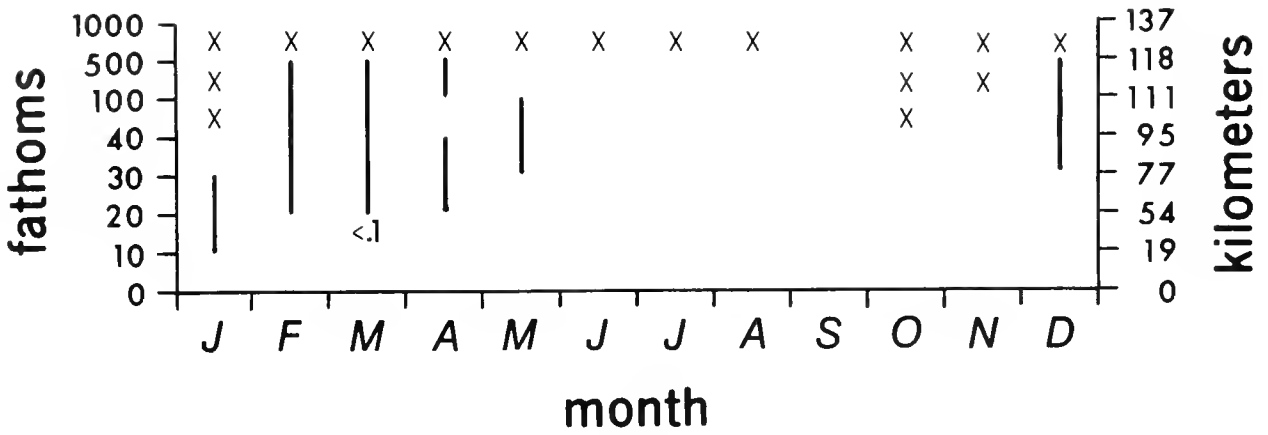
Even with the use of Devillers (1977) descriptive accounts of the world's skuas, field identification was difficult. All but two skuas seen in the northern Chesapeake Bight from 1971 - 1977 were thus recorded as "skua" (Catharacta sp.).

Two birds seen on 9 May 1976 near a fishing trawler, 117 km ESE Ocean City (38°11'N, 73°46'W) were identified as C. maccormicki, based on the extreme wear of flight and body feathers and the uniform slate-brown mantle, back, and head which contrasted strongly with pale buffy gray underparts and collar on the hind neck. Worn plumage in May is to be expected on individuals from the Southern Hemisphere. The normal period of greatest wear in C. skua skua is in mid-winter.

Based on the above accounts, skuas in the northern Chesapeake Bight from December to early April are probably C. s. skua, although non-breeding southern forms may occasionally remain in the northern hemisphere. The occurrence of skuas in mid-April and May coincides with the northward passage of sooty shearwaters and Wilson's storm petrels along the mid-Atlantic coast. These skuas may be Southern Hemisphere forms C. s. lonnbergi, or C. maccormicki. The recent confirmed sightings and specimens suggest that C. maccormicki is the most likely to be seen in spring.

Most skuas appeared after chumming had attracted hundreds of seabirds, mostly gulls and gannets. Skuas seldom lingered near the boat, usually remaining along the trailing fringes of the feeding flocks where close study of plumage characteristics was not possible. Skuas usually foraged freely among other seabirds and seldom displayed the aggressive behavior for which they are notorious.

Few sightings of skuas (reported as C. skua) in the northern Chesapeake Bight off Delaware and Virginia have been reported (Pough 1940, Murray 1957, Burford 1959, Scott 1968, Ake, 1971a, Rowlett 1974a), although I found skuas to be more common than was previously suspected.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 20. Seasonal abundance and seaward distribution patterns of the skuas (Catharacta sp.) in the northern Chesapeake Bight, 1971-1977.

GULLS

Gulls of the genus Larus generally were present offshore during the cold-water months, October through May. All species I observed breed in the Northern Hemisphere during the summer. This fact, plus the absence of the large foreign fishing fleets which attract gulls to offshore areas, account for the scarcity of gulls offshore in summer months. From November through March, 71.8% of the total offshore avifauna counted consisted of gulls of the genus Larus, which often gathered by the hundreds around fishing vessels, especially the foreign fleets which were routinely seen from November to May along the edge of the Continental Shelf in the vicinity of Baltimore Canyon.

Chumming with coarsely ground beef suet and stale bread during this period attracted several hundred gulls, most of which were herring gulls (L. argentatus). Chumming generally failed to attract gulls from mid-May through mid-September.

Running totals of these habitual ship followers, recorded each half hour, were subjectively adjusted on the basis of recognizable individuals and therefore, represent reasonably accurate counts.

GLAUCOUS GULL (Larus hyperboreus)

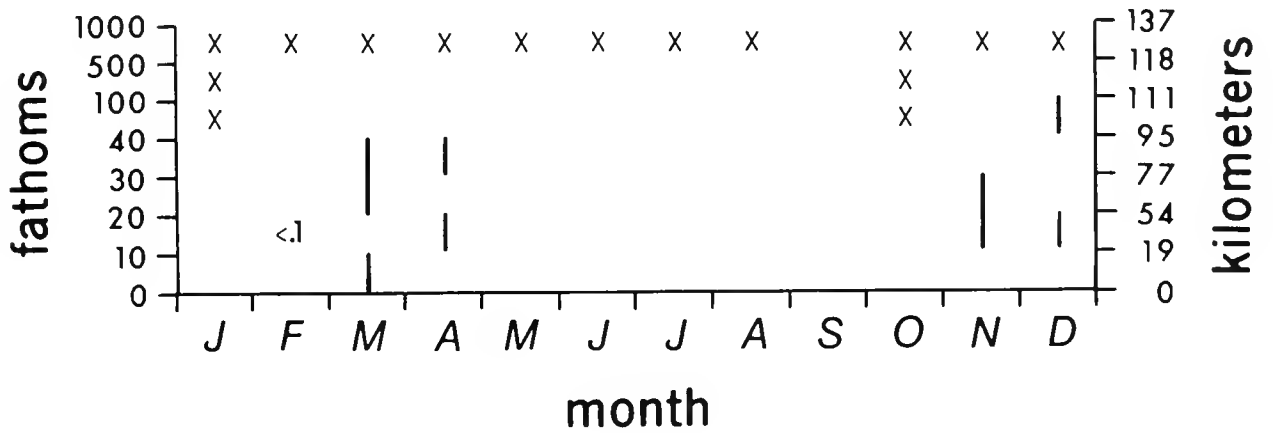
Status.--Rare winter visitant over all zones of the Continental Shelf (Fig. 21).

Earliest winter record.--23 November 1974.

Latest winter record.--30 April 1977.

Maximum counts.--3 among a flock of herring gulls, 81 km ENE Ocean City (38°31'N, 74°09'W), 16 March 1975; 3 in 4 h, 2-92 km ENE Ocean City, 5 March 1977.

Remarks.--All glaucous gulls observed were immatures. They were seen in small numbers among the hundreds of herring gulls that either gathered around fishing vessels or chum.



| =0.1—1.0

MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 21. Seasonal abundance and seaward distribution patterns of the glaucous gull in the northern Chesapeake Bight, 1971-1977.

ICELAND GULL (Larus glaucoides)

Status.--Rare winter and early spring visitant over all zones of the Continental Shelf (Fig. 22).

Earliest winter record.--3 December 1977.

Latest winter record.--30 April 1977.

Maximum counts.--3-5 among a flock of herring gulls, 40 km SE Ocean City, 5 February 1977; 3 in 5 h, 40-115 km SES Ocean City, 7 March 1976.

Remarks.--All sightings were among flocks of herring gulls gathered around fishing vessels or chum. Only 2 of the 22-24 seen were adults; most of the others were in first winter plumage.

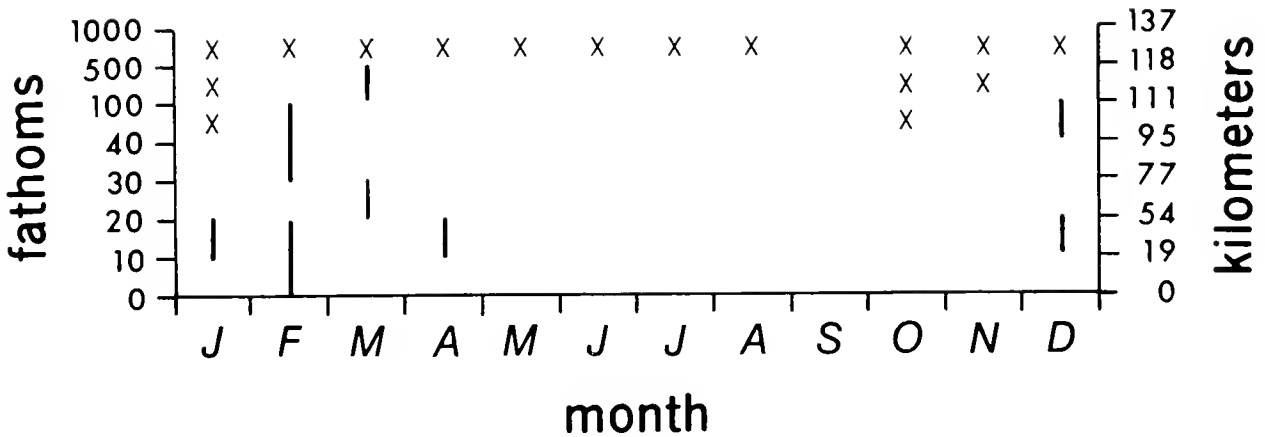


Figure 22. Seasonal abundance and seaward distribution patterns of the iceland gull in the northern Chesapeake Bight, 1971-1977.

GREAT BLACK-BACKED GULL (Larus marinus)

Status.--Uncommon winter visitant from November through April over entire Continental Shelf. Rare offshore in summer (Fig. 23). It is a casual breeder but increasing in number along the Delmarva Peninsula (Armistead 1975).

Maximum counts.--Approximately 260 in 9.5 h, 2-111 km ESE Ocean City, 3 December 1977; 110 in 1.5 h, along the edge of the Continental Shelf from Baltimore Canyon northeast to 38°57'N, 73°00'W, 5 February 1977; 75 in 10 h, 2-57 km ENE Ocean City, 3 March 1973; 36 in 11.5 h, 2-113 km ESE Ocean City, 11 April 1976.

Remarks.--Most commonly gathered around fishing vessels and chum slicks. Only immatures were observed offshore during the summer.

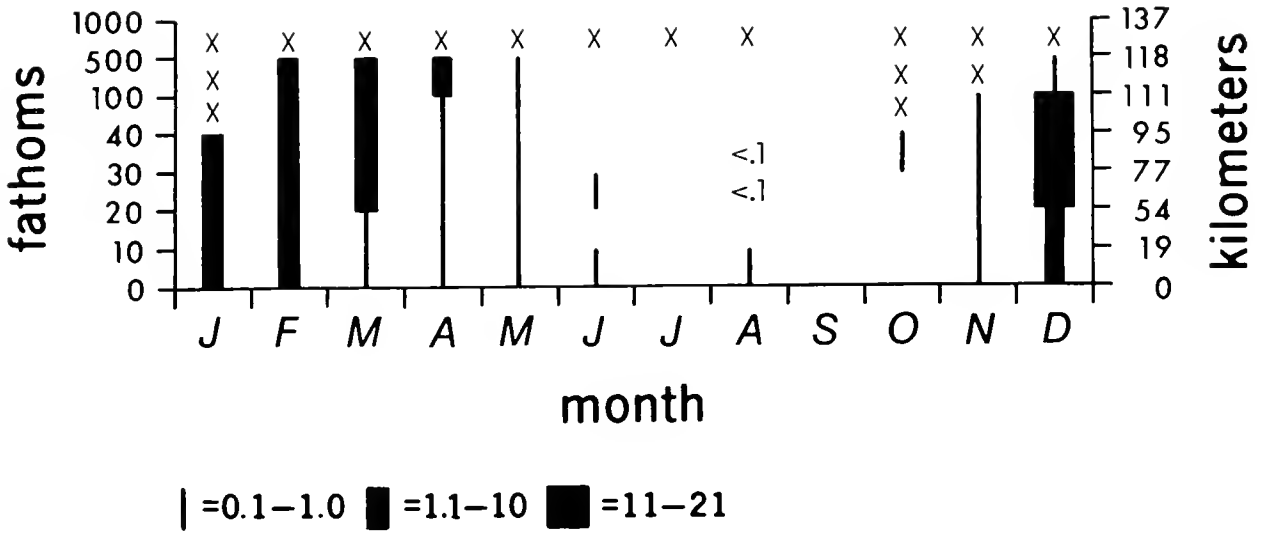


Figure 23. Seasonal abundance and seaward distribution patterns of the great black-backed gull in the northern Chesapeake Bight, 1971-1977.

LESSER BLACK-BACKED GULL (Larus fuscus)

Status.--Rare fall and winter visitant, October through April, over the Continental Shelf.

Records.--1 ad 92 km E Ocean City (38°19'N, 74°02'W), 19 October 1974; 1 imm, 141 km ENE Ocean City (38°26'N, 74°31'W), 5 February 1977; 1 ad, 98 km ESE Ocean City (38°06'N, 74°00'W), 30 April 1977.

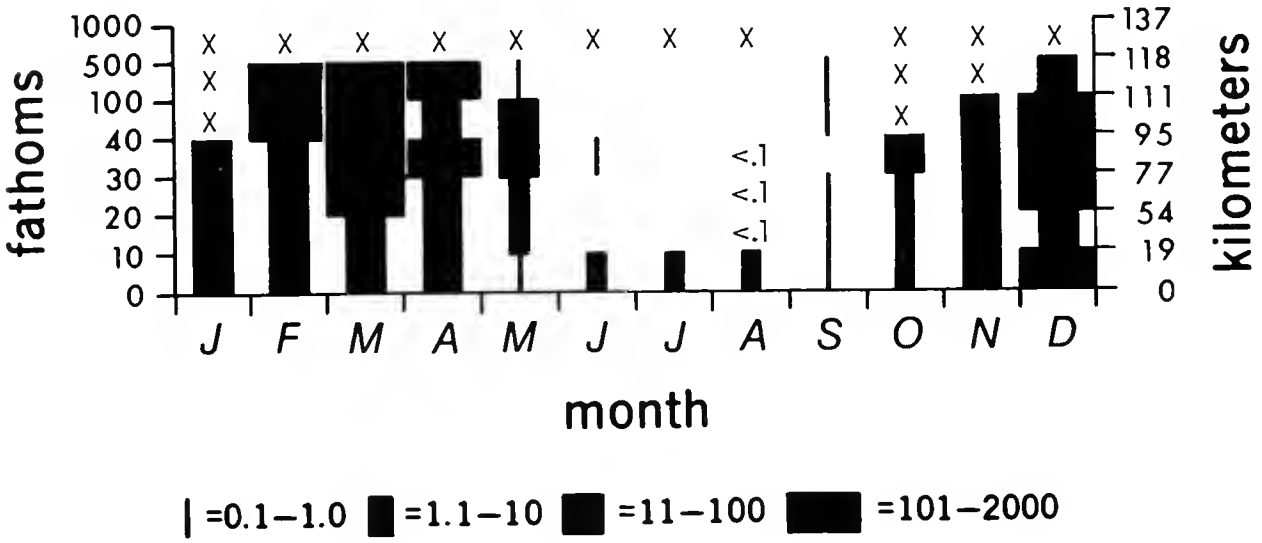
Remarks.--All sightings were in areas where concentrations of other gulls were observed.

HERRING GULL (Larus argentatus)

Status.--Abundant over Continental Shelf, seaward of the 30 fathom contour in winter from October through early May. Uncommon during summer over coastal waters within 20 km of shore; breeds along the coastal Delmarva Peninsula (Fig. 24).

Maximum counts.--A count of 21, 868 in 9.5 h (20,000 gathered around fishing vessels, 75 and 90 km ESE Ocean City), 3 December 1977; 3,700 in 6 h, 120 km E Ocean City, and 140 km E Cape May, New Jersey, mostly around fishing vessels along the edge of the Continental Shelf, 5 February 1977; 1,214 in 4.5 h, mostly 96-119 km ESE Ocean City, 7 March 1976; 3,625 in 11 h, 15-75 km ESE Ocean City where numerous flocks of 50 to 2,000 gathered over schools of Boston mackerel and fin whales, 27 April 11974; 400 gathered over 30-40 fin whales, 87 km ESE Ocean City (38°15'N, 74°07'W), 8 May 1977.

Remarks.--Herring gulls constituted 66.6% of the total offshore avifauna from November through March. On the one-day charter trips, continual chumming attracted large numbers. The flocks increased gradually and reached maximum numbers as we approached the edge of the Continental Shelf. Herring gulls followed the boat as long as the chum was being dispensed. Most summer birds observed were immatures.



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 24. Seasonal abundance and seaward distribution patterns of the herring gull in the northern Chesapeake Bight, 1971-1977.

THAYER'S GULL (Larus thayeri)

Status.--Probably rare winter visitant most likely to be found where large numbers of herring gulls are gathered.

Records.--1 imm, 33 km SE Ocean City (38°08'N, 74°48'W), 5 February 1977 (photographs in Scott 1977). I photographed another imm on shore at Ocean City (38°19'N, 75°05'W), 8 February 1976. These are the first documented records for Maryland and the Chesapeake Bight.

Remarks.--The Thayer's gull has only recently been accorded species status (A.O.U. 1973). The range of variation in plumages of immature Thayer's, Iceland, and herring gulls makes field identification near impossible. Increased numbers of Thayer's gulls reported along the east coast in recent years probably reflects an increased familiarity with the species associated with species status recognition, rather than a southward expansion of its winter range.

RING-BILLED GULL (Larus delawarensis)

Status.--Uncommon in offshore waters to the 30 fathom contour during fall migration; uncommon over coastal waters within sight of land in winter. It is an abundant spring and fall transient and winter visitant along coastal beaches, inlets, and bays from early August to mid-May, and is an uncommon straggler in those areas during summer (Fig. 25).

Maximum counts.--21 in 1.5 h, 2-15 km E Ocean City, 27 April 1974; 15 in 1 h, 2-10 km E Ocean City, 6 December 1975.

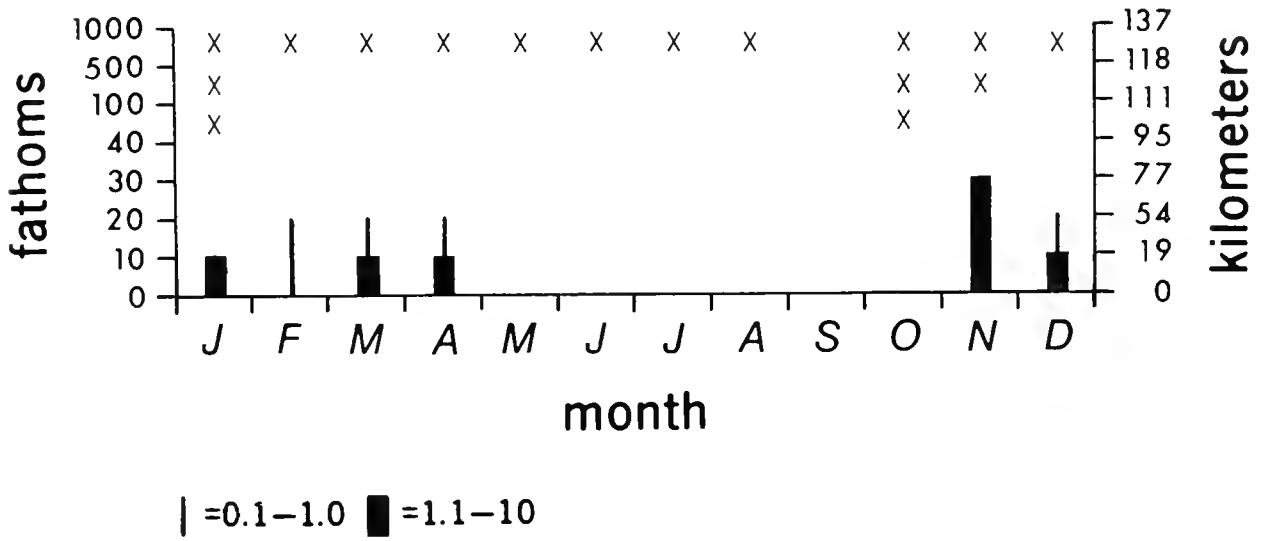


Figure 25. Seasonal abundance and seaward distribution patterns of the ring-billed gull in the northern Chesapeake Bight, 1971-1977.

BLACK-HEADED GULL (Larus ridibundus)

Status.--Rare fall and spring transient and winter visitant.

Records.--1 imm, 18 km E Ocean City (38°22'N, 74°53'W), 19 November 1972; 1 ad, 2 km E Ocean City (38°19'N, 75°04'W), 12 January 1975; 1 ad, 37 km E Ocean City (38°19'N, 74°40'W), 3 February 1973; 1 ad, 28 km ESE Ocean City (38°04'N, 74°06'W), 25 March 1973.

Remarks.--Black-headed gulls were always seen among flocks of Bonaparte's gulls within 50 km of shore, and showed no interest in chum.

LAUGHING GULL (Larus atricilla)

Status.--Fairly common over shallow coastal waters inshore of the 10 fathom contour (ca. 19 km offshore) from early spring to late fall. Spring transients occasionally pass further offshore, and fall transients and post-breeding birds sometimes forage out to, or beyond the 40 fathom contour (ca 95 km offshore) (Fig. 26). The species is an abundant breeding bird along the entire coast of the Delmarva Peninsula.

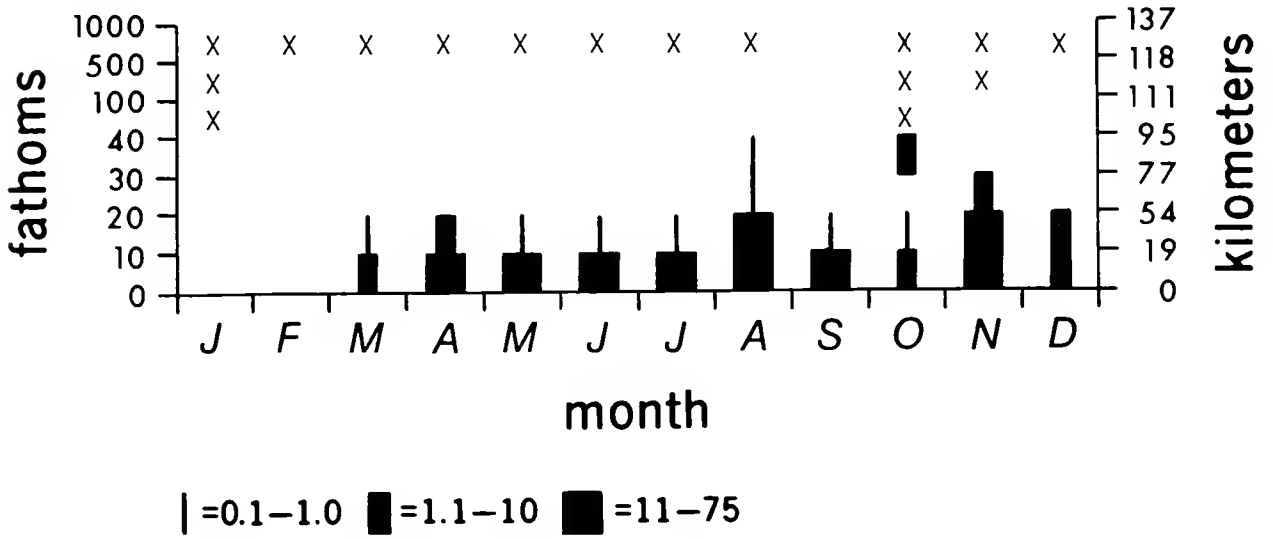
Normal period of occurrence.--Mid-March to mid-December.

Earliest spring record.--16 March 1975.

Latest fall record.--6 December 1975.

Maximum counts.--SPRING: 130 in 3 h, 2-5 km ESE Ocean City, 30 April 1977. SUMMER: 200 in 4 h, 2-60 km E Lewes, Delaware, 11 August 1975; 350 in 0.5 h, 5-15 km SE Ocean City, 23 August 1977. FALL: 202 in 4.5 h, 2-75 km E Ocean City, 23 November 1974.

Remarks.--Laughing gulls occasionally followed vessels leaving shore, but usually departed before sight of land was lost.



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 26. Seasonal abundance and seaward distribution patterns of the laughing gulls in the northern Chesapeake Bight, 1971-1977.

BONAPARTE'S GULL (Larus philadelphia)

Status.--Common fall and spring transient and fairly common winter visitant over shallow coastal waters within 20 km of shore (Fig. 27).

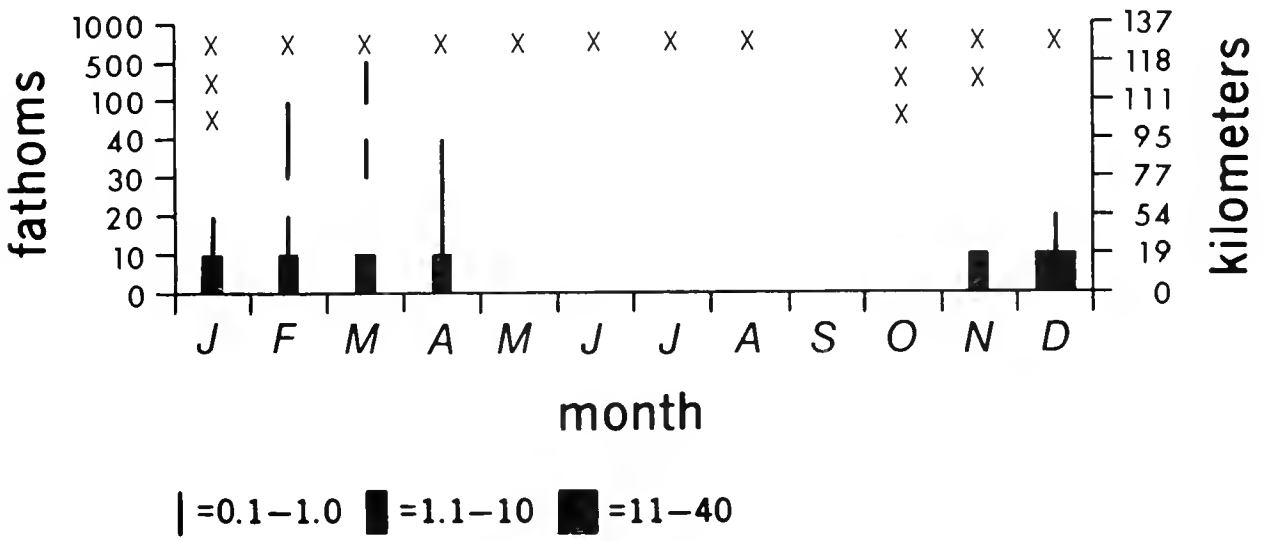
Normal period of occurrence.--Mid-September to mid-May.

Earliest fall record.--19 November 1972.

Latest spring record.--27 April 1975.

Maximum counts.--FALL: feeding flock of 300, 44 km E Ocean City (38°19'N, 74°53'W), 4 December 1976. WINTER: 45 within 2 km of Ocean City Inlet, 12 January 1975. SPRING: 65 within 2 km of Ocean City Inlet 20 March 1976; 41 in 1.5 h, 35-60 km ESE Ocean City, 23 April 1977.

Remarks.--Bonaparte's gulls usually forage in flocks and seldom venture seaward of the 20 fathom contour (ca 54 km offshore). They generally show little interest in chum. Although precise age ratios were not determined, most birds seen were adults.



MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 27. Seasonal abundance and seaward distribution patterns of the Bonaparte's gulls in the northern Chesapeake Bight, 1971-1977.

LITTLE GULL (Larus minutus)

Status.--Rare fall and spring transient, and winter visitant.

Records.--5 ad, 44 km E Ocean City (38°18'N, 74°53'W), 6 December 1976; 1 ad, 37 km E Ocean City (38°19'N, 74°49'W), 16 January 1977; 3 ad, 2 km E Ocean City (38°19'N, 75°04W), ad, 43 km E Ocean City (38°17'N, 74°53'W), 23 April 1977.

Remarks.--Little gulls were seen over nearshore waters where they often associated with flocks of Bonaparte's gulls.

BLACK-LEGGED KITTIWAKE (Rissa tridactyla)

Status.--Common fall and early spring transient and winter visitant over the Continental Shelf, seaward of 10 km offshore (Fig. 28).

Earliest fall record.--26 September 1976.

Latest spring record.--29 May 1977 (late April normal).

Maximum counts.--921 in 10 h, 10-113 km ESE Ocean City, 4 December 1976; 533 in 8 h, 72-96 km offshore, 7 February 1975.

Remarks.--The black-legged kittiwake was considered a casual visitor to Maryland by Stewart and Robbins (1958). Robbins and VanVelzin (1968) found only four records for the state. In light of my recent observations (Rowlett 1973b), this probably reflects the lack of offshore surveys. Kittiwakes are highly pelagic wanderers in winter and are rarely observed from shore.

The southward migration in November and December coincides with similar movements, by gannets. Kittiwakes in first winter plumage ("tarrocks") arrive first, followed by adults. Mid-winter populations consisted of about equal numbers of tarrocks and adults (Table 4). Because sub-adults in second winter plumage could not always be distinguished at a distance from adults, the two age classes were not distinguished during censuses. All counts in early March were much lower than in early February, suggesting that kittiwakes migrate north late in the winter.

Kittiwakes were generally solitary or in small flocks of up to 25 individuals. Occasionally, flocks of more than 200 were seen. In many instances they circled the boat once or twice, sampled the chum, and disappeared. Kittiwakes lingered about the boat longer on stormy days than on clear and calm days.

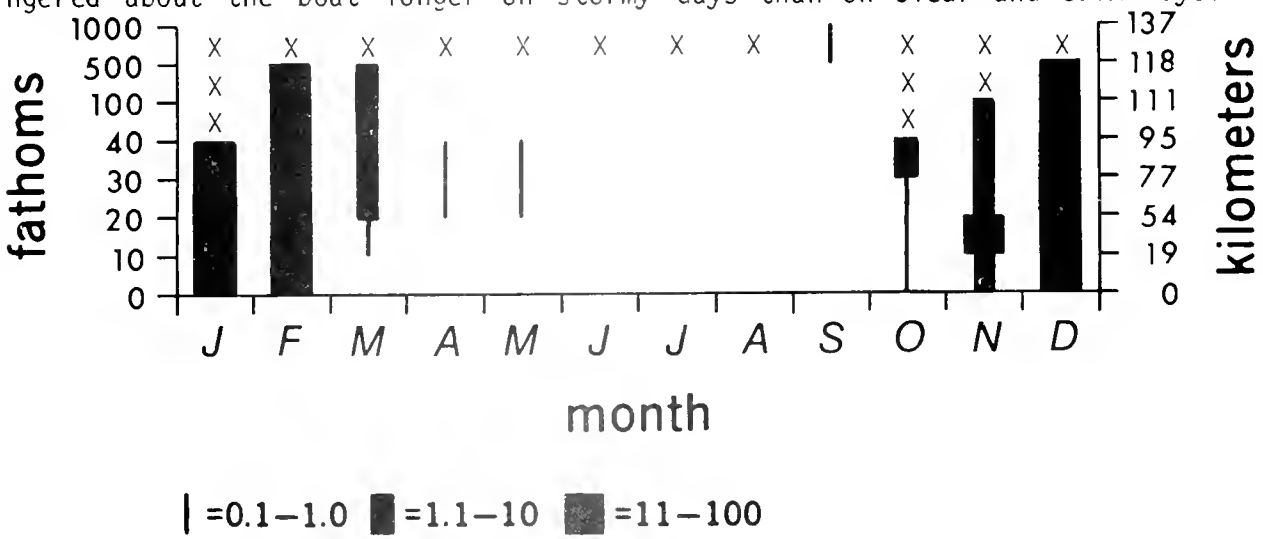


Figure 28. Seasonal abundance and seaward distribution patterns of the black-legged kittiwakes in the northern Chesapeake Bight, 1971-1977.

Table 4. Numbers of black-legged kittiwakes counted and hours of observation in the northern Chesapeake Bight, 1971-1977. Numbers for each age class (based on plumage characteristics) are listed for each month. Subadults are combined with adults.

Month	(Hours of Observation)	Age		
		Adult*[a]	Tarrock*[b]	Total
January	31.0	275	189	464
February	117.0	1,732	2,029	3,761
March	54.5	32	54	86
April	78.5	4	2	6
May	57.5	2		2
June	40.5			0
July	36.5			0
August	230.0			0
September	68.0		1	1
October	9.5	1	7	8
November	24.0	101	108	209
December	37.0	985	1,160	2,145

[a] Adults (3 or more years old--Dwight 1925) represent less than 10% of the birds in this age group.

[b] Tarrocks are birds in first winter plumage.

SABINE'S GULL (Xema sabini)

Status.--Casual spring and fall transient over the Continental Shelf.

Records.--1 offshore record of an ad, 120 km ESE Ocean City (38°09'N, 73°45'W), 9 May 1976 (Rowlett 1976b). On shore records in Maryland on 28 May 1973 (DuMont 1976), 21 May 1976 (Carlson 1976), and 8 September 1977 (Scott 1978) support the probable status. These represent the only Sabine's gull records for the northern Chesapeake Bight.

FORSTER'S TERN (Sterna forsteri)

Status.--Uncommon to locally common breeding bird along the coast of the Delmarva Peninsula. Uncommon fall migrant over shallow coastal waters usually within 20 km of shore. Rare straggler in winter.

Records.--1, 133 km E Rehoboth Beach (38°41'N, 73°34'W), 13 August 1975; 9, 2-20 km E Ocean City, 19 November 1972; 3, ca 8 km E Ocean City, 12 January 1975.

COMMON TERN (Sterna hirundo)

Status.--Common breeding bird during summer along the coast of the Delmarva Peninsula;most common over shallow coastal waters within 20 km of shore, but occasionally seen offshore to the edge of the Continental Shelf (Fig. 29).

Normal period of occurrence.--Early April to mid-November.

Maximum counts.--260 in 5 h, 2-9 km E Ocean City, 14 May 1972; 110 in 3 h, 2-75 km E Cape Henlopen, Delaware, 11 August 1975.

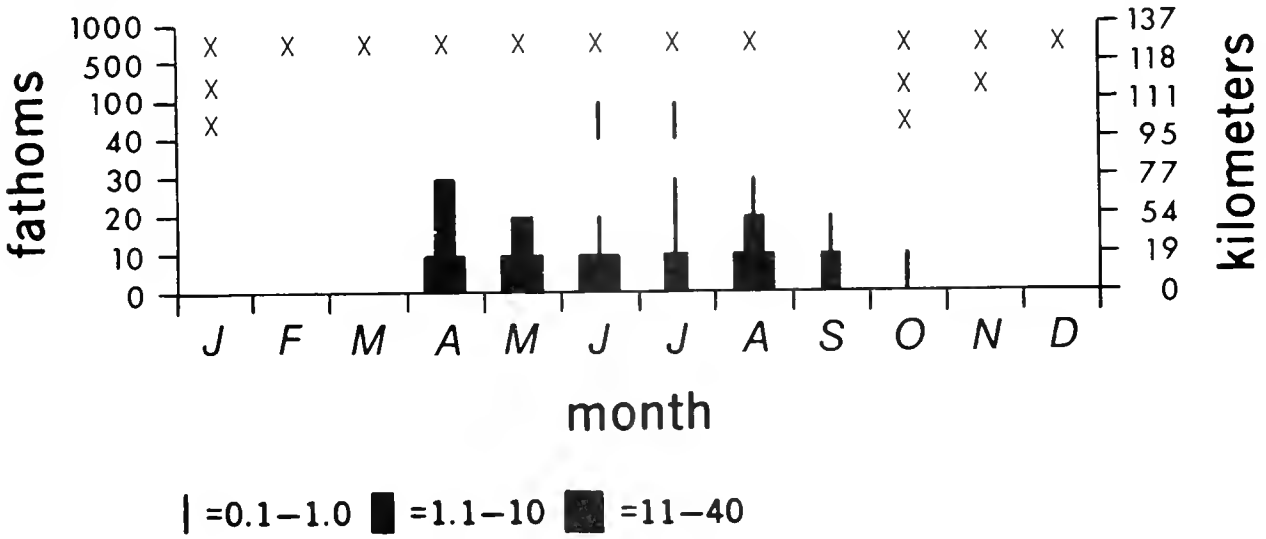


Figure 29. Seasonal abundance and seaward distribution patterns of the common terns in the northern Chesapeake Bight, 1971-1977.

ARCTIC TERN (Sterna paradisaea)

Status.--Rare spring and probably fall transient over the Continental Shelf beyond the 30 fathom contour (ca. 77 km offshore).

Records.--Single birds, 89 km ESE Ocean City (38°11'N, 74°06'W), and 113 km ESE Ocean City (38°10'N, 73°48'W), 16 May 1976 (Rowlett 1976b); 21 mostly near 126 km E Ocean City (38°14'N, 73°40'W), 8 May 1977. Additional offshore sightings include 1 or 2 "10-12 miles off Ocean City" (DuMont and

DuMont 1973a), 12 August 1972, and 2 at "Norfold Canyon, 65 miles east of Norfolk, Va." (Scott and Cutler 1974a), 26 May 1974. Records from shore include 1 at Ocean City, 28 May 1973 (DuMont 1976), and 2 at Cape Henlopen, Delaware, 30 May 1977 (Paxton et al. 1977).

Remarks.--The Arctic tern is a pelagic migrant usually sighted far offshore, and until the early 1970's it was unreported from the mid-Atlantic seaboard.

BRIDLED TERN (Sterna anaethetus)

Status.--Casual late summer visitant over the Continental Shelf when surface water reach maximum temperatures for the year.

Records.--1 sub-adult, 42 km ESE Ocean City (38°15'N, 74°34'W), 26 September 1976 (Rowlett 1977b); 2 sub-adults, 96 km E Hog Island, Virginia over Washington Canyon (37°25'N, 74°25'W), 24 August 1977 (Rowlett in press c).

Remarks.--These are the first records northwest of the Gulf Stream that cannot be attributed to the passage of tropical storms or hurricanes.

LEAST TERN (Sterna albifrons)

Status.--Uncommon to fairly common breeding bird along the coast of the Delmarva Peninsula; forages over shallow coastal waters usually within 20 km of shore (Fig. 30).

Normal period of occurrence.--Late April to mid-September.

Maximum counts.--16 in 5 h, 2-9 km E Ocean City, 14 May 1972; 16 in 2 h, 2-8 km ESE Ocean City, 29 May 1977; 19 in 2 h, 2-10 km ESE Ocean City, 1 June 1975.

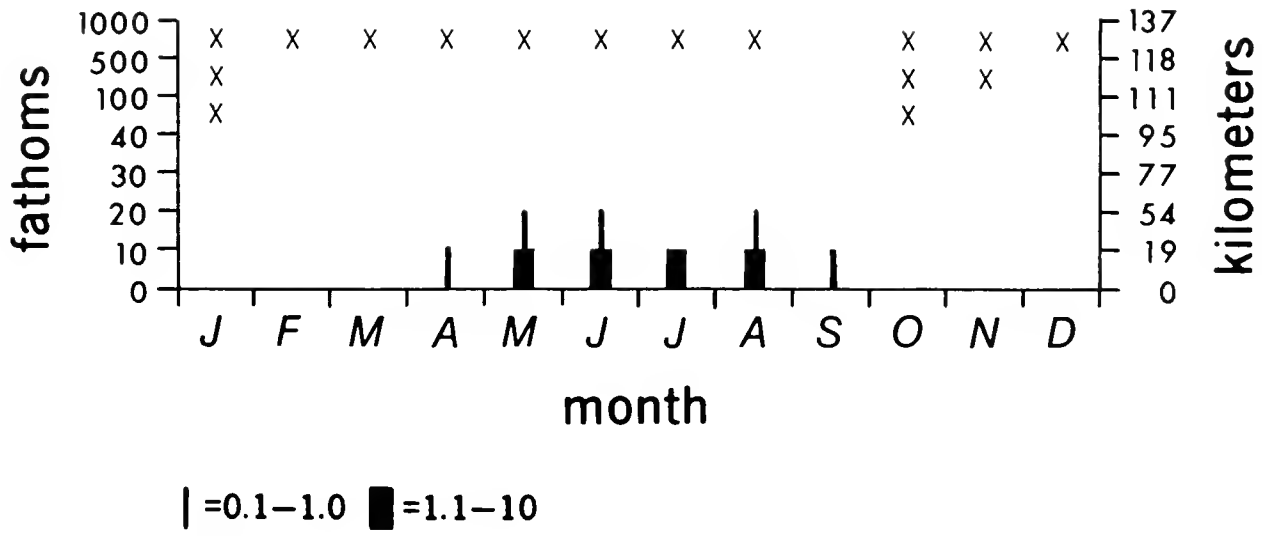


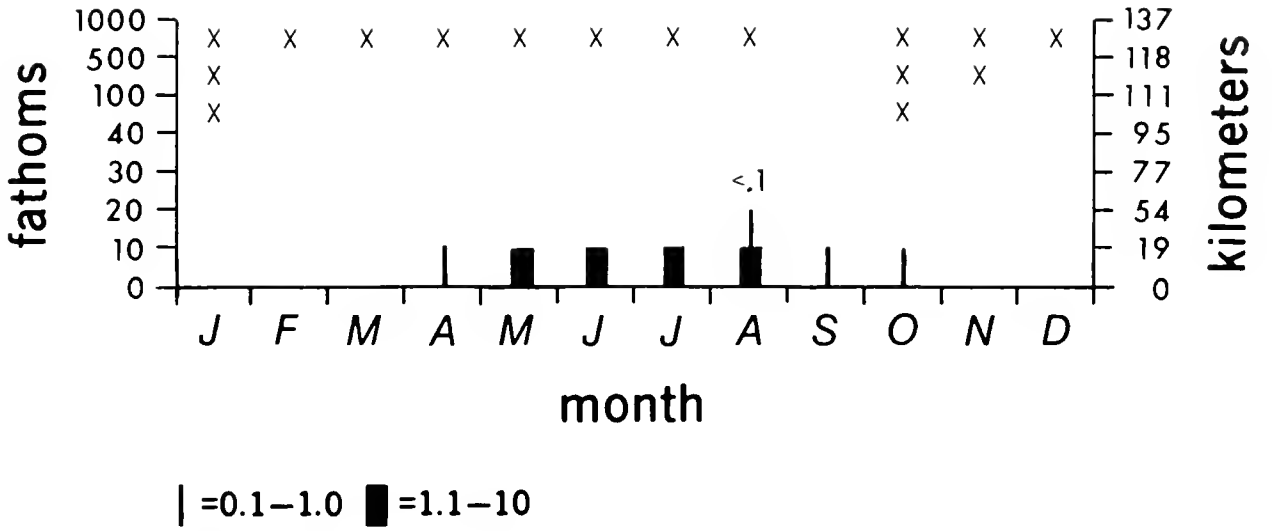
Figure 30. Seasonal abundance and seaward distribution patterns of the least terns in the northern Chesapeake Bight, 1971-1977.

ROYAL TERN (Sterna maxima)

Status.--Uncommon to locally common breeding bird in coastal areas along the Delmarva Peninsula; forages over shallow coastal waters usually within 20 km of shore (Fig. 31).

Normal period of occurrence.--Mid-April to late November.

Maximum counts.--18 in 5 h, 2-9 km E Ocean City, 14 May 1972; 9 in 3 h, 15-22 km ENE Indian River Inlet, Delaware, 11 August 1974; 12 in 1.5 h, 2-20 km, ESE Ocean City, 7 September 1975.



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MEAN NUMBER OF INDIVIDUALS OBSERVED PER HOUR

X = ZONE NOT SAMPLED IN THIS MONTH

Figure 31. Seasonal abundance and seaward distribution patterns of the royal terns in the northern Chesapeake Bight, 1971-1977.

SANDWICH TERN (Sterna sandvicensis)

Status.--Rare breeding bird in coastal areas of Maryland and Virginia (Weske et al. in press).

Records.--2, 9 km E Ocean City, 14 May 1972 (Rowlett 1973a).

Remarks.--The sandwich tern usually forages over shallow coastal waters off North Carolina where the species is common. Late summer occurrence of post-breeding wanderers at the northern Chesapeake Bight is likely.

CASPIAN TERN (Sterna caspia)

Status.--Uncommon to fairly common spring and fall transient along coast, rarely ranging offshore beyond sight of land; a rare breeding bird along the Virginia coast (Weske et al. in press).

Normal period of occurrence.--Mid-April to early November.

Records.--5, 2-5 km E Ocean City, 19 October 1974.

BLACK TERN (Chlidonias niger)

Status.--Transient, probably rare in spring and uncommon in fall, over Continental Shelf.

Normal period of occurence.--SPRING: early to late May. FALL: early July to late September.

Records.--17 in 2 h, 2-50 km E and SE Ocean City, 23 August 1977; 1, 2 km E Ocean City, 24 August 1977.

RAZORBILL (Alca torda)

Status.--Uncommon winter visitant, generally ranging offshore to the 30 fathom contour (Fig. 32).

Earliest winter record.--23 December 1972 (Stewart and Robbins (1958) report a 4 December 1926 sighting.)

Latest winter record.--25 March 1973.

Maximum counts.--28 in 7 h, 9-39 km SE Ocean City, 16 January 1977; 53 in 4 h, 18-35 km ENE Ocean City, 12 Febuary 1977; 8 in 2 h, 22-28 km ESE Ocean City, 25 March 1973.

Remarks.--Occasionally, large numbers of alcids migrate southward in winter to shelf waters along the eastern North American coast. The record numbers of razorbills off Maryland in January - February 1977 may have been associated with a mass southward movement along the New England coast reported by Vickery (1977) for the winter of 1976-1977. Except for early 1977, razorbills in the northern Chesapeake Bight were solitary or in groups up to three. They were seldom associated with other seabirds. Razorbills, like most alcids, usually dive rather than fly away from a boat. This habit undoubtedly resulted in many individuals being overlooked. On 12 February 1977, linear groups of 3-10 were observed on the water, perpendicular to the boat's approach. When we approached to about 15 m, all birds dove at once. Razorbills generally showed no interest in chum.

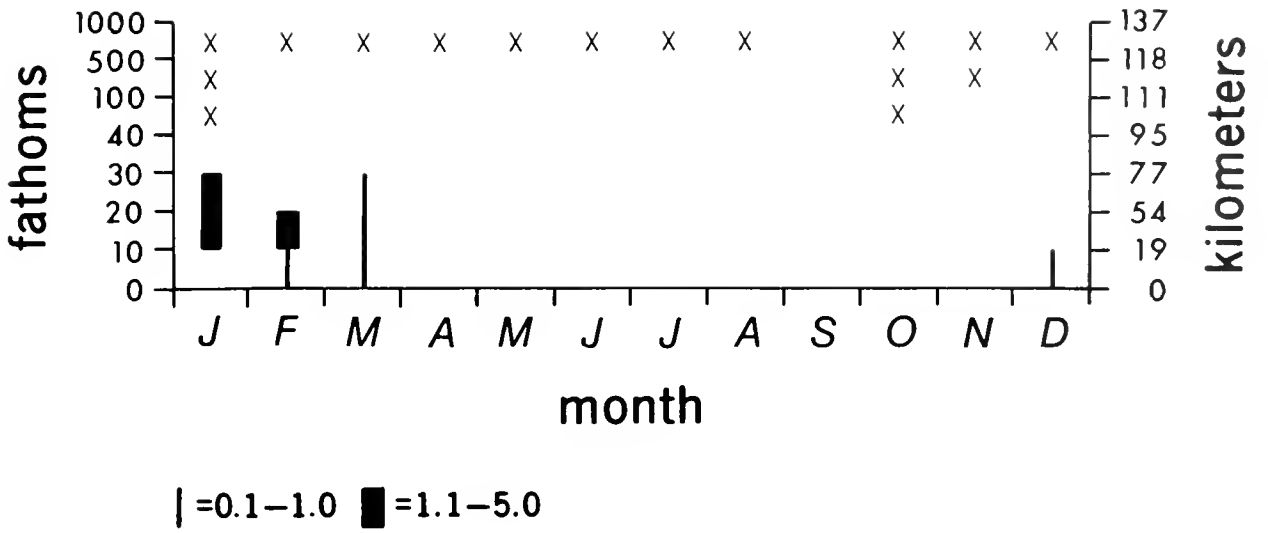

Figure 32. Seasonal abundance and seaward distribution patterns of the razorbills in the northern Chesapeake Bight, 1971-1977.

COMMON MURRE (Uria aalge)

Status.--Rare winter visitant in coastal waters inshore of the 20 fathom contour.

Records.--1 in the Ocean City Inlet (38°20'N, 75°06'W), 29 December 1976; 2 at "Jackspot," a shoal fished by sports fishing headboats, 35 km SE Ocean City (38°05'N, 74°46'W), 16 January 1977 (first records for Maryland--Rowlett 1978); 1, ca 31 km E Hog Island (37°20'N, 75°20'W), Virginia, 9 February 1976 (Philip B. Stanton).

THICK-BILLED MURRE (Uria lomvia)

Status.--Probably rare and irregular winter visitant over shallow waters inshore from the 30 fathom contour.

Records.--1, 70 km ENE Ocean City (38°25'N, 74°24'W), 3 March 1973 (Rowlett 1973b); 1 photographed in the surf, 6 km S Ocean City Inlet (38°16'N, 75°08'N), along Assateague Island, 9 January 1977 (Rowlett 1978).

Remarks.--A massive southward migration of thick-billed murres was observed along the New England coast during the winter of 1976 - 1977 (Vickery 1977). Apparently, the southward advance stopped along the "Cape Cod Front," the leading edge of cold water that flows southward from the Bay of Fundy,

along the Cape Cod Peninsula and over Georges Bank. Most previous records in coastal areas resulted from strong northeast storms.

DOVEKIE (Alle alle)

Status.--Uncommon winter visitant over most of the Continental Shelf from mid-November to mid-March (Fig. 33).

Earliest winter record.--6 December 1975.

Latest winter record.--20 March 1976.

Maximum counts.--73 in 5.5 h, 55-110 km SE Ocean City, 6 December 1975; 51 in 5 h, 88-116 km ENE Ocean City, 1 February 1976.

Remarks.--Like other alcids, dovekies occasionally have large southward flights into shelf waters off the mid-Atlantic States. These flights may be interrupted by coastal storms and strong onshore winds, blowing birds inland where they are reported as "wrecks"--the source of most previous records from the mid-Atlantic coast. The largest flight of dovekies ever observed in the area was in late January 1949, when "thousands were reported 10-15 miles offshore from Ocean City" (Stewart and Robbins 1958).

Undoubtedly, more dovekies were present during the winter transects than my records indicate, but owing to their small size and reluctance to fly, many were undoubtedly overlooked.

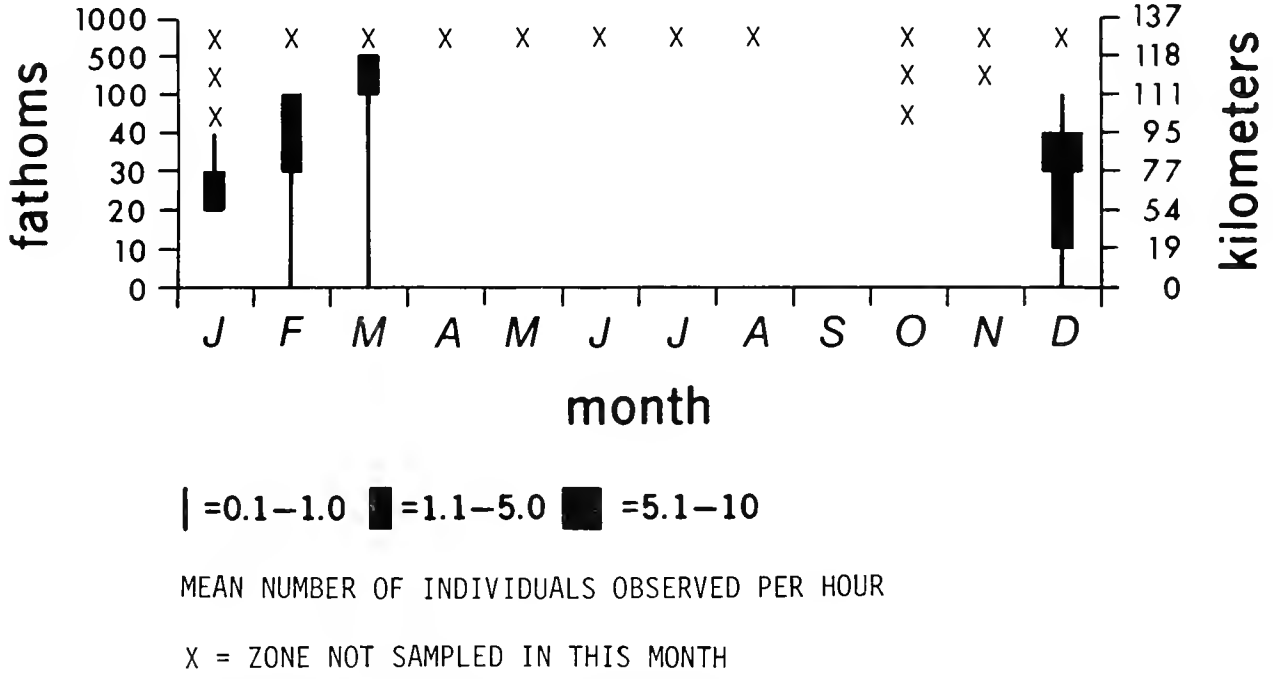

Figure 33. Seasonal abundance and seaward distribution patterns of the dovekies in the northern Chesapeake Bight, 1971-1977.

COMMON PUFFIN (Fratercula arctica)

Status.--Probably uncommon winter visitant to waters over the outer Continental Shelf and slope beyond the 30 fathom contour (ca 77 km offshore, Fig. 34).

Records.--53 individuals sighted between 1 February and 16 March.

Maximum counts.--16 in 1.5 h, in vicinity of Baltimore Canyon, 111 km ESE Ocean City, 2 February 1975; 7 in 2.5 h, 94-113 km ENE Ocean City, 16 March 1975.

Remarks.--The occurrence of the common puffin in the northern Chesapeake Bight was first reported by Rowlett (1975). Most were singles or pairs and were seldom observed in flight. Puffins prefer to dive when approached by a boat. Their reluctance to fly leads me to suspect that puffins reach the latitudes of the Chesapeake Bight by drifting with surface currents, which generally flow southward over the Continental Shelf at speeds of 7 - 18 km per day. Common puffins are present in these waters during the latter half of the winter, when surface water temperatures are the lowest in the year.

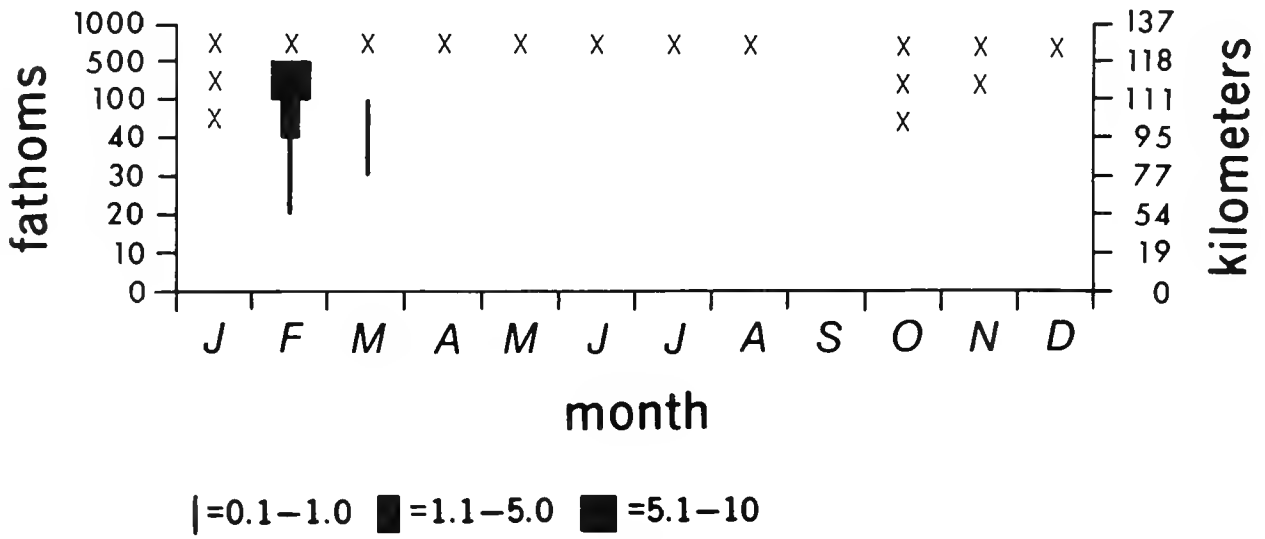

Figure 34. Seasonal abundance and seaward distribution patterns of the common puffin in the northern Chesapeake Bight, 1971-1977.

Additional species

The following list contains seven additional species, generally pelagic, which were reported by other observers at sea or on shore in the northern Chesapeake Bight.

BLACK-BROWNED ALBATROSS (Diomedia melanophris)

Status.--Hypothetical in the northern Chesapeake Bight; vagrant (accidental) in the North Atlantic.

Records.--"An ad and imm black-browed albatross were carefully observed flying together off Cape May Point (New Jersey) October 7, 1974 (Scott and Cutler 1975).

Remarks.--A vagrant from the Southern Hemisphere in the north, this species is most often seen in the northeast Atlantic (Bourne 1967). McDaniel (1973) reported three sightings in the northwestern Atlantic since 1935. There have been a few additional, unsubstantiated reports since then. All documented albatross sightings off the U.S. Atlantic coast have been yellow-nosed albatrosses.

WHITE-FACED STORM PETREL (Pelagodroma marina)

Status.--Probably a casual late summer and fall vagrant over the Continental Shelf.

Records.--1 recorded "20 miles" E Rehoboth Beach, Delaware, 26 August 1972 (Barnhill and DuMont 1973).

Remarks.--Several mid- and late summer records in the western North Atlantic suggest post-breeding wandering in small numbers from breeding areas in the mid-eastern Atlantic (Palmer 1962, Buckley and Winston 1970).

WHITE-TAILED TROPICBIRD (Phaethon lepturus)

Status.--Probably a casual late summer and early fall vagrant over warm slope waters and eddies of the Gulf Stream along the edge of the Continental Shelf.

Records.--Philip B. Stanton (personal communication) observed an adult approximately 120 km E Chesapeake Bay Bridge-Tunnel (ca 37°00'N, 74°37'W), Virginia, on 24 September 1975. Butcher et al. (1968) listed several records of tropicbirds seen over deep water north to 40°N, between 68°W and the Continental Slope. Although these locations are east of my survey area, the presence of tropicbirds at these latitudes is worthy of mention.

BROWN BOOBY (Sula leucogaster)

Status.--Probably a casual post-breeding vagrant to the northern Chesapeake Bight in late summer and early fall.

Records.--1 imm seen from shore at Chincoteague, Accomac Co., Virginia, 30 September 1972 (DuMont and DuMont 1973b).

MAGNIFICENT FRIGATEBIRD (Fregata magnificens)

Status.--Vagrant, casual in spring, summer, and fall.

Records.--Jim Farlow and William Bunting (personal communication) described a frigatebird at Washington Canyon (ca 37°26'N, 74°27'W) during a summer in the early 1970's. Sightings from shore were recorded at Hog Island, near Wachapreague, Virginia, 14 July 1972 (Scott and Cutler 1973a); 1 ad male near Ocean City, Maryland, 14 April 1976 (Dale Brown personal communication); 1 imm male (USNM 567754) at Chincoteague, Virginia, 14 - 17 May 1976 (Scott 1976).

ROSEATE TERN (Sterna dougallii)

Status.--Probably rare transient spring and fall. Formerly bred in small numbers on barrier islands along the Delmarva Peninsula (Murray 1952, Stewart and Robbins 1958).

Records.--5 recorded 12-15 km off Ocean City, 12 August 1972 (DuMont and DuMont 1973a).

Remarks.--Watson (1966) noted that roseate and Arctic terns occur further offshore over deeper, clearer water than other black-capped maritime terns. Widely scattered sightings from shore in the northern Chesapeake Bight indicate that small numbers pass near shore in spring and fall, usually among flocks of common terns.

SOOTY TERN (Sterna fuscata)

Status.--Casual vagrant in summer and early fall, most frequently seen after tropical storms and hurricanes.

Records.--1 report at sea of a "probable adult, a few miles off Ocean City," on 11 August 1977 (Scott 1978). Sightings from shore include; 1 ad at Fishermans Island, Virginia, 17 July 1971 (Ake 1971b); 2 imm at Fishermans Island following hurricane "Doria," 28 August 1971 (Grant 1971); 1 ad at Cape May, New Jersey, following hurricane "Agnes," 23-24 June 1972 (Scott and Cutler 1972); 1 ad on Assateague Island, Maryland, following tropical storm "Carrie" (DuMont and DuMont 1973b); and 1 ad found dead near a common tern colony south of Rehoboth Beach, Delaware, 26 June 1978 (Maurice Barnhill personal communication).

MARINE MAMMALS

Eleven species (90 sightings) of marine mammals were recorded in the northern Chesapeake Bight during 784 h of observations from 1971 - 1977.

None were recorded before April 1974, however, probably because trips were of short duration and never beyond the 20 fathom contour. All sightings are summarized in Table 5.

STRIPED DOLPHIN (Stenella coeruleoalba)

Status.--Uncertain; probably uncommon in late summer and fall.

Records.--1 sighting of 12 and another of 6-10, ca 124 km SE Ocean City (38°02'N, 73°43'W abd 38°00'N, 73°43'W), 26 September 1976 (Fig. 35).

Remarks.--Striped dolphins in both groups were adults (ca 2 m in length) and were in mixed pods with Grampus griseus.

The distribution of S. coeruleoalba in the northern Chesapeake Bight is probably within warm slope and Gulf Stream water along the edge and seaward of the Continental Shelf.

SPOTTED DOLPHIN (Stenella plagiodon)

Status.--Uncertain; probably uncommon in late summer and early fall.

Records.--Pod of 12, 76 km ENE Ocean City (38°23'N, 74°14'W), 8 August 1974; pod of 125, 80 km ESE Ocean City (38°11'N, 74°12'W), 26 September 1976 (Fig. 35).

Remarks.--All individuals seen on 8 August 1974 were adults (2-2.5 m in length). Approximately 50 of the 125 seen on 26 September 1976 were young (1-2 m long) which were not spotted, and superficially resembled Tursiops truncatus.

The normal distribution of S. plagiodon is within continental waters of the tropical and warm temperate western North Atlantic, especially south of Cape Hatteras (Leatherwood et al. 1976). Their occurrence in the northern Chesapeake Bight is most probable during summer and early fall when water surface temperatures are high and slope and Gulf Stream waters spread over the Continental Shelf. Several commercial fishermen and captains of sports fishing boats have reported dolphins with "speckles" off Ocean City in late summer; these were probably S. plagiodon.

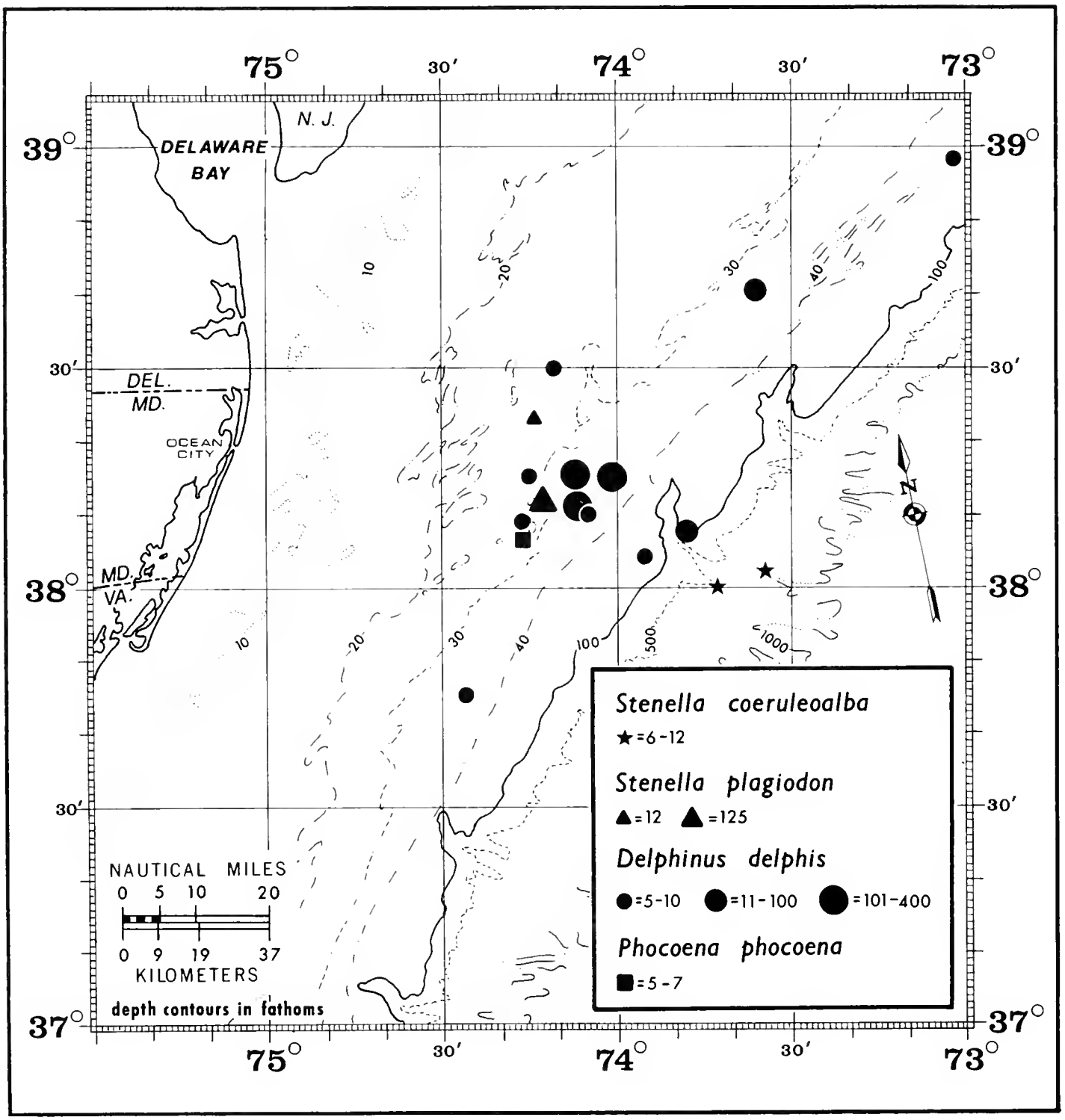

Figure 35. Sightings of striped dolphins (Stenella coeruleoalba), spotted dolphins (Stenella plagiodon), saddleback dolphins (Delphinus delphis), and harbor porpoises (Phocoena phocoena) in the northern Chesapeake Bight, 1971-1977 (see Table 5 for dates).

ATLANTIC BOTTLENOSED DOLPHIN (Tursiops truncatus)

Status.--Fairly common in spring, summer, and fall.

Records.--10 pods recorded between 8 May and 18 September along the edge of the Continental Shelf. No nearshore sightings were recorded on cruises, although the species was observed often from shore from May -October (Fig. 37).

Remarks.--The average pod of T. truncatus seen along the edge of the Continental Shelf contained 20 individuals. Although sightings from shore were not recorded, those pods ranged in size from 20-30 individuals.

The Atlantic bottlenosed dolphin ranges in the western North Atlantic from New England to Florida. My observations suggest that two distinct populations may exist. Those seen along the edge of the Continental Shelf tend to possess slightly shorter snouts, taller, more falcate dorsal fins, and brighter pigmentation (yellowish-tan to yellowish-gray) than do the more uniform gray animals seen from shore.

SHORT FINNED PILOT WHALE (Globicephala macrorhynchus)

Status.--Uncertain; probably uncommon in late summer and fall.

Records.--22, 120 km ESE Ocean City (38°06'N, 73°45'W), 18 September 1977 (Fig. 36).

Remarks.--The distribution of the short finned pilot whale in the western North Atlantic is in warm waters, chiefly south of Cape Hatteras, although they range north to Virginia in summer (Leatherwood et al. 1976).

HARBOR PORPOISE (Phocoena phocoena)

Status.--Uncertain; probably rare in winter and early spring.

Records.--5-7 observed surfing in the wake of a small charter boat in close proximity to 3-6 fin whales, 75 km ESE Ocean City (38°08'N, 74°16'W), 23 April 1977 (Fig. 35).

Remarks.--The 1977 record off Maryland coincided with a major southward movement of harbor porpoises; at least 60 were stranded along the North Carolina coast from January - May (James G. Mead personal communication). Harbor porpoises are usually restricted to cold, shallow inshore waters of harbors and bays; thus the deep water sighting was unusual.

MINKE WHALE (Balaenoptera acutorostrata)

Status.--Uncertain.

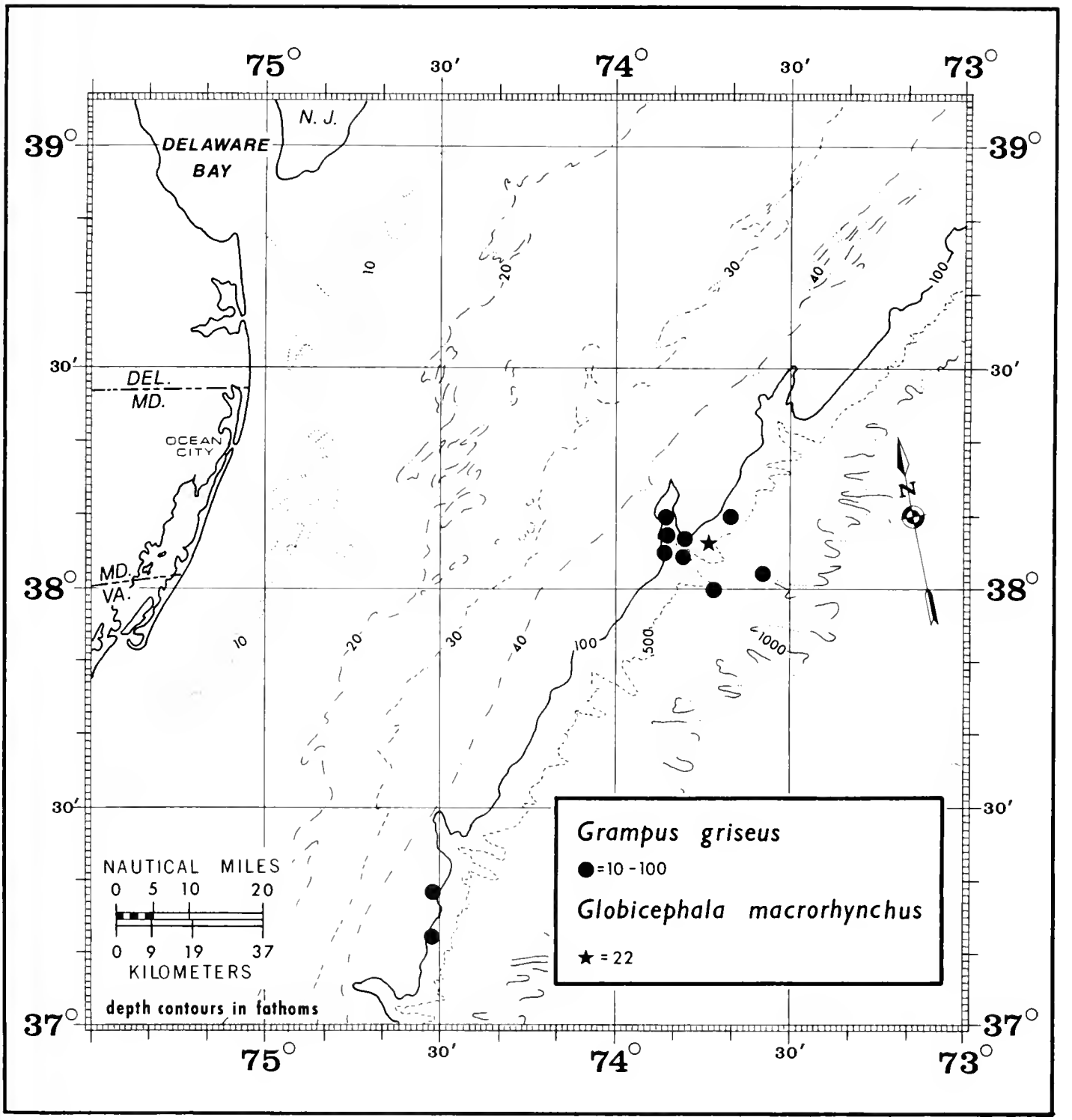

Figure 36. Sightings of grampus (Grampus griseus) and shortfinned pilot whales (Globicephala macrorhynchus) in the northern Chesapeake Bight, 1971-1977 (see Table 5 for dates).

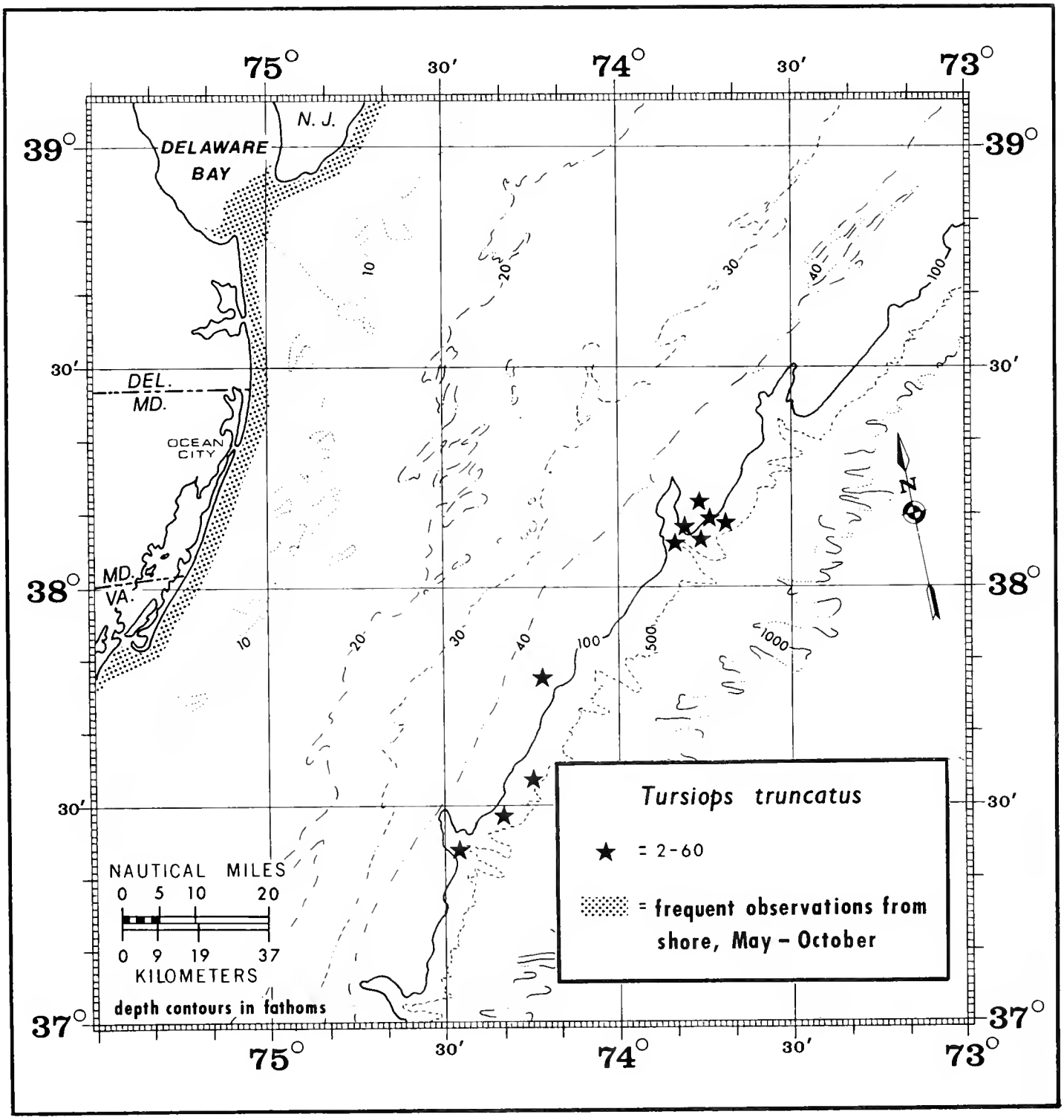

Figure 37. Sightings of Atlantic bottlenosed dolphins (Tursiops truncatus) in the northern Chesapeake Bight, 1971-1977 (see Table 5 for dates).

Records.--1 seen on the outer fringe of a pod of 20 fin whales, 94 km ESE Ocean City (38°15'N, 74°00'W), 1 June 1975.

Minke whales occur throughout the western North Atlantic, but appear to be most numerous north of latitudes 40°N from May to October (Leatherwood et al. 1976).

SEI WHALE (Balaenoptera borealis)

Status.--Uncertain.

Records.--1, 74 km ESE Ocean City (38°12'N, 74°15'W), 15 August 1976.

Remarks.--This whale was seen repeatedly at 100-300 m over a period of about 20 min, and was compared directly to several fin whales in the vicinity at the same time.

Little information is available on the distribution of sei whales in the western North Atlantic (Leatherwood et al. 1976).

FIN WHALE (Balaenoptera physalus)

Status.--Uncommon resident, becoming locally common in spring (mid-April to early June) when Boston mackerel are migrating north.

Records.--24 positive and 14 probable sightings from 1974 - 1977 (Table 5; Fig. 38).

Remarks.--The average pod of fin whales contained 3 - 5 individuals; however, pods numbering 20-40 were seen each spring, 1974-1977, near 38° 15'N between the 30 and 40 fathom contours. Associated with these whales on 9 and 16 May 1976, and 8 May 1977, were 300-400 saddleback dolphins.

Fin whales with calves (5.5 - 9 m in length) were often noted during the spring.

Fin whales are probably the most numerous and widely distributed large species in the western North Atlantic (Leatherwood et al. 1976).

CALIFORNIA SEA LION (Zalophus californicus)

Status.--Exotic

Records.--1 photographed as it rested on the No. 5 buoy outside the Ocean City Inlet (38°20'N, 75°06,W) on 1 June 1975.

Remarks.--According to James G. Mead (Personal communication), several Z. californicus were reported to have escaped from a marine aquarium in Atlantic City, New Jersey, in the early 1970's.

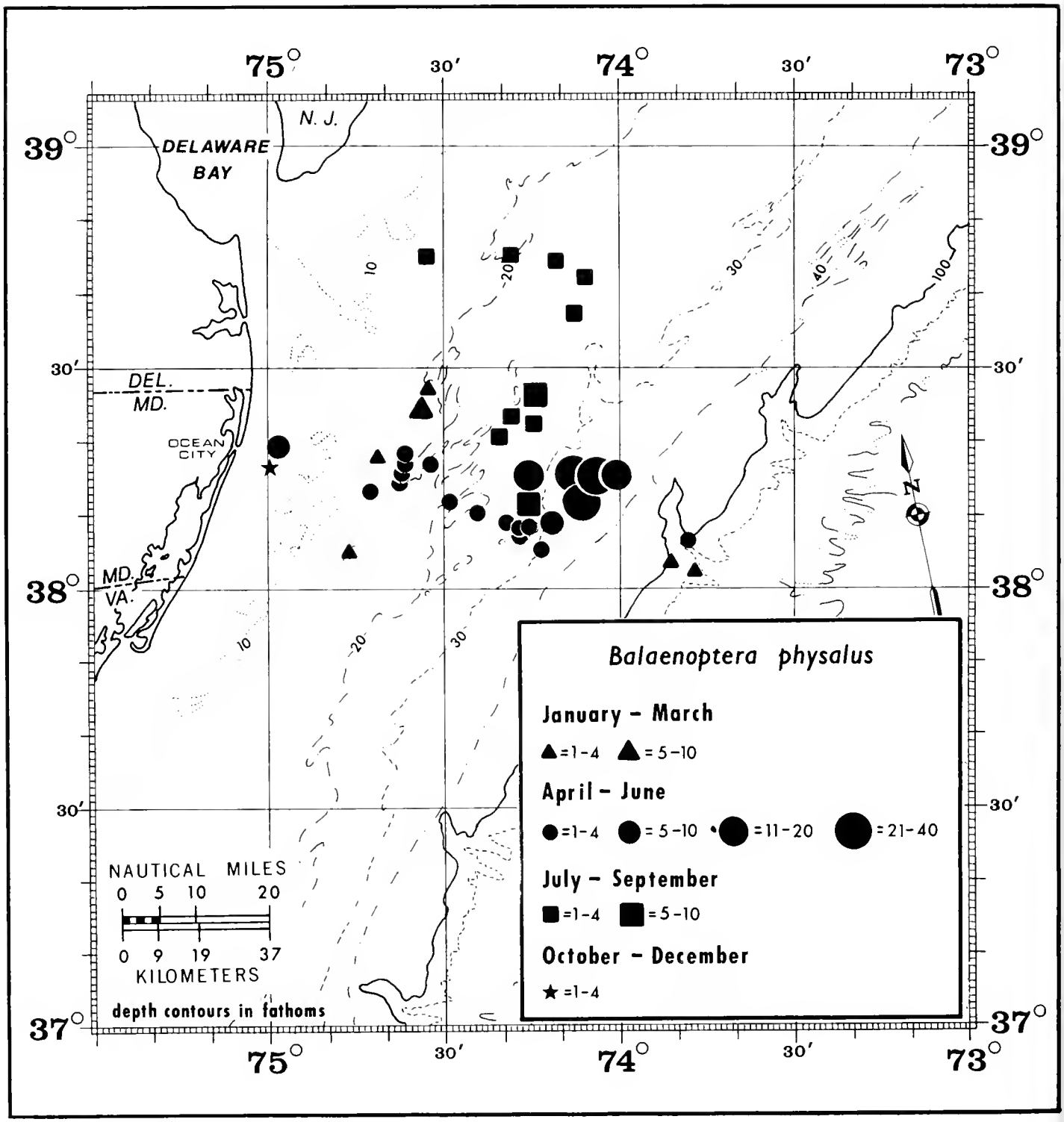

Figure 38. Positive and probable sightings of fin whales (Balaenoptera physalus) in the northern Chesapeake Bight, 1971-1977 (see Table 5 for dates).

Table 5. Summary of marine mammal sightings recorded over the Continental Shelf and Slope in the northern Chesapeake Bight between latitudes 37°N and 39°N from 1971-1977.

Species	Date	Position	Number	Associated With
CETACEA				
Stenella coeruleoalba	26 Sep 1976	38°02'N, 73°34'W	12	30 G. griseus
Stenella coeruleoalba	26 Sep 1976	38°00'N, 73°43'W	6-10	15 G. griseus
Stenella plagiodon	8 Aug 1974	38°23'N, 74°14'W	12	
Stenella plagiodon	26 Sep 1976	38°11'N, 74°12'W	125	
Delphinus delphis[a]	27 Apr 1974	38°10'N, 74°05'W	5	
Delphinus delphis[a]	27 Apr 1974	38°15'N, 74°15'W	20	10-20 B. physalus
Delphinus delphis	6 Feb 1975	37°45'N, 74°26'W	7	
Delphinus delphis	27 Apr 1975	38°30'N, 74°10'W	2-6	
Delphinus delphis	9 May 1976	38°04'N, 73°55'W	10	
Delphinus delphis	9 May 1976	38°08"N, 73°48"W	40	
Delphinus delphis	9 May 1976	38°15'N, 74°01'W	300	30 B. physalus
Delphinus delphis[a]	16 May 1976	38°11'N, 74°06'W	300	30 B. physalus
Delphinus delphis	5 Feb 1977	38°40'N, 73°36'W	40	
Delphinus delphis	5 Feb 1977	38°58'N, 72°59'W	6-10	

Table 5 (Continued)

Species	Date	Position	Number	Associated With
Delphinus delphis	30 Apr 1977	38°09'N, 74°16'W	8	1 B. physalus
Delphinus delphis[a]	8 May 1977	38°15'N, 74°07'W	300-400	40 B. physalus
Grampus griseus[a]	9 May 1976	38°08'N, 73°48'W	85	30 T. truncatus
Grampus griseus[a]	16 May 1976	38°09'N, 73°51'W	65	
Grampus griseus[a]	16 May 1976	39°07'N, 73°48'W	35	
Grampus griseus	10 Jun 1976	37°12'N, 74°32'W	100	
Grampus griseus	26 Sep 1976	38°05'N, 73°40'W	10-15	
Grampus griseus[a]	26 Sep 1976	38°02'N, 73°34'W	30	12 S. coeruleoalba
Grampus griseus	26 Sep 1976	30°00'N, 73°43'W	15	6-10 S. coeruleoalba
Grampus griseus[a]	4 Dec 1976	38°05'N, 73°50'W	30	
Grampus griseus[a]	30 Apr 1977	38°08'N, 73°51'W	65	
Grampus griseus	4 Jul 1977	37°18'N, 74°32'W	10	
Tursiops truncatus[a]	9 May 1976	38°08'N, 73°48'W	30	85 G. griseus
Tursiops truncatus[a]	16 May 1976	38°09'N, 73°42'W	14	
Tursiops truncatus[a]	8 May 1977	38°06'N, 73°49'W	20	
Tursiops truncatus	8 May 1977	38°11'N, 73°45'W	15	
Tursiops truncatus[a]	29 May 1977	38°09'N, 73°44'W	10	
Tursiops truncatus	3 Jul 1977	37°47'N, 74°13'W	6	

Table 5 (Continued)

Species	Date	Position	Number	Associated With
Tursiops truncatus	3 Jul 1977	37°33'N, 74°14'W	2	
Tursiops truncatus	3 Jul 1977	37°28'N, 74°20'W	60	
Tursiops truncatus	4 Jul 1977	37°23'N, 74°28'W	20	
Tursiops truncatus[a]	18 Sep 1977	38°07'N, 73°47'W	10	
Globicephala macrorhychus[a]	18 Sep 1977	38°06'N, 73°45'W	22	10 T. truncatus
Phocoena phocoena[b]	23 Apr 1977	38°08'N, 74°16'W	5-7	3-6 B. physalus
Balaenoptera acutorostrata[b]	1 Jul 1975	38°15'N, 74°00'W	1	20 B. physalus
Balaenoptera borealis[b]	15 Aug 1976	38°12'N, 74°15'W	1	5-7 B. physalus
Balaenoptera physalus[a]	27 Apr 1974	38°19'N, 74°59'W	5	
Balaenoptera physalus	27 Apr 1974	38°17'N, 74°32'W	1	
Balaenoptera physalus[a]	27 Apr 1974	38°15'N, 74°15'W	10-20	20 D. delphis
Balaenoptera physalus[c]	8 Aug 1974	38°23'N, 74°18'W	1-2	
Balaenoptera physalus[c]	9 Aug 1974	38°22'N, 74°14'W	2	
Balaenoptera physalus[c]	10 Aug 1974	38°20'N, 74°20'W	1-3	
Balaenoptera physalus[c]	13 Aug 1974	38°44'N, 74°10'W	1-2	
Balaenoptera physalus	13 Aug 1974	38°42'N, 74°05'W	2-4	
Balaenoptera physalus[c]	13 Aug 1974	38°38'N, 74°07'W	2	

Table 5 (Continued)

Species	Date	Position	Number	Associated With
Balaenoptera physalus[c]	13 Aug 1974	38°26'N, 74°14'W	6-10	
Balaenoptera physalus[a]	16 Aug 1974	38°45'N, 74°32'W	1	
Balaenoptera physalus	23 Nov 1974	39°18'N, 74°59'W	2	
Balaenoptera physalus[c]	8 Feb 1975	38°18'N, 74°41'W	1	
Balaenoptera physalus	1 Jun 1975	38°15'N, 74°00'W	15-20	1 B. acutorostrata
Balaenoptera physalus[c]	11 Aug 1975	38°45'N, 74°18'W	1	
Balaenoptera physalus[c]	1 Feb 1976	38°27'N, 74°32'W	1	
Balaenoptera physalus[c]	7 Mar 1976	38°02'N, 73°46'W	1	
Balaenoptera physalus[a]	7 Mar 1976	38°03'N, 73°52'W	1-3	
Balaenoptera physalus[c]	20 Mar 1976	38°25'N, 74°33'W	4-6	
Balaenoptera physalus[a]	11 Apr 1976	38°13'N, 74°42'W	4	
Balaenoptera physalus[a]	11 Apr 1976	38°09'N, 74°12'W	6	
Balaenoptera physalus[c]	11 Apr 1976	38°18'N, 74°36'W	4	
Balaenoptera physalus[a]	9 May 1976	38°10'N, 74°24'W	1	
Balaenoptera physalus[a]	9 May 1976	38°15'N, 74°01'W	30	300 D. delphis
Balaenoptera physalus[c]	9 May 1976	38°17'N, 74°35'W	1	
Balaenoptera physalus	16 May 1976	38°07'N, 73°48'W	2	

Table 5 (Continued)

Species	Date	Position	Number	Associated With
Balaenoptera physalus[a]	16 May 1976	38°11'N, 74°06'W	30	300 D. delphis
Balaenoptera physalus	15 Aug 1976	38°12'N, 74°15'W	5-7	1 B. borealis[b]
Balaenoptera physalus	16 Jan 1977	38°05'N, 74°46'W	2-4	
Balaenoptera physalus[a]	23 Apr 1977	38°08'N, 74°16'W	3-6	5-7 P. phocoena[b]
Balaenoptera physalus	24 Apr 1977	38°08'N, 74°16'W	4	
Balaenoptera physalus[a]	30 Apr 1977	30°14'N, 74°38'W	2	
Balaenoptera physalus[a]	30 Apr 1977	38°09'N, 74°19'W	5	
Balaenoptera physalus	30 Apr 1977	38°09'N, 74°16'W	1	8 D. delphis
Balaenoptera physalus[c]	30 Apr 1977	38°15'N, 74°37'W	2	
Balaenoptera physalus[a]	8 May 1977	38°15'N, 74°07'W	30-40	300-400 D. delphis
Balaenoptera physalus[a]	29 May 1977	38°12'N, 74°29'W	3	
Balaenoptera physalus[a]	29 May 1977	38°05'N, 74°13'W	4	
Unidentified whale	9 Aug 1974	38°04'N, 74°29'W	1	
Unidentified whale	13 Aug 1974	38°31'N, 74°12'W	1	
Unidentified whale	14 Aug 1974	38°25'N, 74°06'W	1	
Unidentified whale	16 Aug 1974	38°45'N, 74°32'W	2	
Unidentified whale	26 Sep 1976	38°12'N, 74°15'W	1	

Table 5 (Concluded)

Species	Date	Position	Number	Associated With
Unidentified whale	4 Dec 1976	38°07'N, 73°58'W	6	
Unidentified whale	8 May 1977	38°22'N, 74°50'W	1	
Unidentified whale	3 Dec 1977	38°05'N, 74°27'W	1	
Unidentified dolphin	7 Feb 1975	38°17'N, 74°15'W	10	
Unidentified dolphin	16 Mar 1975	38°22'N, 74°10'W	1	
Unidentified dolphin	5 Feb 1977	38°12'N, 73°45'W	6-8	
PINNIPEDIA				
Zalophus californicus[a]	1 Jun 1974	38°20'N, 75°06'W	1	

[a]Observation documented with photographs; copies on file at USNM.

[b]Large rorquals believed to be *Balaenoptera physalus*.

[c]No photographic documentation.

DISCUSSION

The thoroughness of observations and accuracy of counts on any given day were influenced by an assortment of variables. Overall viewing conditions were influenced by sea and sky conditions (Table 6). Ideal viewing conditions occurred on calm days when the sky was thinly overcast with no reflective solar glare. These conditions allowed 360° of visibility and provided a high contrast of birds against the water. Bright clear days with slightly choppy seas often rendered distant small, dark colored birds such as storm petrels and alcids nearly invisible, but spouts of large whales and pale colored seabirds such as gannets and gulls became more conspicuous. Viewing conditions were poorest on cloudy, rough days when viewing was restricted to the stern of the smaller boats, which were only a few feet above the water line. This resulted in many birds and cetaceans being overlooked.

Trips when several experienced observers were on board yielded better coverage, although the thoroughness was proportional to sea and sky conditions. Generally, the larger the vessel the more complete the coverage due to the advantage of being able to view from a higher level. However, cetaceans were more easily observed and identified from the more maneuverable small charter boats.

The accuracy of marine bird censusing is somewhat questionable because "chum" were dispersed on most trips. When this procedure succeeded in attracting birds to the boat, it thereby created a bias in the sampling. Generally, chumming was most successful during cold weather months (October to May) when herring gulls were the predominant seabird. Continuous chumming while moving during the winter months proved highly successful in obtaining a relatively large sample of birds along seaward transects. Gulls tended to follow longer as the distance from shore increased. In turn, gulls often attracted pelagic species to the boat, including fulmars, shearwaters, gannets, jaegers, and skuas.

The distribution of seabirds was apparently affected by commercial fishing vessels. These included small American fishing trawlers, and clam and scallop draggers, most often encountered along the 30 fathom contour; and the fleet of large foreign trawlers most often observed along the edge of the Continental Shelf at Baltimore Canyon. Foreign trawlers had the greatest effect during the winter months.

Seabird distribution may also be influenced by winds (Tuck 1961, Rowlett 1973b). Strong winds which accompany hurricanes and intense extra-tropical storms temporarily carry some birds well beyond their normal range or usual feeding areas. Southern hemisphere shearwaters migrate northward in spring and pass through the northern Chesapeake Bight rather quickly to reach nutritionally productive waters over the Georges and Grand Banks. Most of these birds probably pass through unnoticed and are usually detected only when an observer along the shore sights a flight which has been blown inshore (Teulings 1972, Buckley 1973).

Table 6. Variables in weather conditions which affected daily observation condition ratings.

Sky	Wind (Knots)[a]	Sea State	Surface Texture	Spray	% of Observations	Ratings
Thin overcast	0	Calm	Slick	None	5 %	Ideal
Clear	0	Calm	Slick	None	5 %	Excellent
Thin overcast	2-5	Calm	Rippled	None	5 %	Very good
Clear	2-5	Calm	Rippled	None	5 %	Good
Clear	6-15	.3-1 m	Choppy	Slight-moderate	30 %	Fair[b]
Overcast	16-25	1-2 m	Rough	Moderate - heavy	10 %	Poor[b]
Overcast	16-25	1-2 m	Rough	Moderate - heavy	10 %	Poorest[b]

[a]1 knot = one nautical mile/hr = 1.852 km/hr

[b]Observations usually restricted to stern or leeward side of small charter boats when vessel was moving along transect, except when sailing with a fallwind.

The distribution of marine birds and cetaceans is undoubtedly related to physical and biotic characteristics of oceans. Unfortunately, most marine biologists and oceanographers do not relate the physical and biotic environment to birds and mammals; and most ornithologists and cetologists are not oceanographers. Also, the relative inconvenience and expense of studying pelagic life limits our understanding of how oceanic factors affect seabird and cetacean abundance and distribution (Ainley 1976). Regardless of the above, Ashmole (1971) Shuntov (1972), and Brown (1976) have presented excellent discussions of the marine environment relative to the ecology of seabirds.

Iselin (1936) classified four regimes of oceanic waters adjacent to the east coast of the United States based on salinity -- coastal or shelf water, slope water, Gulf Stream, and ocean water.

Coastal water, as the name implies, is restricted to areas over the Continental Shelf. It is the least saline because it is subjected to fresh water run-off from the mainland. The greenish appearance on the water is attributed to suspended sediments. Shelf waters are productive feeding areas for non-pelagic seabird species; they were most often seen in these waters.

Slope water is a mixture of Gulf Stream and shelf waters and is usually present from the Continental Slope, to the western margin of the Gulf Stream where it often forms a conspicuous green-blue interface. In the northern Chesapeake Bight, slope water is visible during the summer months, especially from July through September when it often laps over the Continental Shelf, inshore to the 30 fathom contour. It can be easily recognized by its blue color, a characteristic of high salinity.

The Gulf Stream flows northeastward along the edge of the Continental Shelf from the Florida Straits to Cape Hatteras, where it then veers east ward away from the Continental Slope and out over open ocean. The western margin usually passes about 150 km southeast of the edge of the Continental Shelf at Baltimore Canyon, 38°10'N, 73°50'W (Fig. 1). The Gulf Stream is prone to meandering off its central axis, especially north and east of Cape Hatteras late in the summer, and occasionally, eddies spin off and drift northward along the Continental Slope into the northern Chesapeake Bight.

The ocean waters of the Sargasso Sea lie beyond the Gulf Stream and have no significant bearing on the fauna observed in the northern Chesapeake Bight.

The occurrence of warm slope waters and Gulf Stream eddies in late summer coincides with the presence of mats of sargasso weed (Sargassum sp.), Portuguese man-of-war (Physalia sp.), flying fish (Exocoetus sp.), and those seabirds and cetaceans which are usually associated with warm tropical and Gulf Stream water. These include Audubon's shearwaters, black-capped petrels, white-tailed tropicbirds, bridled terns, spotted dolphins(Stenella plagiodon), striped dolphins (S. coeruleoalba),and short finned pilot whales (Globicephala macrorhynchus).

Late summer distribution of the blue slope water over the Shelf in the northern Chesapeake Bight is often spotty, and Maury (1963) noted that it

often occurs in narrow streaks, and shifts from day to day with winds and currents; it may override shelf water and vice versa.

Surface circulation in the North Atlantic is very complex and has been analyzed by Bumpus (1973). Generally, surface circulation through the Chesapeake Bight flows over the Continental Shelf, parallel to the coast line from northeast to southwest. Along the steep Continental Slope, currents may slide off to the east or flow northeastward opposite the inshore current.

The temperature structure of surface water over the Continental Shelf along the eastern North American coast has been colorfully illustrated by Walford and Wicklund (1968). A summary of mean monthly temperatures on the Continental Shelf along the 38°N parallel has been taken from their work and is presented in Table 7. Surface water passes through an annual cooling and warming cycle, reaching its lowest mean temperature in March, and its highest mean temperature in late August in the northern Chesapeake Bight. Generally, the surface temperature gradually warms with increasing distance from shore. Wind and seasonal air temperatures have the most immediate and noticeable effects on shallow coastal waters, while deep offshore waters are more stable due to the tempering influence of the Gulf Stream and slope water.

The phytoplankton component of the microbiotic community in offshore waters south of Cape Cod is little known (Smayda 1973, Bureau of Land Management 1977), but the zooplankton component is fairly well known (Jeffries and Johnson 1973). In general, temperature and salinity have the most pronounced effects on the abundance and distribution of plankton.

Ovchinnikov (1971) noted that plankton often flourished in nearshore regions where less saline coastal waters mix with more saline oceanic waters. One such area may exist along the 30 fathom contour off the coast of Maryland, where numbers of seabirds and cetaceans, notably fin whales and saddleback dolphins, were often gathered. This area is also an important fishing ground used by small commercial American vessels year round and sports fishermen seeking white marlin (Makaira albida) during the summer. Between the 40 and 100 fathom contour, a void often exists in the distribution of birds and cetaceans. Activity usually increases again along the edge of the Continental Shelf and over the canyons. The major canyons in the northern Chesapeake Bight (Wilmington, Baltimore, Washington, and Norfolk (-- see Fig. 1) are gashes in the edge of the Continental Shelf, whose walls are V-shaped in profile, with the bottoms sloping seaward. The steep walls are rocky whereas the gradually sloping shelf is covered with soft sediment. The mixing of southward flowing surface currents over the edge of the Shelf and canyon, with cold, nutrient rich bottom currents, yields areas of high primary productivity. Zooplankton flourishes in these areas and fish, birds, and cetaceans sometimes congregate. These canyon areas were prime fishing grounds for vessels of the foreign fishing fleets before the 200 mile (322 km) territorial fishing limits were imposed in March 1977.

Table 7. Average monthly water surface temperature (°C) at 30' longitudinal increments along the 38°N parallel (from Walford and Wickland 1968).

	Longitude				
Month	75°00'W	74°30'W	74°00'W	73°30'W	x
January	5	7	12	12	9.0
February	5	7	9	11	8.0
March	5	7	8	9	7.3
April	8	9	10	11	9.5
May	13	12	12	13	12.5
June	17	16	17	18	17.0
July	21	23	23	24	22.8
August	23	24	24	25	24.0
September	22	23	23	23	22.8
October	18	19	22	20	19.8
November	14	16	17	18	16.3
December	9	12	13	14	12.0

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APPENDIX

CUMULATIVE TRANSECTS, 1971-1977

Figure 39. Cumulative cruise transects for January, 1971-1977.

Figure 40. Cumulative cruise transects for February, 1971-1977.

Figure 41. Cumulative cruise transects for March, 1971-1977.

Figure 42. Cumulative cruise transects for April, 1971-1977.

Figure 43. Cumulative cruise transects for May, 1971-1977.

Figure 44. Cumulative cruise transects for June, 1971-1977.

Figure 45. Cumulative cruise transects for July, 1971-1977.

Figure 46. Cumulative cruise transects for August, 1971-1977.

Circled star indicates position where the vessel was anchored for seven consecutive days; observations were made during this period.

Figure 47. Cumulative cruise transects for September, 1971-1977.

Figure 48. Cumulative cruise transects for October, 1971-1977.

Figure 49. Cumulative cruise transects for November, 1971-1977.

Figure 50. Cumulative cruise transects for December, 1971-1977.

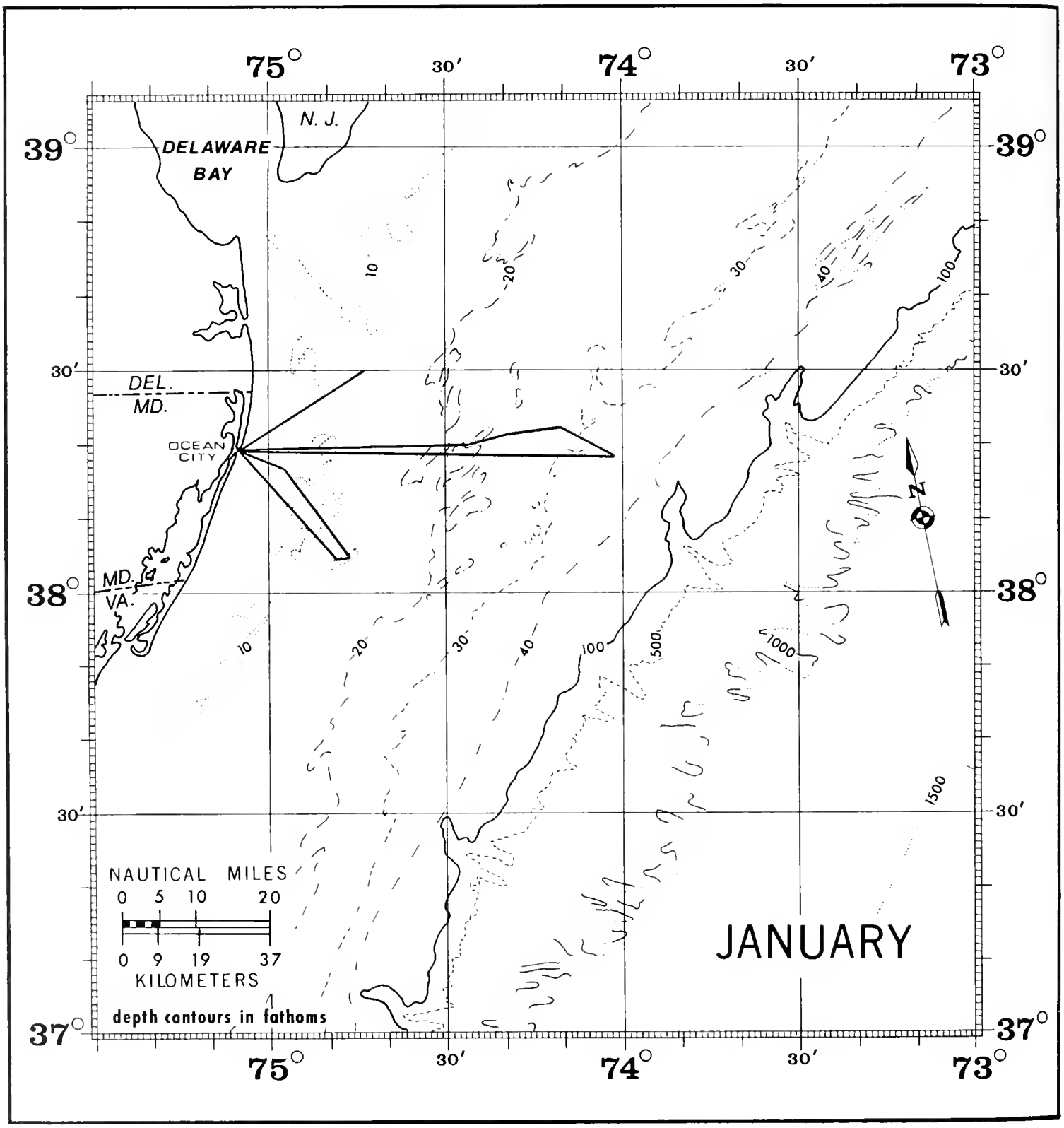

Figure 39. Cumulative cruise transects for January, 1971-1977.

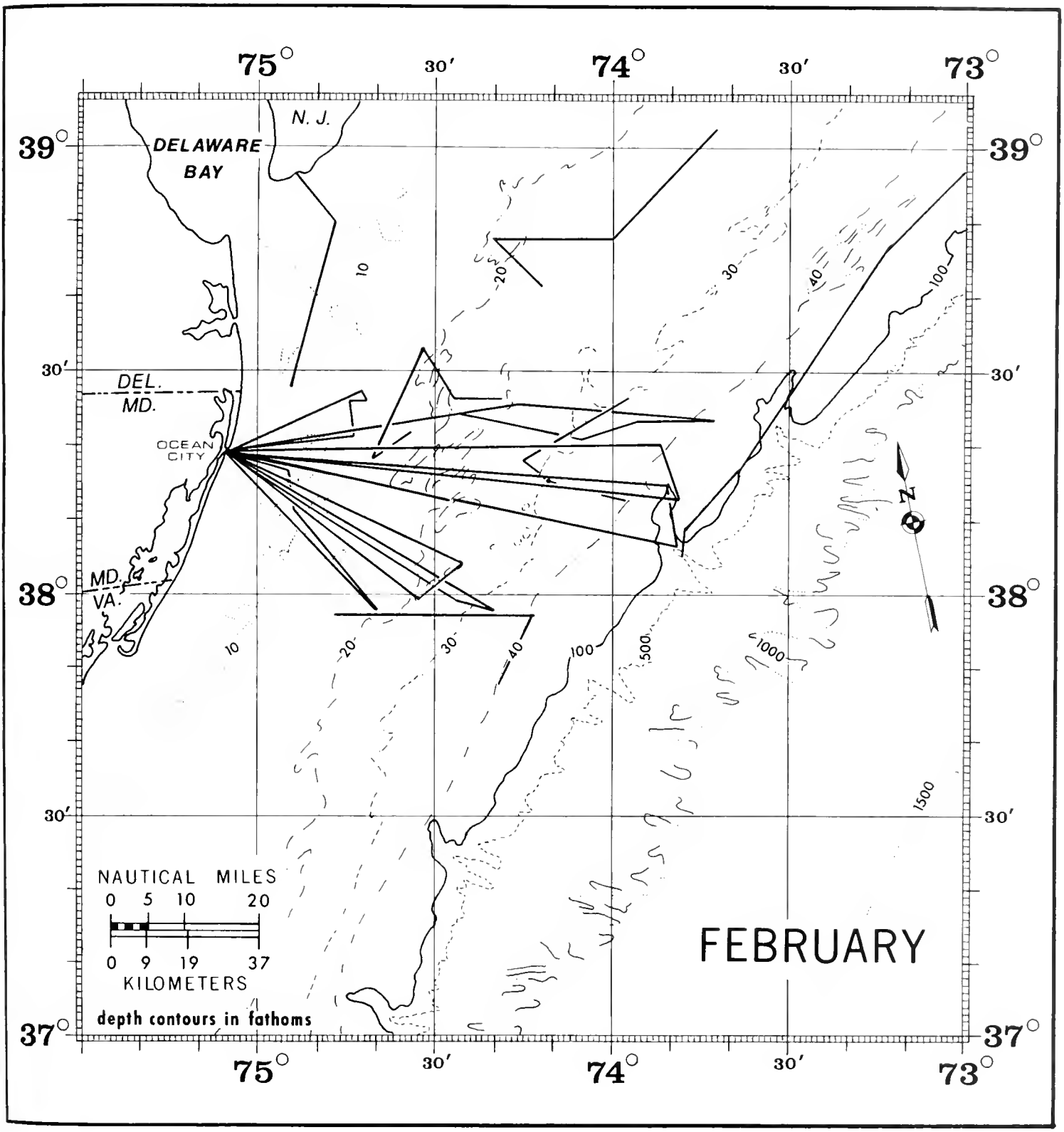

Figure 40. Cumulative cruise transects for February, 1971-1977.

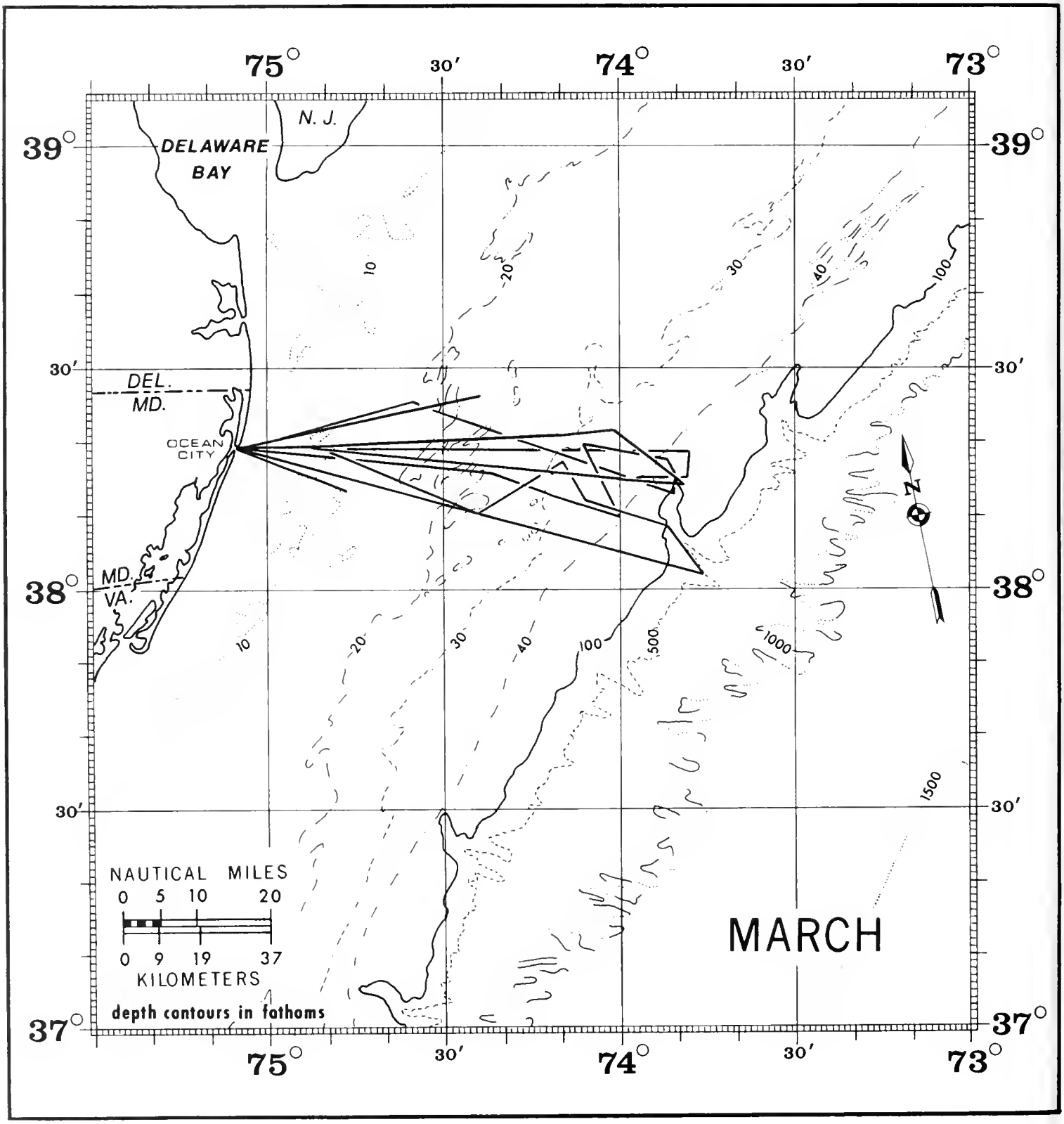

Figure 41. Cumulative cruise transects for March, 1971-1977.

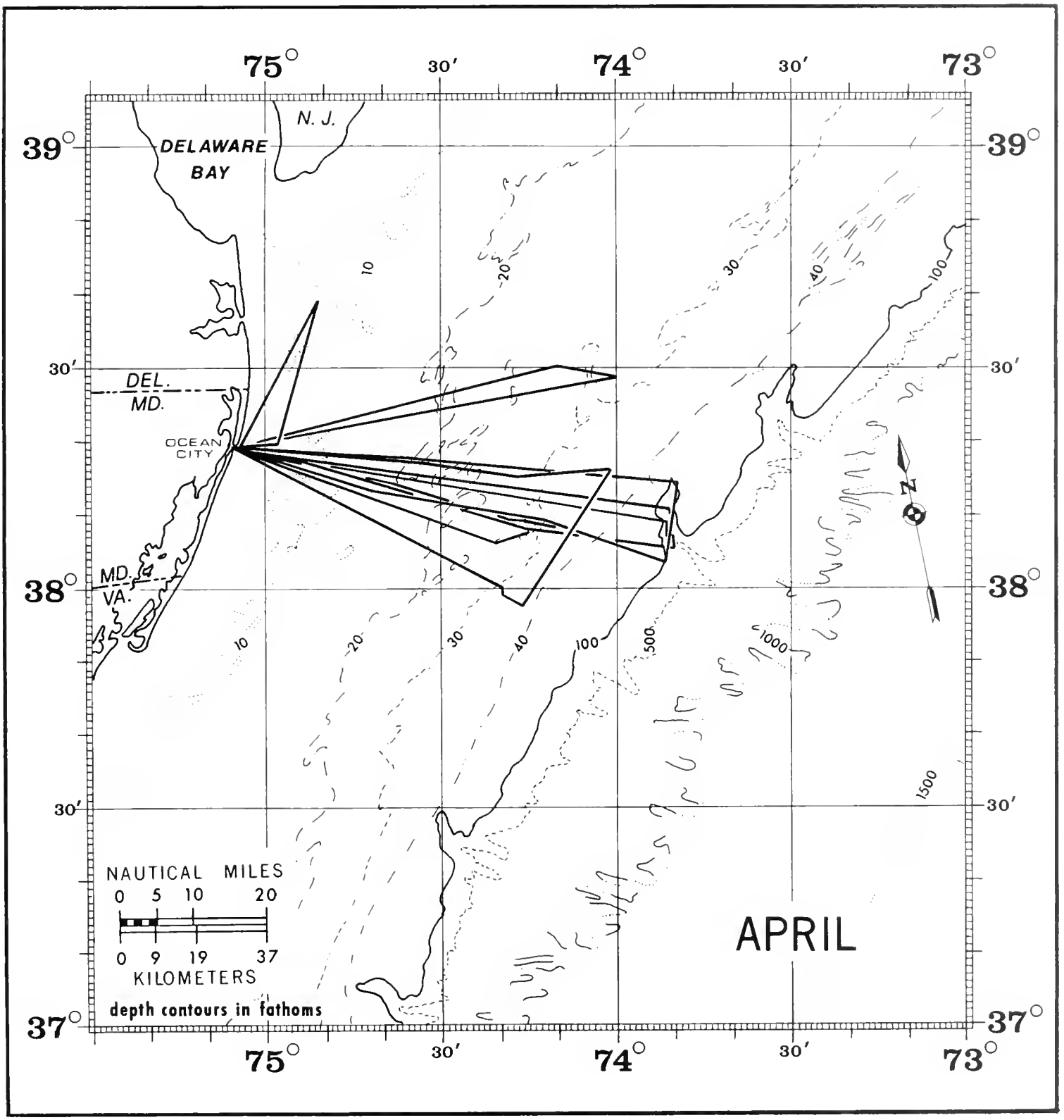

Figure 42. Cumulative cruise transects for April, 1971-1977.

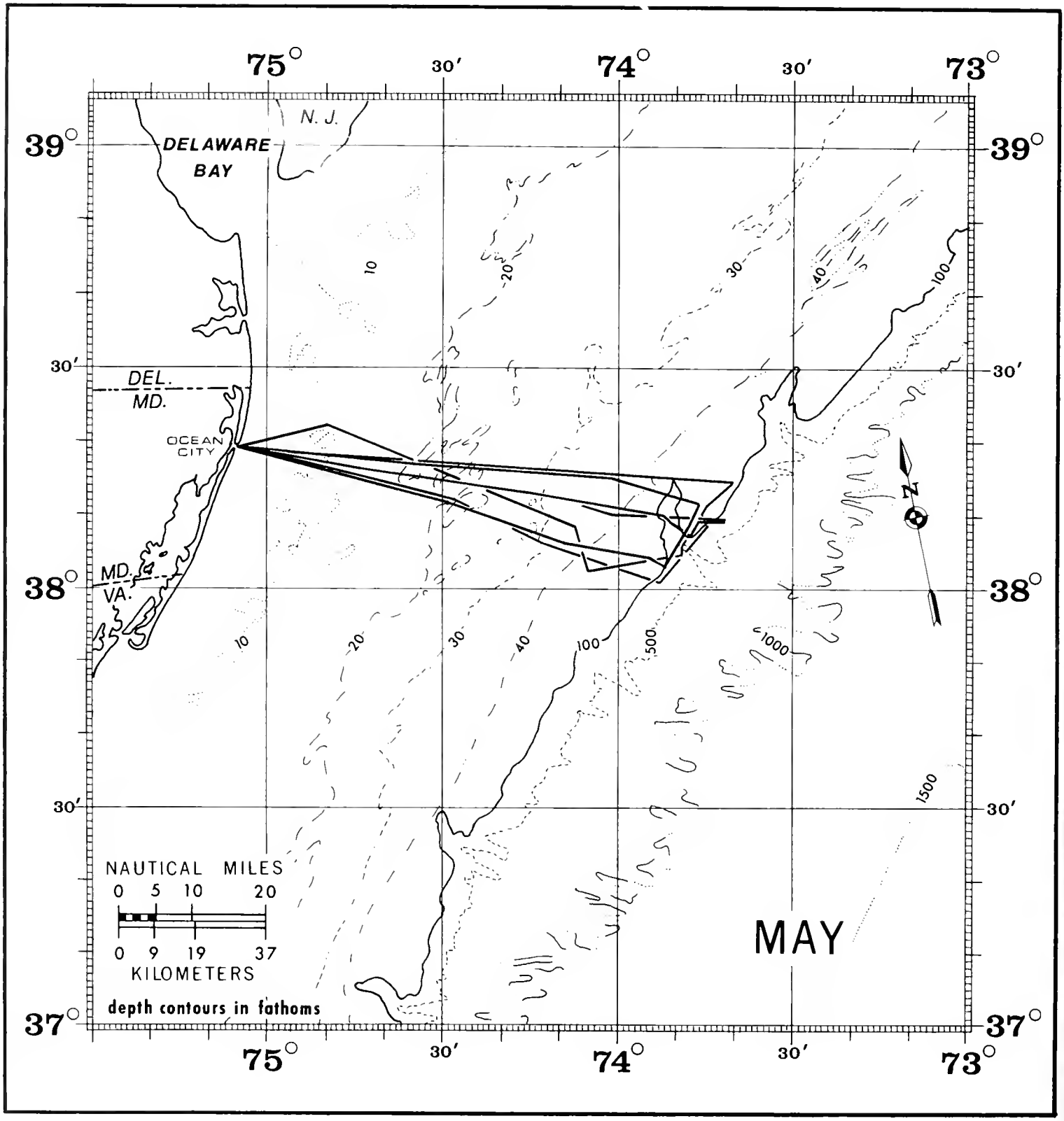

Figure 43. Cumulative cruise transects for May, 1971-1977.

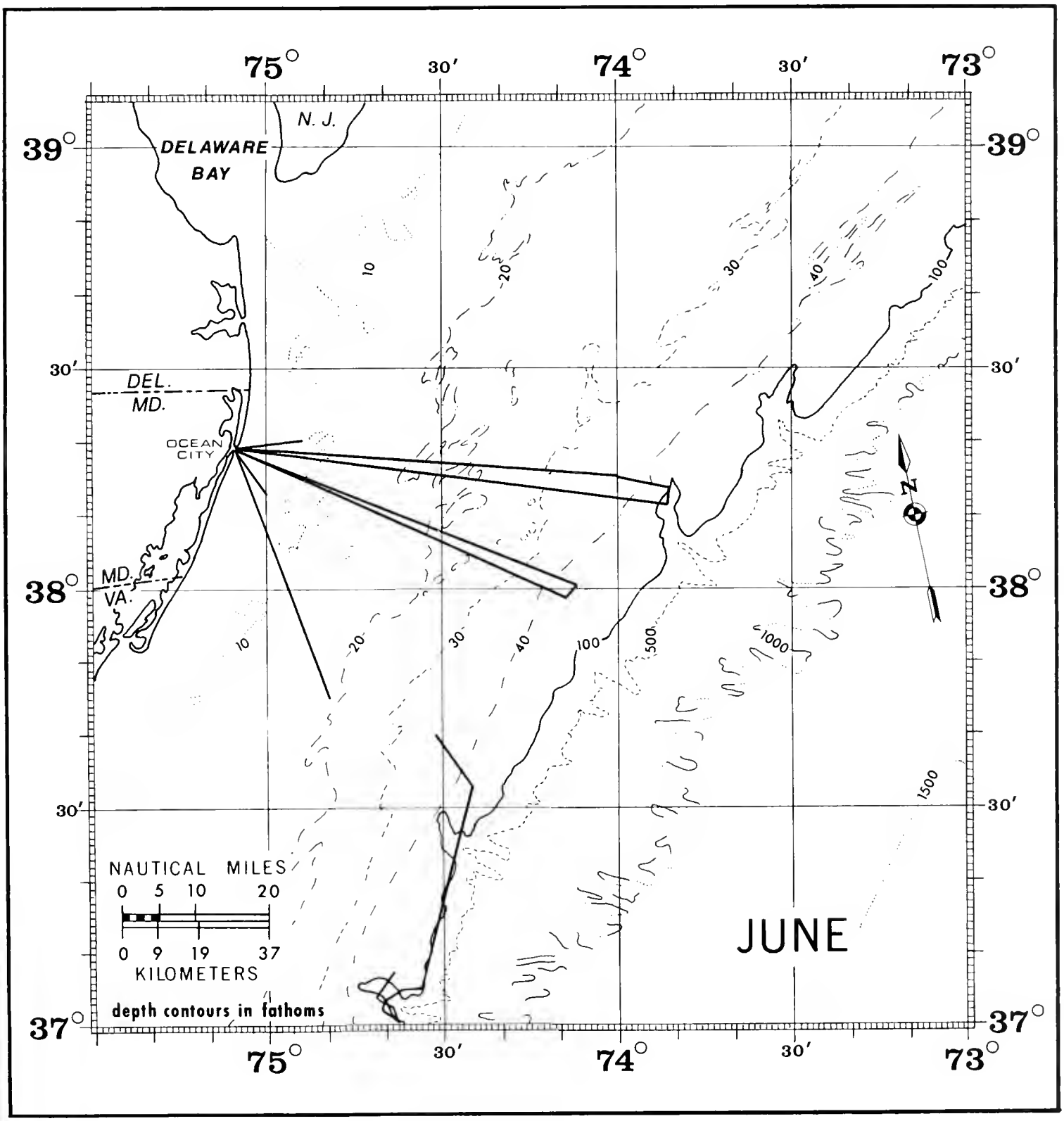

Figure 44. Cumulative cruise transects for June, 1971-1977.

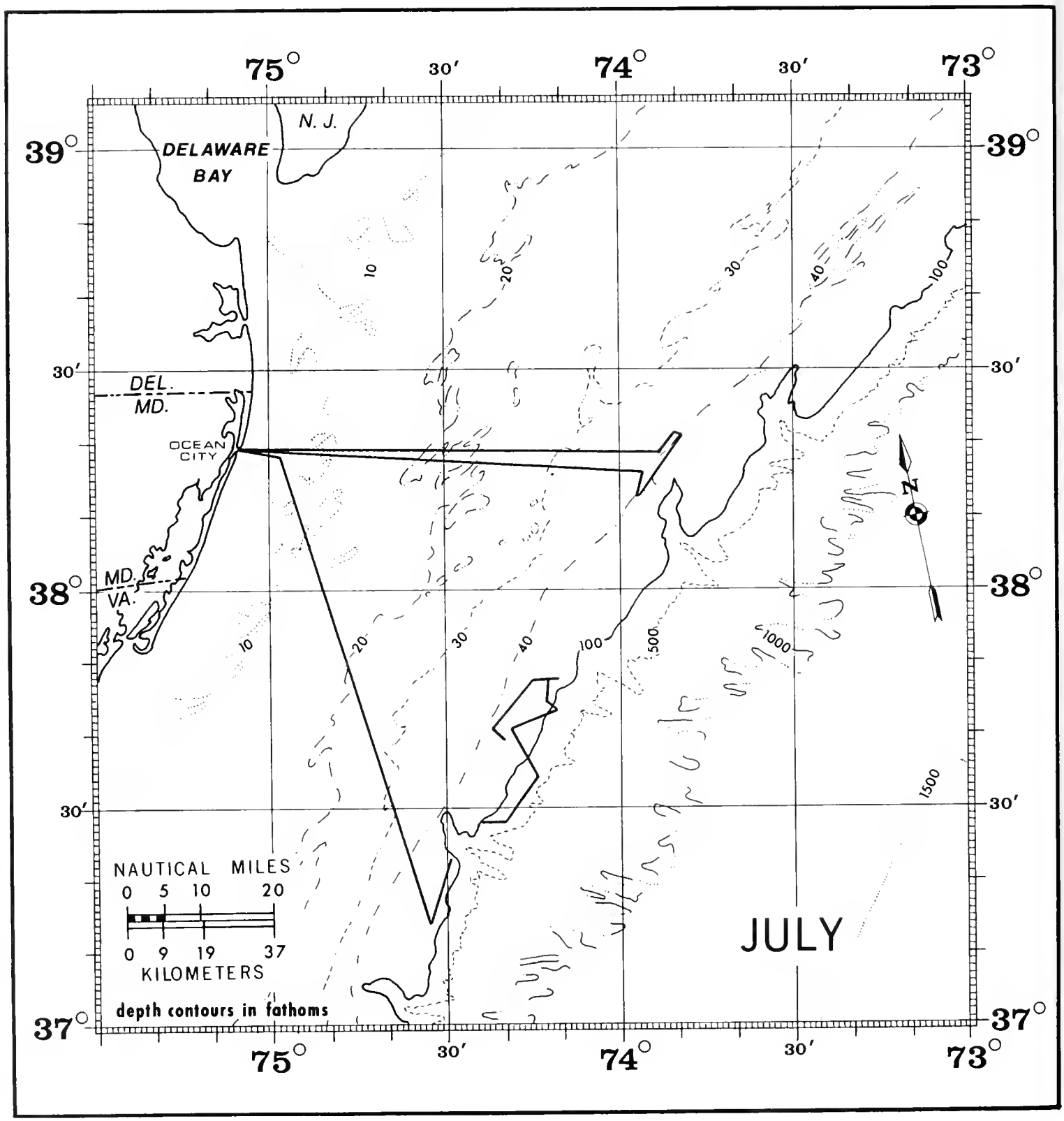

Figure 45. Cumulative cruise transects for July, 1971-1977.

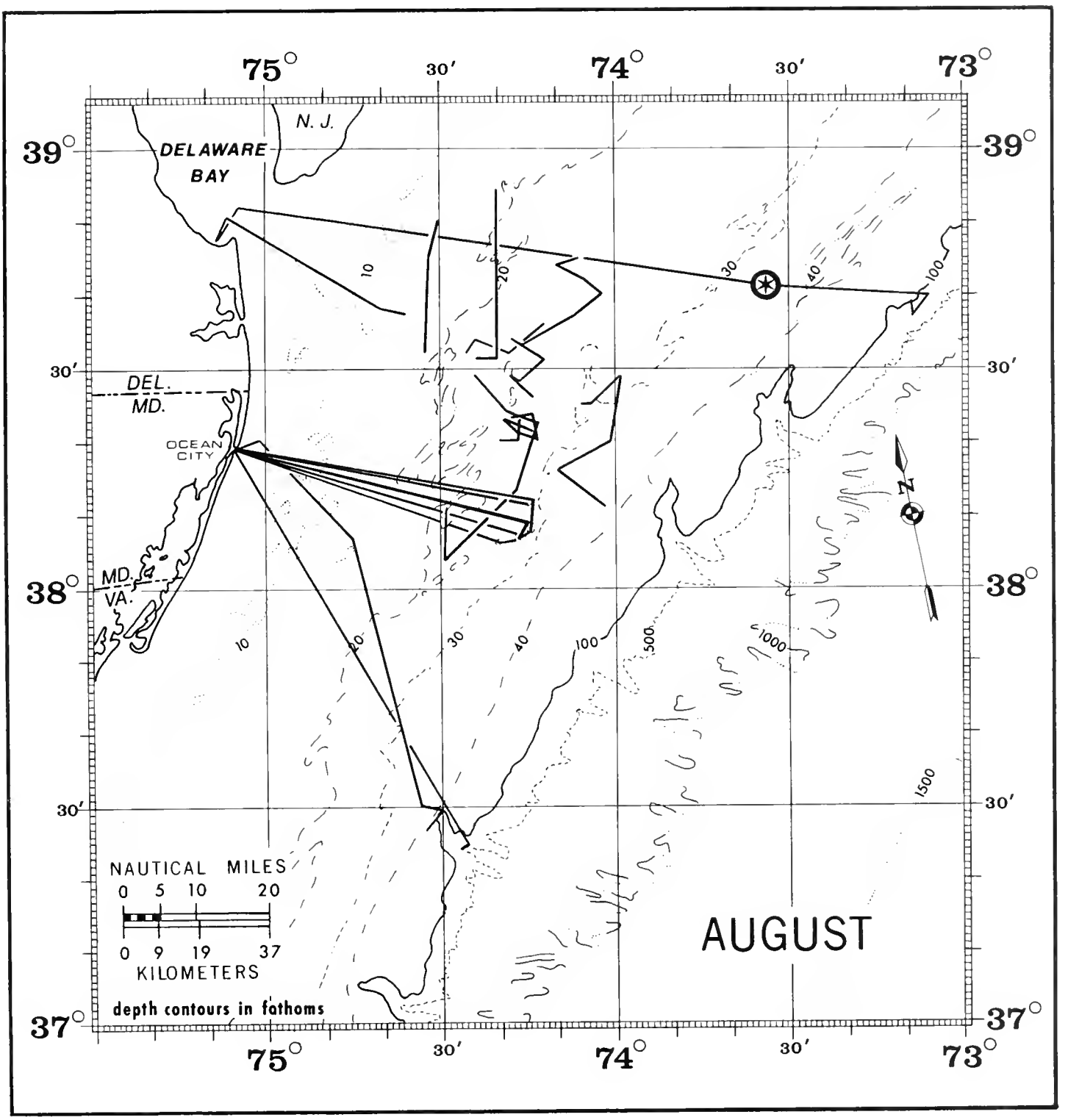

Figure 46. Cumulative cruise transects for July, 1971-1977. Circled star indicates position where the vessel was anchored for seven consecutive days; observations were made during this period.

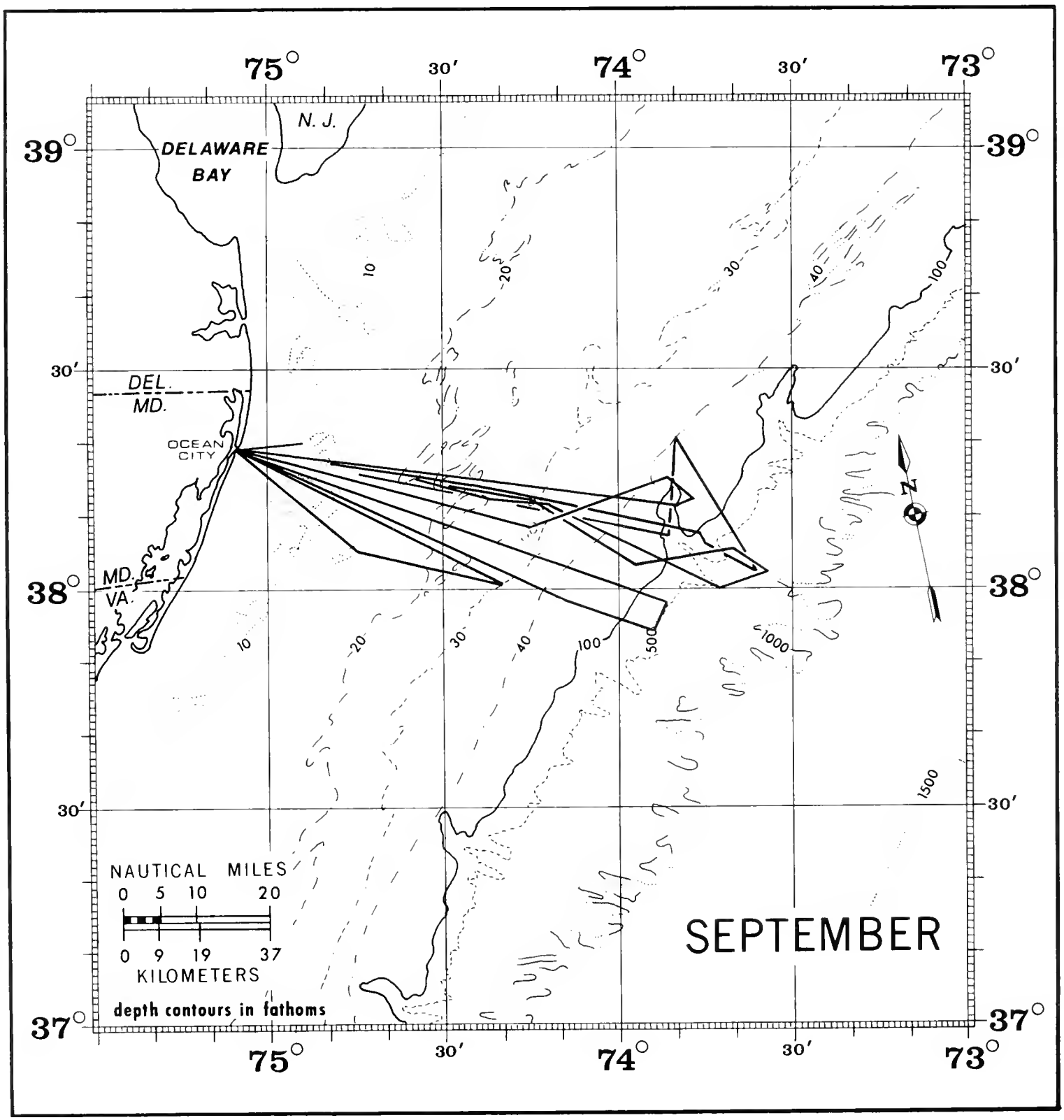

Figure 47. Cumulative cruise transects for September, 1971-1977.

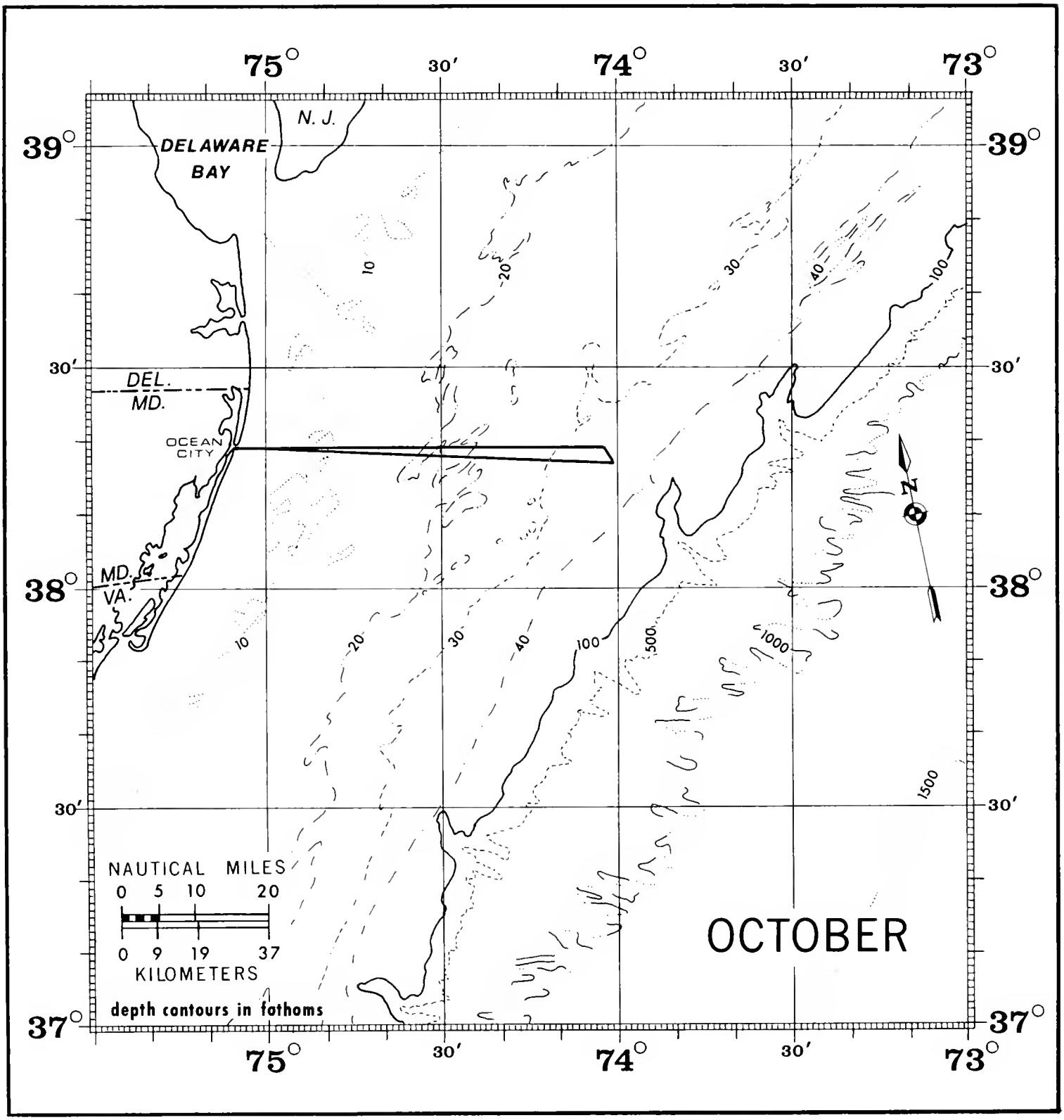

Figure 48. Cumulative cruise transects for October, 1971-1977.

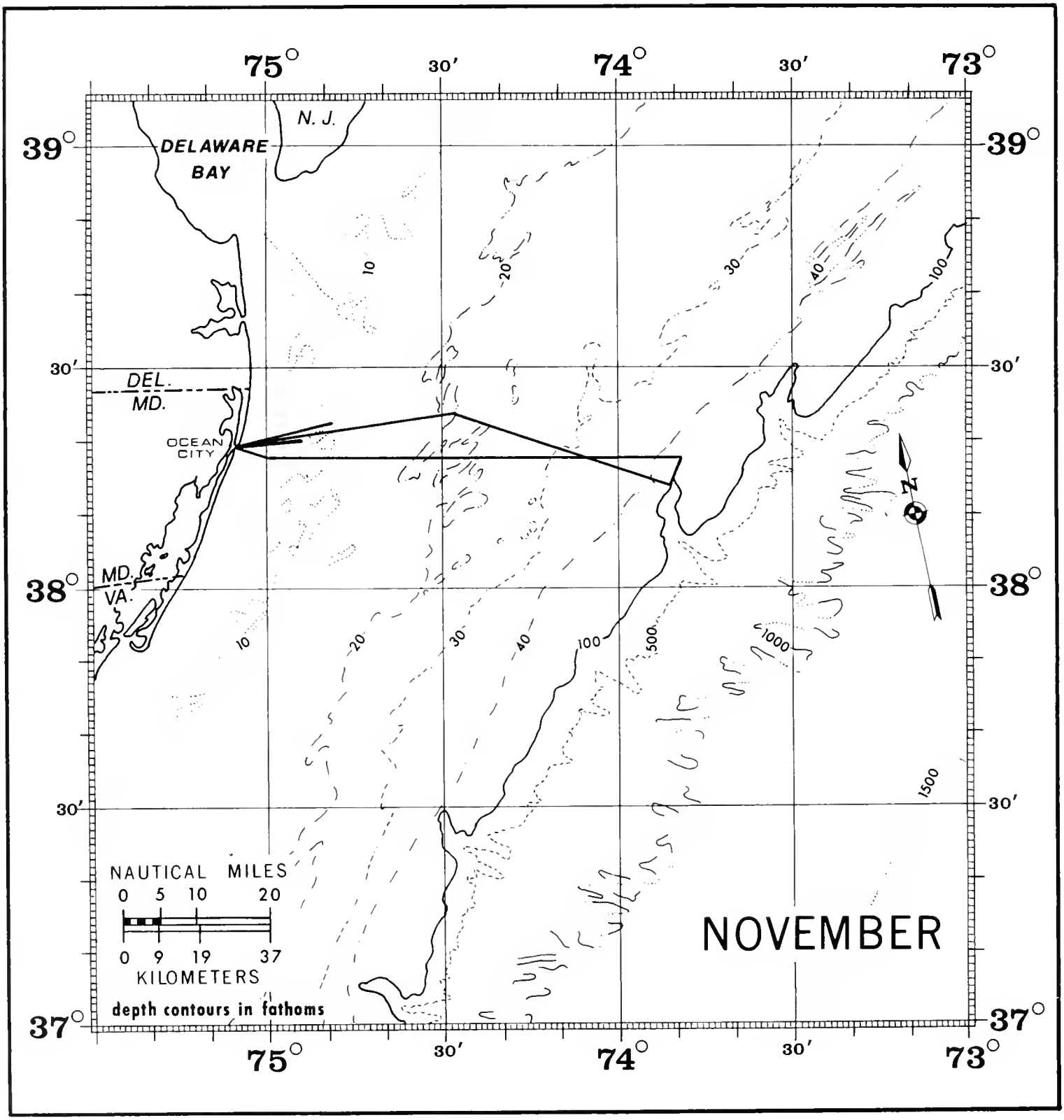

Figure 49. Cumulative cruise transects for November, 1971-1977.

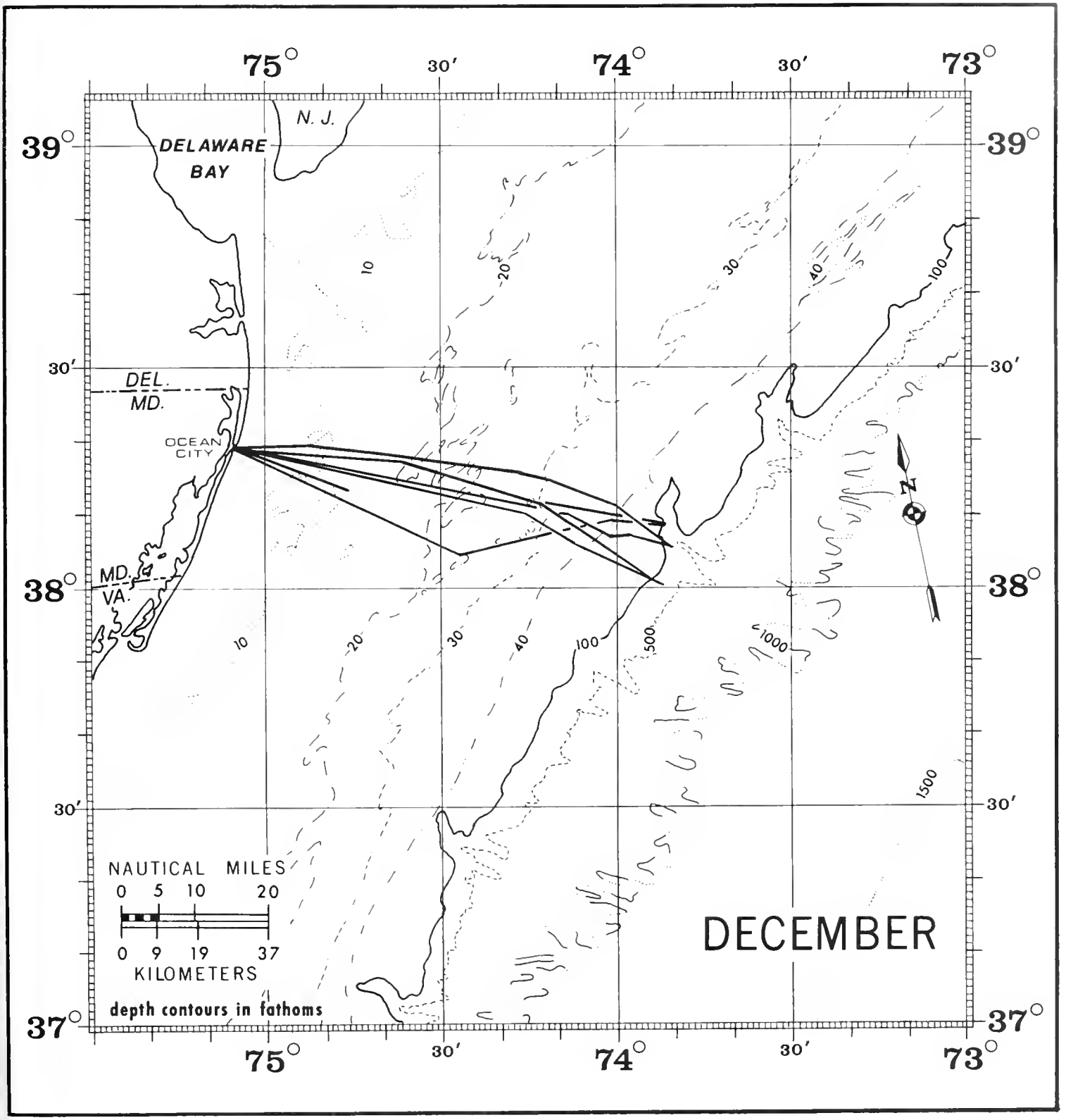

Figure 50. Cumulative cruise transects for December, 1971-1977.

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DEPARTMENT OF THE INTERIOR

U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.